# A Review of the Livestock Sector in the Republic of Indonesia

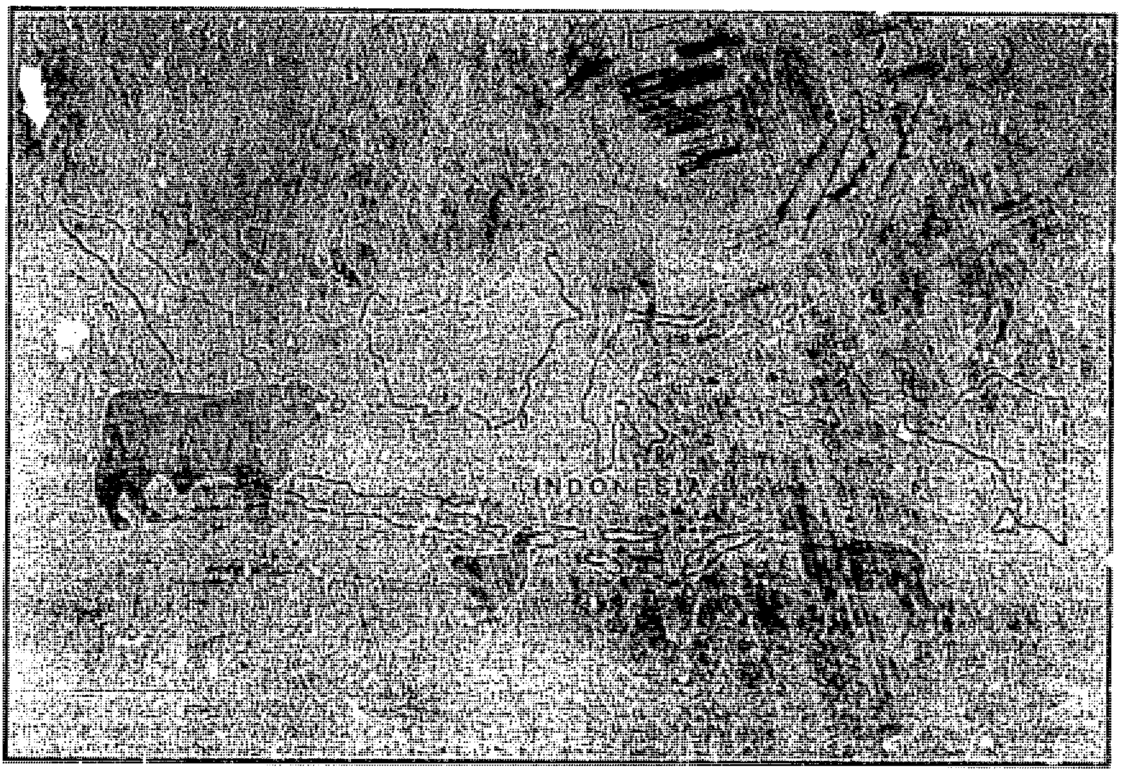
## VOLUME I: MAIN REPORT

Prepared for

The Asian Development Bank, Manila

and

The Republic of Indonesia




Winrock International Institute for Agricultural Development

A REVIEW OF THE LIVESTOCK SECTOR
IN THE REPUBLIC OF INDONESIA

VOLUME I:  MAIN REPORT

# A REVIEW OF THE LIVESTOCK SECTOR IN THE REPULIC OF INDONESIA

Prepared for:

The Asian Development Bank, Manila

and

The Republic of Indonesia

Prepared by:

Winrock International Institute
for Agricultural Development
Morrilton, Arkansas 72110
U. S. A.

March, 1986

## A REVIEW OF THE LIVESTOCK SECTOR IN THE REPUBLIC OF INDONESIA

### TABLE OF CONTENTS



(continued)



4

TABLE OF CONTENTS



(continued)

## TABLE OF CONTENTS

# LIST OF TABLES

| Number | Title | Page |
|---|---|---|

CHAPTER I



CHAPTER II



CHAPTER III



(continued)



7

| Number | Title | Page |
|---|---|---|



(continued)



9

| Number | Title | Page |
|---|---|---|

CHAPTER VI



CHAPTER VII



(continued)

| Number | Title | Page |
|---|---|---|



(continued)



10

APPENDIX TABLES

CHAPTER I



(continued)

CHAPTER II



(continued)



\12

| Number | Title | Page |
|---|---|---|



(continued)



13

| Number | Title | Page |
|---|---|---|
| 3.20 | Body measurements on champion cattle in Central/West Java contests .................. | Appendix 3 - 22 |
| 3.21 | Production from a sample of milk producers, August, 1983 .................................. | Appendix 3 - 24 |
| 3.22 | Dairy farm production costs in Java ........... | Appendix 3 - 25 |
| 3.23 | Estimated number of agricultural households producing small ruminants, by region ........... | Appendix 3 - 26 |
| 3.24 | Weights of supplemented nature sheep and goats on Indonesia ....................... | Appendix 3 - 27 |
| 3.25 | Flock composition for selected samples of small ruminant herds/flocks ................ | Appendix 3 - 27 |
| 3.26 | Goat production traits in Indonesia ........... | Appendix 3 - 28 |
| 3.27 | Reproduction parameters of sheep .............. | Appendix 3 - 29 |
| 3.28 | Summary of sheep production traits in Indonesia ................................. | Appendix 3 - 30 |
| 3.29 | Estimated share of small ruminant income of total income for sheep and goat keepers ..... | Appendix 3 - 31 |
| 3.30 | Gross farm income component at kecamatan level in Kabupaten Deli Serdang, North Sumatra ...... | Appendix 3 - 32 |
| 3.31 | Goat budgets for East Kalimantan .............. | Appendix 3 - 33 |
| 3.32 | Annual net returns to goat recipients under different payback schemes ............... | Appendix 3 - 33 |
| 3.33 | Breeding, feeding, health care and economic parameters of small ruminant farms ............ | Appendix 3 - 34 |
| 3.34 | Budgets for six specialized ruminant farms in Cirebon and Garut ........................ | Appendix 3 - 35 |
| 3.35 | Performance of native chickens in East Kalimantan ........................... | Appendix 3 - 36 |
| 3.36 | Egg production data of kampung chickens ....... | Appendix 3 - 37 |
| 3.37 | Chamges in population of native chickens ....... | Appendix 3 - 38 |
| 3.38 | Native chicken (ayam kampung) mortality data .. | Appendix 3 - 39 |
| 3.39 | Body weights of native chickens .............. | Appendix 3 - 39 |
| 3.40 | Mean live weights of five types of local chickens ........................... | Appendix 3 - 40 |
| 3.41 | Some egg production traits of ducks under intensive mamangement .................. | Appendix 3 - 41 |
| 3.45 | Mean liveweight, feed conversion ratio and carcass characteristics of Alabio, Tegal and crossbred drakes at 4, 8, 12 and 16 weeks of age ........ | Appendix 3 - 42 |
| 3.43 | Characteristics of fully herded duck egg production systems ........................... | Appendix 3 - 43 |
| 3.44 | Prices for duck products, Kendal, Central Java ......................... | Appendix 3 - 44 |
| 3.45 | Annual enterprise budget (non-labor costs only) for semi-intensive 50-duck market egg production flock, Kec. Kendall, Central Java ................... | Appendix 3 - 45 |

(continued)



14

CHAPTER 4



(continued)



15

(continued)



\16

(continued)



17

(continued)



18

CHAPTER 7

## LIST OF FIGURES



(continued)



20

21

## LIST OF ACRONYMS

| | |
|---|---|
| AARD | Agency for Agricultural Rese^rch and Development |
| ADB | Asian Development Bank |
| AIC | Agricultural Information Center (BIP, or Balai Informasi Pertanian) |
| A.P.B.D. | Aggaran Pendapatan dan Belanja Daerah, Regional budget distinguished by:<br>APBD tingkat I - Province level<br>APBD tingkat II - Regency level |
| A.P.B.N. | Aggaran Pendapatan dan Belanja Negara - National development budget |
| ATR | Agricultural technician (reproduction) |
| BAPPENAS | Badan Pencencana Penbangunan Nasional (National Planning Organization) |
| BAPPEDA | Badan Penbangunan Daerah (Provincial Regional Development Planning Organization) |
| BIMAS | Bimbingan Massal Sembada Bahan Makanan (Mass Guidance for Self Sufficiency in Foodstuffs) |
| BPP | Balai Penyuluhan Pertanian (rural extension centers, excluding animal health and A.I. Centers) |
| BPSD | Bimbingan Perternak Sapie Daging (beef cattle husbandry guidance) |
| BRI | Bank Rakyat Indonesia (People's Bank of Indonesia) |
| BULOG | Badan Urusan Logistik (National Logistics Organization) |
| DGLS | Directorate General of Livestock Services |
| DIC | Disease investigation center |
| D.O.C.S. | Day-old chicks |
| FKPP | Forum Kordinasi Penyuluhan Pertanian, level II at regency level |
| GKSI | Gabungan Koperasi Susu Indonesia (National Union of dairy cooperatives of Indonesia |
| IBRD | International Bank for Reconstruction and Development (World Bank) |
| ISDB | Islamic Development Bank |
| INPRES | Instruksi Presiden (Presidential Instructions for Rural Development Programs) |
| IFAD | Internationl Fund for Agricultural Development |
| IDRC | International Development Research Center, Ottawa. Canada |
| INTEK | Intensifikasi Ternak Kerja (Draft Animal Intensification Scheme) |
| INTAB | Intensifikasi Ternak Ayam Buras (Village Poultry Intensification Scheme). |
| INTI | The "nucleus" in Nucleus Estate Schemes |
| KUD | Koperasi Unit Desa (Village Coop Unit) |
| Kontak tani | Contact farmers |
| Kelompok | farmers group |
| Keswan | Kesehatan hewan (animal health unit) |
| KUT | Kredit Usaha Tani (farmers credit) |
| KEPRES 50 | Presidential Decree limiting size of poultry units |
| KMKP Massal | Kredit Modal Kerja Permanen Massal (mass credit for permanent working capital) |
| NGO | Non-governmental organizations |



22

| | |
|---|---|
| PPS | livestock subject matter specialists |
| PPM | Middle level extension offices |
| PIR | Perusahaan Inti Rakyat - Nucleus Estate Scheme for Poultry |
| PPL | Field extension workers |
| PUSPETA | Pusat Pelayanan Petani (farmer extension centers) |
| PUTP | Panca Usaha Ternak Potong (mass credit for meat production) |
| PKK | Program Kesejahteraan Keluarga (family welfare program) |
| PMO | Project Management Office |
| PMU | Project Management Unit |
| REC | Rural Extension Centers |
| REPELITA | Rencana Pembangunan Tahun - (National Development Plan) |
| RTC | Regional training center |
| SMTP | Agricultural technology schools |
| SPP | Sekolah Pembangunan Pertanian (agricultural development schools) |
| SNAKMA | Animal husbandry schools |
| UPT | Unit Pelahsana Teknis (technical management units) |
| USAID | United States Agency for International Development |
| UWIB | Unit Wilayah Inseminasi Buatan (district level A.I. unit) |
| ULIB | Unit lokasi inseminasi buatan (local A.I. unit) |
| UHT | Ultra-high temperture milk |
| VETMA | Veterinary biologics center |
| WME | Whole milk equivalent |

## PREFACE

### A. Background to the Review

1. The Asian Development Bank has made major commitments to project activities within Indonesia aimed at increasing the population and productivity of livestock. These commitments have reflected the fact that Indonesia has abundant natural resources for livestock production, but has very low consumption levels of livestock products, low ratios of livestock numbers to human population, and a large requirement for draft animals, particularly in newly settled transmigration areas. The initial loan to the Government of Indonesia was for the South Kalimantan Livestock development Project in 1979. A second loan was made for the Sumatra Livestock Development Project in 1981. At present, a loan agreement was recently signed for the Second Kalimantan Livestock Development Project to cover the Provinces of West, Central and East Kalimantan.

2. The Government of Indonesia recognizes the importance of livestock in meeting national development goals, particularly the potential for livestock to provide additional employment and income for smallholders, to more effectively utilize land resources in the sparsely settled areas, to provide draft power in settled as well as in transmigration areas, to provide manure for enhanced crop production, to provide more meat, milk and eggs to meet national human nutrition goals and reduce the amount of foreign exchange being used for livestock product imports.

3. As a result of the above commitments and the future needs for investment in the livestock sector, the Government of Indonesia asked that the Asian Development Bank provide a technical assistance grant to undertake a comprehensive review of the livestock sector in Indonesia which would provide a framework for cost-effective, long-term development strategies. This report is a result of that technical assistance grant and is intended to provide not only a thorough review of the current status of the livestock sector in Indonesia but also to provide a better understanding of the role of livestock in Indonesian farming systems, interactions between crops, livestock, households, markets, and social structure, and to utilize this production systems framework to suggest appropriate development strategies and to identify potential development projects required for implementation.

### B. Operational Strategy

4. Sector analysis bridges the gap between the macroeconomics of national investment management and the microeconomics of individual projects (Baum and Tolbert, 1985; p.30). Sector analysis is most useful in setting forth broad objectives, needs and priorities for officials in developing countries, and in guiding project design and selection by external lending agencies.

---

During the time of the study, the exchange rate was between Rupiah 1114 and 1121 per U. S. $1.00.

5. Sector analysis serves to provide a better understanding of development policies and issues in the sector. These are discussed in Chapters I, III and, particularly, in Chapter VIII. This improved understanding helps enhance the potential contribution that the livestock sector can make to overall economic development strategy, and in ensuring that sector policy is conductive to sound project work (Baum and Tolbert, 1985). This is the focus of Chapter VIII.

6. Sector analysis also aids in the evaluation of institutional capacity within the sector in terms of ability to implement desired policies, programs, and projects. This is the focus of Chapter VI.

7. Finally, sound sector analysis serves to guide sector investment priorities which help guide the subsequent identification and selection of specific projects. This is the focus of Chapter IX.

8. The goal of this sector review is to improve the process of formulating sector development strategies and designing development projects. This is done by focusing on the various components which make up the sector through a farming systems approach. The various farming systems under which livestock are (or could be) produced serve as the focal point for the various inputs and outputs of that system. The report is structured so that the first six Chapters describe in detail the various components which interact with farming systems. This includes the economic background of the country (Chapter I), the people and their social conditions (Chapter II), the animal resource base (Chapter III), the feed resource base (Chapter IV), the status of animal health (Chapter V), and the institutions supporting animal production (Chapter VI). Each chapter also has a section dealing with the long-term outlook or with the strengths and weaknesses of each component.

9. In Chapter VII, various Indonesia farming systems are described and analyzed with assistance of information provided in the preceding chapters. This allows us to analyze the productivity of some current Indonesian farming systems, to examine what types of support for marketing and institutional inputs exist, and to discuss what changes are needed for the system to become more productive.

10. By focusing on farming systems under which livestock are currently produced, we can recommend development strategies that are oriented towards producer needs rather than strategies which focus on strengthening just one component of the sector (e.g. marketing, institutions, feed resources) and to tie together the ways in which the various components interact at the producer level. In this way, we can suggest development policies and development strategies that take a broad view of the major factors influencing production. The same procedures are used for designing projects.

## C. Operational Approach

11. The consultant team, along with counterparts from the Directorate General of Livestock Services and Provincial Departments of Livestock Services, undertook a series of extensive field visits to 22 provinces. These visits were used to improve the descriptions of production systems,

get up-to-date costs and prices, improve our understanding of institutional capabilities in the field, visit development projects, interview farmers, traders, extension officers and feed shops, and to collect provincial-level data and reports. This information is incorporated into the report in the appropriate sections. To the extent possible, the field survey groups were composed of multidisciplinary teams that worked together on the description of the various farming systems. Data gathered by the field teams were then collected and checked by the group upon return to home office. Following the preliminary descriptions of the farming system, the results from the survey questionnaire were analyzed and summary coefficients were used to improve these models, as well as to attach some measures of variability to such key elements as land availability, family size, labor use, crop yields, livestock populations and productivity, feed resources and marketing. These models represent the base upon which project priorities were developed and they also served to indicate which types of off-farm support services were critical to the livestock strategies outlined.

D. Livestock Sector Survey

12. An additional operational feature of this study was a large survey of producers carried out by staff of DGLS and provincial Livestock Services officers. The questionaire was designed by staff of the Fisheries and Livestock Division, ADB. The study consultant team assisted with collation, entry, checking, processing and analysis of this data.

13. The initial plan was for 100 producers to be sampled in 26 out of Indonesia's 27 provinces (D. I. Jakarta was excluded). Questionaires were returned in various stages of completeness from 24 provinces (West Sumatra and NTT questionnaires were not received). In addition, some of the provinces returned more than 100 responses so the total sample size was 2700 farmers but without equal sample size by province.

14. For most of the regional analysis of survey results (Chapter II and VI), it was too cumbersome to present results by each of the 24 provinces so similar groups of provinces were combined as follows:

| Region | Provinces included |
|---|---|
| Northern Sumatra | D. I. Aceh<br>North Sumatra<br>Riau |
| Southern Sumatra | Jambi<br>Bengkulu<br>South Sumatra<br>Lampung |
| West Java | West Java |
| Central Java | Central Java<br>D. I. Yogyakarta |
| East Java | East Java |
| Nusa Tenggara | Bali, NTB, East Timor |



26

| Region | Provinces included |
|---|---|
| Kalimantan | East, South, Central and West Kalimatan |
| Sulawesi | North, Central, South and Southeast Sulawesi |
| Moluccas | Moluccas |
| Irian Jaya | Irian Jaya |

15. The survey format covered details of family profile, social indicators, support from institutions, crops grown and livestock reared. A total of about 480 questions were possible for each family although no families had all - 'egories of crops and livestock covered by the questionaire.

16. Most questions required answers within a range of alternatives (e..g., excellent, good, fair, poor) whereas some questitons were numerical (e.g., number of cattle, kgs of fertilizer used).

17. Data from the questionsires were entered directly into a Lotus 1-2-3 spreadsheet format. These data were then transferred to an intermediate file and processed using the Statistical Package for Social Sciences (SPSS). Data from the summary printouts were then re-entered into Lotus spreadsheets for further analysis and table printing.

## E. The Livestock Sector Review Study Team

18. Winrock International Institute for International Agricultural Development provided the following consultants who, along with counterparts from the Directorate General for Livestock Services, formed the Sector Review Study Team:

| | |
|---|---|
| A. John DeBoer | Agricultural Economist (Team Leader) |
| Jim Yazman | Production Specialist |
| Allen D. Tillman | Animal Scientist |
| David Banks | Veterinarian |
| Rod Campbell | Veterinarian |
| Loy Crowder | Agronomist |
| John Ihalauw | Sociologist |
| Hendrik C. Knipscheer | Marketing Specialist |
| B.R. Rao | Meat Scientist |



27

## F. Acknowledgements

The consultants wish to thank many Indonesian individuals and institutions for their assistance with all stages of this project. Within the Directorate General of Livestock Services, the following deserve special thanks:

Drh. Daman Danuwidjaja, Director General
Drh. Jamen Zailani, Secretary of Livestock Services
Ir. Erwin Soetirto, Director of Livestock Programming
Drh. Soemarmo Pospodihardjo, Director of Livestock Production
Drh. Soedjasmiran Prodjodihardjo, Director of Livestock Industry and Smallholder Development
Dr. Masduki Partadiredja, Director of Animal Health
Drh. A. Hermansyah, Director of Livestock Distribution and Development
Mr. Soemarso Wiryoprajitno, Director of Extension

20. Our counterparts also assisted us, both in the Project Management Office and on long, difficult field visits. Those accompanying us on field visits included Ms. Lorinda Harahap, Ms. Hariyati, Mr. M. T. Rajagukguk, Mr. Waidi Budisusetyo, Mr. Chaerul Arifin, Mr. Bonar Lubis, Mr. Nusantara Nasution, Mr. Sri Dadi and Mr. Chalil Usman.

21. In the provinces, the following Kepala Dinases provided assistance and served as gracious hosts during our field visits:

Drh. Endang Suharya, West Java
Drh. R. Koesmono, Central Java
Drh. Kridarso Budi Prayitno, Yogyakarta
Drh. A. Silitonga, East Java
Drh. I. Wayan Masudana, Bali
Drh. Omik Koswara, N.T.B.
Drh. Ch. J. Malessy, N.T.T.
Drh. B. P. Manurung, Irian Jaya
Drh. Moch Rachmat Sanusi, Maluku
Drh. Abdul Wahab Yusuf, Aceh
Drh. Rusli Harahap, North Sumatra
Drh. Tazril Tembok, West Sumatra
Drh. Markun, Lampung
Drh. J. B. Soedibjo, West Kalimantan
Drh. Harjoto Djojo Soekarto, Central Kalimantan
Drh. Padang Bambang Wirjono, South Kalimantan
Drh. Hadi Sunarto, East Kalimantan
Ir. Ilyas Laraga Lamakatutu, Central Sulawesi
Ir. Don Puryono Utoyo, South East Sulawesi
Drh. H. M. Rapi, South Sualwesi
Drh. Supodo, Jambi

22. Our particular thanks go out to Dr. Mark Gaylord, Project Liaison Officer of the Small Ruminant Collaborative Research Support Program in Bogor, and to the coordinator of this project, Ir. Subandriyo, who helped provide support staff and computers for data processing and production of the first draft and Draft Final report. Mrs. Kustiani, Mr. Dikdik, Mr Yusnandar and Mr. Tatto all spent long hours working with us, as did Ms. Michelle Waldron, a computer consultant from Bogor who supervised data entry from the ADB/DGLS survey and carried out the statistical analysis.

23. At the headquarters office for Winrock Internationcl several persons provided valuable assistance in the preparation of this Final Report. They include Sandra Miller, Vanetta Vaughn, Sara Cragar, Ramona Jolly, Kerrie Alexander, Tom Coates, Tony Gifford, Ken Young and Pervai Amir.

# EXECUTIVE SUMMARY

## 1. Socio-economic background for livestock production

24. The macroeconomic outlook influencing the development of the livestock sector is moderately favorable. Following a decided slowdown in the early 1980's, the economy now seems to be back on the track of moderate growth in GDP (4.0 - 5.5% forecast), a gradual diversification away from the high dependence on oil and gas production and continuing large investments in transmigration and rural infrastructure.

25. Current levels of consumption of animal products are very low and highly skewed towards middle to upper income urban classes. Therefore, a large potential demand exists that is not being filled because of livestock product prices that are high relative to rural and urban wage rates. One kg of beef costs the equivalent of 3 days of rural wages while a liter of fresh milk costs at least one-half a daily rural wage. Increasing consumption to anywhere near recommended daily allowances will be a long-run process and will depend upon continued growth in real disposable incomes and increased efficiency of livestock production to keep prices at realistic levels relative to rural and lower income urban wage rates.

26. Sound social relationships between the village collectors provide a healthy social climate pertinent for further encouragement of livestock production. Finally, the social roles of informal leaders show the possibilities for private organizations to support the development of livestock in Indonesia.

27. Poor soil conditions, small size of landholdings and complex land tenure arrangements may hinder small farmer-animal holders in obtaining sufficient amounts and higher quality of feed for their animals and limit the number of livestock raised by the family. Shortcomings may also arise due to the smaller family size and weakness in community and farmers' group leadership and decision-making.

28. Disharmony in social relations among the transmigrants and the indigenous settlers may create problems that prevent further expansion of sound social relationships for livestock development. Finally, an informal leader who becomes too influential and obtains a wide power base in a community may pose unacceptable competition to the formal community power structure. This situation discourages livestock development.

29. Generally, the sociological environment and social organizations provide a sound basis for the development of livestock in Indonesia. Nevertheless, the following matters need to be further considered for action in the future.

- Introduction of new kinds of livestock into a community needs sufficient preparatory training in order to give the community members some basic knowledge and skills.

- In order to obtain the support from the village formal structure, their involvement in the preparatory process and training seems to be crucial for the community.

- Attitude changes provide sound basis for long-lasting behaviorial changes. For this very reason, the development of livestock must be implemented in stages beginning with the kinds of livestock which requires only limited skills and a simple operation.

- To speed up the development process in livestock production, sufficient consideration must be given to the greater involvement of private organization at the village level.

- Additional extension services must be provided to indigenous settlers to enable them to cope with the better experience, skill and technology held by the transmigrants.

- Recognizing the great differences in experience and skill in raising livestock, thorough consideration must be given to extension policies strategies, and methods in order to better fit the needs of a particular village community.

- Social organizations that have proved effective in expanding livestock production should be encouraged and be continuously improved.

2. <u>The institutional base supporting the livestock sector</u>

30. Institutions impacting upon livestock production, distribution, marketing, processing, research and policy fall under three main groupings -- public, private and non-governmental organizations (NGO's). Institutions reviewed in this study include the Directorate General of Livestock Services, the Provincial Livestock Services (Dinas Peternakan), the Department of Transmigration, the Department of Cooperatives, the Agencies for Agricultural Research and Development (AARD) and Agricultural Education, Training, and Extension (AAETE); educational institutions, the National Logistics Agency (BULOG), and the National Planning Agency (BAPPENAS). Private sector institutions include feed mills, poultry shops, agricultural input suppliers, private marketing agents, and dairy factories. NGO's and semi-public agencies include the association of dairy cooperatives (GKSI), cooperative institutions such as the Cooperative League of the USA, and various aid programs.

3. <u>The agricultural resource base supporting animal production</u>

31. Of the approximately 130 million hectares of arable land in Indonesia, croplands cover only 29 million ha. About 9 million ha are dryland and 8 million ha are wetlands, including rainfed land suitable for rice. About 7 million ha are planted to perennial crops. Secondary crops including maize, cassava, peanuts and soybeans cover more than 5 million ha. Food crops are an important source of livestock feed, especially in the inner islands and older transmigration areas. Current mapping of Indonesia soils shows four predominant types: red-yellow soils (51 million ha: 27%), high fertility volcanic (1.3. million ha) mainly in Java and



31

Sumatra, recent volcanic soils (0.17 million ha) on Java and Bali and hydromorphic and alluvials which tend to be waterlogged.

32. Soil surveys and analysis are an integral part of the transmigration planning operation and aid the identification of areas with crop potental. Land use patterns are well-defined and quantified and, although some differences occur between estimates by the Agraria and the Department of Statistics, a feature of both data bases is the considerable variation in land usage between provinces and even within regions. In general, most lowlands yield rice while the higher drylands are used for secondary crops. Villages are concentrated in the more fertile lowland areas of the inner islands. The most important limiting factor of land use is slope, though low rainfall and forest cover are also significant factors.

33. Land use is conveniently classified by the Agraria into rice land, dryland, estate crops, mixed garden, forest, grassland and other types. Livestock (including fish) production is integrated with one or more of these systems. Draft cattle and buffalo represent the most integrated form of animal agriculture. The place of wetland rice is paramount in the national economy, both as a food and a potential export commodity. Production is most intensive in the inner islands where more than double cropping may be achieved. The intensity of land-use is among the highest in the world with rice-rice or rice-secondary crops farming an almost continuous system.

### 4. Feed Resource Base

34. In Indonesia, grasses and herbaceous weeds provide a major portion of livestock feed resources. Land utilization has great influence on the feed resource base. Livestock feed supply is inversely proportional to cropping except for by-products. In parts of the outer islands, ecological factors alone (e.g low rainfall) are dominant. Improved pasture and forage technology are used mainly by specialized dairy and beef producers. In rice cropping areas, a large range of casual grasses and several legumes provide grazing and cut and carry feed, but quality tends to be low. Shrubs and tree legumes (e.g. *Leucaena spp*) are, however, an additional resource and are common at higher elevations. A feature of transmigrant areas is the progressive reduction of available feed as land pressure increases. Where forest clearance has occurred, invasive grasses, especially Imperata, may quickly dominate. Large areas of grazing land occur on some parts of the outer islands, but they may be highly rain-dependent and ruminants sometimes suffer nutritional stress through drought. At high elevations, Kikuyu grass has proved to be useful for dairy production.

35. Although available grasses, legumes and forage trees are intensively used by farmers, little concern is given to their stage of growth and nutritive value., Moreover current practices may lead to land degradation. Greater attention should be given to optimal harvesting of forage. Management of some feeds (e.g. imperata grass) in transmigration areas needs detailed study. The transfer of technology from research station to the farmer should be improved. Many improved species have been identified but not fully exploited. Steps should be taken to disseminate this genetic material more widely. There is great scope for the



32

integration of food crops and legumes. Crop residues are widely used but more efficient systems have been developed which await transfer to the field. Seasonal lack of availability of some crops necessitates some method of storage. A new technology for storage and processing is urgently required. Innovation is also required on the use of non-conventional feeds derived from the agro-industrial sector and other sources. The commercial feed industry is recognized as a major component in the chain of livestock production, but it has inadequate quality control.

5. Animal Health

36. Indonesian livestock suffer from most of the common diseases found in other parts of South East Asia, and more detailed descriptions of animal diseases and their impact on agricultural systems can be found in Chapter V. In terms of economic loss, Newcastle Disease of poultry is probably the most important, estimated at US$ 40 M per annum. However, apart from diseases which result in heavy mortalities, such as Haemorrhagic Septicaemia in cattle and buffalo, there are a number of other less obvious conditions which nevertheless have a far-reaching effect on animal agriculture because of their high prevalence and wide distribution. An example of this is Surra (trypanosomiasis) which may not often kill affected animals, but significantly reduces the work output in up to 80% of draft animals in some areas. Similar effects of mastitis on milk production, of internal parasites on growth rates in small ruminants, and of fascioliasis on abattoir wastage result in severe economic loss, but are frequently overlooked because most cases are subclinical. Rabies, brucellosis and cysticercosis (in Irian Jaya) also have major public health significance. Many other diseases are still poorly defined.

37. One of the major improvements to the animal health status in Indonesia has been the control and possible eradication of foot and mouth disease. Not only have the heavy losses from this disease been drastically reduced (apart from the cost of the final vaccination campaign), but the government has also gained valuable experience in disease eradication programs. Similarly, the internal quarantine system, together with the island geography, will assist continuing attempts to eliminate other diseases. The Veterinary Biologics Centre (VETMA) at Surabaya produces vaccines which, although deficient in quantity, are of good overall quality. Support institutions also benefit from a good supply of relatively inexpensive technical assistants, many of whom have attained a sound educational background at SNAKMA and other high schools.

38. With the exception of annual vaccination programs to protect livestock against haemorrhagic septicemia, anthrax and Newcastle disease, the impact of the field services on animal health has not been profound. Two relatively recent developments, however, have the potential for improvement. The first is the construction of animal health posts (Pos Keswan) manned by field veterinarians and their livestock assistants in areas of greatest need. Although few in number at the moment, they provide an essential direct link between the farmer and veterinary expertise, which has been lacking in the past. The second change is the trend for private companies and cooperatives to provide animal health services for their clients and members.

39. With the exception of FMD eradication, the animal health status of Indonesia has, in a qualitative sense, shown little improvement since independence 40 years ago. The identification of new diseases (e.g. Jembrana disease) and the importation of others (e.g. infectious bronchitis and possibly bovine brucellosis) has added to the list of pathogens affecting livestock. Annual vaccination programs have reduced the effects of some diseases, but they are not universally applied.

40. There are numerous reasons why the 1,500 veterinarians in Indonesia have not yet had the impact on agriculture that might have been hoped for. One often-quoted reason is lack of veterinary manpower. This is undoubtedly true and should be rectified in time, but there is also inefficient useage of the existing manpower, particularly in government services. Government veterinarians are employed in a wide range of purely administrative positions which do not require veterinary training or, for example, at forage research stations where their training is inappropriate for the task.

41. There appears to be a lack of direction in animal health policy at the field level because of little reliable field data, making policy formulation difficult. Although the presence or absence of some major diseases affecting livestock is uncertain (e.g. Hog cholera and virulent Bluetongue of sheep), there is very little information available on the prevalence (quantity) of diseases or their economic impact. This is due to the absence of an effective epidemiological surveillance system (one has been established but is not fully operational), and a lack of research into disease economics.

42. A self-critical internal review of the government veterinary service (and possibly the veterinary profession as a whole) is required to determine its long-term goals. Successes and failures must be addressed with equal candor so that policies can be formulated which, in time, will reduce and even eliminate some disease constraints which limit livestock productivity.

43. Finally, effective policies cannot be made at the national or provincial level without reliable field information on disease prevalence, distribution and economics. A well-designed pilot surveillance program has been established through the DIC's and Balitvet, but is still not functioning effectively. Strong emphasis should be placed on establishing a nationwide disease surveillance system, to provide the information needed to design future animal health policies.

### 6. The animal resource base

44. Indonesia possesses an enviable gene pool of adapted livestock, especially among large and small ruminants. Their potential has not been fully exploited in terms of growth rate or reproduction, and studies are recommended (Chapter IX) to help clarify the situation. Of particular interest are Ongole and Bali cattle and several breeds of small ruminants. Established breeds of ducks already have proven potential.

45. Both swamp buffalo and cattle remain an essential part of the draft animal enterprise, including new farms in transmigration areas. Steps are needed to improve their performance and utilization, particularly

in marginal farming areas. A proposed project addresses this issue in Chapter IX.

46. Sheep and goats offer great potential for improved productivity on existing smallholder units, as well as for increasing incomes of recipient farmers who do not yet have them. With proper planning and selection, they should be the preferred species in some transmigration areas.

47. Inherent in all these is efficient management of animal health. This should complement proposed efforts to improve animal husbandry extension efforts. The framework for a good animal health delivery system already exists, but we propose an Animal Health Field Service project which is urgently needed to make the animal resource base more efficient. (Chapter IX).

48. Undernutrition is the most common and widespread problem affecting all species. In other sections, we recommend promising areas for pasture, forage, legume and browse improvement programs. Major efforts are also needed to assess and improve utilization of the most common feed resource-crop residues and by-products. A project to start work in this area is proposed in Chapter IX.

49. Overall animal management remains a serious constraint affecting all species, but particularly in the dairy cattle and village chicken units. A combination of nutritional, environmental, health and general management problems in dairy farms have led to low milk yields, poor reproduction performance, high calf mortalities and problems with product quality. A study is suggested in Chapter IX to examine which areas need improvement and what resources are needed to raise industry standards of productivity and product quality.

50. In the transmigration areas, adapted cattle are preferable to imports. Improved planning and advisory services are needed to improve utilization levels of draft animals. High-grade Brahman cattle imports may still be appropriate for ranching and mini-ranching operations.

51. Major losses occur among village chickens in their first 8 weeks of age. Improved management, health, feeding and housing inputs can help large numbers of smallholders capitalize on excellent markets for village birds and eggs.

52. In all animal systems, satisfactory production will not be achieved without better management, nutrition and disease control. In Chapters VIII and IX we outline the key role that DGLS and provincial Livestock Services could play in these areas and possible means to provide these services are suggested.

### 7. Marketing and processing

53. Supply of livestock products depends not only upon local market conditions, but also upon farm needs for draft power, liquidity, and manure production. Expenditure surveys indicate that livestock product demand is increasing rapidly as confirmed by trends in regional prices. Large ruminant prices have tripled over the 5-year period 1977-1982.

54. Livestock product marketing is generally satisfactory and conditions for competition between traders are in place at most markets. Depending upon expected market volume, some new market sites could be established and some slaughterhouse expansion/improvement could be warranted. GOI has played a minor role in livestock marketing with the exception of dairy products and purchases of animals for redistribution programs. Dairy product marketing and pricing is heavily influenced by GOI policy. Milk supplied for processing is handled by village cooperatives (KUD) and milk treatment center (GKSI) cooperatives. Selling prices to factories are largely a function of the government-controlled ratio between local milk : imported solid - non fat (SNF). Milk quality is a serious problem due to on-farm disease problems and poor storage. Minimum butterfat standards are too low and encourage dilution.

55. Slaughterhouse management might be improved by transferring public slaughterhouse management to private enterprise with the exception of meat inspection regulations and control over slaughterhouse sanitation, which must rest with the local government under the technical supervision of DGLS. If this is not possible, the next best policy is to remodel selected slaughterhouses and upgrade them to modern standards of hygiene and public health. The DGLS has identified certain slaughterhouses in the country for priority rehabilitation. A majority of these slaughterhouses may be turned over to private sector management with DGLS retaining authority over slaughterhouse sanitation and meat inspection. The profit motivated private industry would have more incentive to maintain quality standards, thereby improving the product quality, while the government control over inspection and sanitation assures wholesome meat to the consumer. Private industry, concerned over meat quality, would help to modernize transport of slaughter cattle from the farmers/markets to their holding grounds. They also feed and condition the animals before slaughter. As their profit depends on latest marketing techniques, the consumer should benefit through increased competition between the markets.

56. The market information position of the farmers vis a vis the middlemen should be improved by developing a reliable livestock market information system which routinely, would yield market price data and production projections. Market prices might be broadcast and published daily. Production projections should be based on the periodic verification of livestock numbers and production parameters. Greater use of microcomputers on provincial and district levels would facilitate data processing and validation. Present livestock statistics are often contradictory and apparently unreliable.

### 8. Farming Systems Research/Extension

57. The diversity of farming systems in Indonesia has evolved and developed in response to population densities, available soil moisture, soil fertility and topography, and has been influenced by culture and tradition. Common attributes among systems, however, permitted the identification of three general categories, namely 1) food crop-based, 2) estate crop-based, and 3) livestock-based farming systems. By use of simple diagrams which highlight the household, labor use, the role of crops and animals, sources of food and feed, and off-farm linkages, composite-type systems were described and characterized so as to appreciate and



36

understand the interactions and relationships of physical, environmental, and social elements of the whole farm operation. These analyses identify strengths and weaknesses of the crop-livestock systems, permit comparisons across environments, and provide guidelines for research and development strategies, and guidelines for agencies and individuals at the farm level to study the whole farm enterprise in more detail. Essentially, this comprises the Farming Systems Research/Extension program. Information from this approach assists planners at the macrolevel to develop more appropriate regional and national policies for the well-being of small farmers.

58. A strong interaction and interdependence exists among components of the food crop-based systems, in which animals provide draft power and off-farm sales. In turn they utilize the crop residues and by-products and facilitate the recycling of nutrients through manure and compost. In the livestock-based systems, farmers are still highly dependent on crop and mixed garden residues and by-products as a source of feedstuff, except for some of the beef fattening and poultry operations. Some farmers, whose cash income is largely derived from livestock, have established improved grasses and legumes on their farm sites. This increases the nutrient input into the system, which, of course, benefits the crop component. There is less animal-crop interaction in the estate-based systems, but this could be increased by more effective utilization of legume ground cover under rubber trees and oil palms, as well as establishment of imported grasses and legumes under coconut palms.

### 9. Livestock sector development strategies and policies.

59. Major GOI livestock development strategies focus on animal distribution programs using local plus imported stock, building infrastructure to support these programs, animal disease control, dairy development, and regulatory functions. Smaller programs are in place to improve the utilization and numbers of draft animals through intensification schemes, to create Nucleus Estate Schemes to serve groups of dairy and village poultry producers, and to improve extension services for livestock holders. Improvement of animal health services also receives a high priority.

60. Livestock distribution schemes have been a key element of Indonesia's livestock development stategy. The uneven distribution of people and animals relative to the land resource base (Chapters I - IV) would seem to indicate as much. However, the extensive review of feed resources (Chapter IV) indicates that most animals are distributed according to the avaiability of feed resources which, in turn, are closely linked to cropping activities. In addition, the review of past and current redistribution schemes (Chapter VIII) found many problems in maintaining adequate levels of productivity among redistributed animals.

61. The consultant team suggests that rather than make animal distribution the key development strategy, the focus should instead be on making the current stock of animals more productive in their present locations. Animal distribution would play a complimentary and supporting role to this overall strategy. We propose that animal distribution schemes be more limited in scope, that the recipients be better targeted and that better support services be provided.



1,1

62. Analysis in Chapter III indicated the major gains in livestock product output that could be expected through marginal improvements in key parameters such as the male/female ratio, reproductive performance, reduction of mortality and faster growth rates. Our recommended development projects (Chapter IX) are based on these conclusions as well as supporting evidence from the technical analysis carried out in the various chapter of this report.

63. By implication, sector development strategy will require a shift on focus from one concentrating on animal population as an indicator of goal achievement to one concentrating on productivity and output as the relevant indicators. This would require improvement of the feed resource base, animal health support, more technical staff in the field and better support for such staff, easing of regulations covering female slaughter and live animal exports, and a rational genetic improvement program. Each of these aspects is covered in Chapters III - VIII.

64. There is an urgent need to reduce production costs of commercial systems by liberalizing imports of feed ingredients. The view of the consultant team is that none of these qualify as strategic commodities and import authority should be transferred from BULOG to the private sector.

65. The dairy industry is not making its maximum contribution to the sector. We recommend a development strategy which closely links the product users (dairy factories) with the producers to improve productivity, quality control, and lower the handling/marketing costs. More private sector participation is called for and less govenment subsidies. In addition, much higher levels of technical support are needed covering areas such as feed production, feeding practices, animal health, product quality control, calf rearing, dairy herd recording, genetic improvement, and general management. Analyses in Chapters III - VI highlight the nature and serverity of the problems. Several projects are proposed in Chapter IX which would help overcome these problems.

66. Animal health support strategies include concentration on diseases and health problems of major <u>economic</u> importance, sharply reducing neonatal mortalities, improving veterinary field services, improving links between DGLS and research institutions, and additional training. Several projects are proposed in Chapter IX which would assist in meeting these objectives.

67. On the institutional side, we recommend reallocation of resources away from administrative/clerical positions towards technical positions and towards extension activities. This would be a logical step needed to implement the projects identified.

68. Outreach pilot projects for the use of rice straw and estate crops-animal integration should seriously be considered. These would be included as components of several projects outlined in Chapter IX.

### 10. <u>Livestock projects</u>

69. A major objective of the sector review was to build up an information base and carry out selected analysis which would help identify

specific project activities. These activities should clearly flow (a) from the analysis of sector development goals and strategies and (b) from the analysis of contraints currently operating within the sector.

70. A total of 10 projects were identified as having immediate priority.

71. Projects that the team identified that could possibly be justified based on further study include the Java/North Sumatra dairy industry development study, a feasibility study of livestock marketing/slaughterhouse improvement, a feed resource evaluation/animal feed requirements study, a breed evaluation study, and a study to assess potential areas of collaboration between DGLS, provincial Livestock Services and animal helath research institutes.

72. Projects that we feel are ready for an implementation phase include the animal health field services project, the integrated draft animal improvement project, an intensive animal fattening project for large and small ruminants, a village poultry development project, and an integrated livestock services/livestock credit project that would include many of the discrete projects mentioned above.

## PART I. SOCIOECONOMIC BACKGROUND

### CHAPTER I. THE ECONOMY

A. The General Economy

1.1 Indonesia comprises more than 13,000 islands spanning about 5,000 km from east to west. The country supported a population of about [illegible] million in 1983. The current population estimate is 162 million p[illegible] About 60% of the population is concentrated on the inner islands o[illegible] Madura, Lombok and Bali, which in total account for only about seven [illegible] cent of the land surface. The population is estimated to grow at an average rate of about 2.2% per annum and remains predominantly rural. Chapter II provides additional details on Indonesia's population, land area, and population distribution.

1.2 The resource base in the country includes primary energy sources, minerals, timber, and a diversified agricultural base. Prior to the international recession in 1981, an average annual economic growth of about eight per cent had been achieved. To counter the effects of the recession on the Indonesian economy, the Government of Indonesia (GOI) undertook new initiatives including a 28% devaluation of the currency, major rephasing of projects in the public sector, institution of price increases in petroleum products, financial reform affecting interest rates and credit ceilings, and a tax reform program. However, active debate continues regarding the efficacy of these policies, particularly in the highly protected industrial sector (Dick, 1985a).

1.3 The recession in the industrialized countries first reduced the demand for major non-oil exports and then reduced earnings from oil. Increased exports of LNG and LPG have helped compensate, in part, but Indonesia continues to face depressed prices for major commodity exports. A severe drought in 1982 reduced agricultural output. Consequently, growth in GDP in 1982 was only 2.2%, implying no growth in per capita income.

1.4 Recently, national income estimates for 1984 were revised to be consistent with an updated 1980 input-output table. In 1983, a combination of factors, firstly, an expanding world economy, led to GDP growth of 4.2%. Agricultural output recovered from the drought-affected 1982 level (2.1% growth over 1981) to grow by 4.8% in 1983. GDP growth in 1984 was 5.8% at constant 1983 prices (Dick, 1985a).

1.5 Growth of the economy was narrowly based on increased natural gas production (about 40% of the increment) and increased agricultural output (24% of the increased value of output). The economy was sluggish throughout 1985, with forecast GDP growth of 1.6% probably not met due to declining petroleum prices throughout th year. Promotion of non-oil exports has suffered under the burden of high domestic production costs, a consequence, in part, of inefficient and highly protected local industries.

Per capita income in 1985 is about $620, which classifies Indonesia as a middle income developing country.

1.6 Recent (early 1986) steep declines in world oil prices are leading to further GOI cutbacks in development expenditures. These macroeconomic developments make it highly unlikely that Indonesia will meet target growth rates of GDP of 5-5.5%/annum that were projected for the current five year development plan (Repelita IV covering 1984/85 - 1988/89).

1.7 Inflation has been moderate by standards of most developing countries, with 9% in 1982/83, 13% in 1983/84, and about 7% in 1984/85. The current surplus of rice and depressed prices for many exports will help hold down food-related costs. GOI development expenditures for 1985/86 will be about even with, or slightly less than, the rate of population growth. Oil and gas receipts continue to make up about 90% of GOI budget revenues. External reserves are about $5 billion, equivalent to about 4 months of merchandise imports. However, the current account deficit is expected to increase as oil earnings decline in the face of current and medium-term pressure on oil prices. Sluggish domestic demand has curtailed imports (a 25% drop in value between the first half of 1984 and the first half of 1985). Table I.1 presents some summary data on the Indonesian economy.

1.8 The formal financial sector is composed of a commercial banking system dominated by five state owned development banks, a state development bank, the Central Bank (Bank of Indonesia), 70 private national commercial banks, 11 foreign banks, 3 development finance companies and 26 regional development banks. The state commercial bank that has been most heavily involved in loans to the agricultural sector is the Bank Rakyat Indonesia. Chapter VI provides additional details on financial institutions impacting upon the livestock sector.

1.9 A major task facing the country is to provide employment opportunities for a rapidly expanding labor force. During the current Five Year Plan, labor force supply is projected to increase at 2.8% per year and a total of 9.3 million new entrants will have to be accomodated during this period. Given the proportion of the labor force in agriculture, this represents a major task for the agricultural sector. The GOI recognizes the key role of agriculture in the balance of payments, in employment, in income distribution and in food supply areas, and channels a considerable amount of development expenditures to the sector. A sustained rate of growth of 5% per annum is considered necessary to have a significant impact on employment creation and poverty alleviation. The economy must create approximately 1.8 million new jobs per year to maintain current workforce participation levels. As mentioned above, there is now little likelihood of Indonesia currently reaching this 5% growth in the economy, so job creation is the agricultural sector will become an even more critical task.

Table I.1 Summary data on the Indonesian economy (as of 30 June, 1985)

| Item | Measure | 1960 | 1970 | Most recent estimate | Remarks |
|---|---|---|---|---|---|
| Area | Total (000 sq. km) | | | 1919.44 | 1982 |
| Per capita GNP | (US $) a/ | | | 560 | 1983 |
| Life expectancy at birth | (years) | 41 | 47 a/ | 54 | [illegible] |
| Infant mortality | (per 1000 live births) | 150 | 121 a/ | 102 | |
| Daily per capita calorie supply | (cal) | n.a. | 1970 | 2380 | 1982 |
| Daily per capita protein supply | (gm) | n.a. | 41 | 51 | 1982 |
| Adult literacy rate (%) | | 39 | 57 b/ | 68.3 | 1982 |
| Income distribution: % income received by: | | | | | |
| Highest 5% of households | | n.a. | n.a. | 23.5 | 1976 |
| Highest 20% of households | | n.a. | n.a. | 49.4 | 1976 |
| Lowest 20% of households | | n.a. | n.a. | 6.6 | 1976 |
| Lowest 40% of households | | n.a. | n.a. | 14.4 | 1976 |

| Labor force ('000) | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| Total force | 52,541 | 60,762 | 59,599 | n.a. | n.a. |
| Total employed | 51,553 | 59,123 | 57,803 | n.a. | n.a. |
| Agriculture, forestry, fisheries | 28,834 | 36,336 | 31,593 | n.a. | n.a. |
| Mining and manufacturing | 5,067 | 5,053 | 6,413 | n.a. | n.a. |
| Others | 17,652 | 17,734 | 19,797 | n.a. | n.a. |
| Unemployed or underemployed | 868 | 1,639 | 1,796 | n.a. | n.a. |
| Unemployment/underemployment rate(%) | 1.7 | 2.7 | 3.0 | n.a. | n.a. |

(continued)

Table I.1: (Continued)

| Gross domestic product, constant 1973 money prices | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| % share by industry: | | | | | |
| Agriculture, forestry fishery | 30.7 | 29.8 | 29.8 | 29.9 | n.a. |
| Mining and manufacturing | 24.5 | 24.4 | 23.0 | 22.6 | n.a. |
| Construction | 5.7 | 6.0 | 6.1 | 6.3 | n.a. |
| Electricity & water | 0.7 | 0.7 | 0.9 | 0.9 | n.a. |
| Transport & communications | 5.5 | 5.6 | 5.8 | 5.9 | n.a. |
| Trade | 16.6 | 16.9 | 17.5 | 17.4 | n.a. |
| Others | 16.4 | 16.5 | 16.8 | 17.0 | n.a. |
| Growth rate (%) | | | | | |
| Agriculture, forestry, fishery | 5.2 | 4.9 | 2.1 | 4.8 | n.a. |
| Mining & manufacturing | 12.2 | 7.6 | -3.1 | 2.1 | n.a. |
| Others | 12.0 | 10.2 | 5.5 | 4.9 | n.a. |
| GDP | 9.9 | 7.9 | 2.2 | 4.2 | 5.8 |
| Consumer price index | | | | | |
| Consumers, Jakarta April 1977-March 1978=100 | 149.8 | 162.6 | 177.2 | 196.2 | 219.2 |
| % change | 15.4 | 8.5 | 9.0 | 10.7 | 11.7 |

Source: Asian Development Bank. 1985. Report and recommendations of the President to the Board of Directors on a proposed loan to the Republic of Indonesia for the Fisheries Industries Credit Project. RRP no. 705 -INO. Asian Development Bank, Manila.

a/ World Bank estimate, 1984.

b/ Period between 1969-1971.

1.10 Agriculture continues to be the most important segment of the Indonesian economy, accounting for 30% of GDP, 60% of total employment and 70% of non-oil exports. Accordingly, the GOI has placed high priority on agricultural development through its successive Five-Year Development Plans (Repelita), the fourth of which is current. The growth of agriculture during Repelita IV is targeted at 3.0%. The objectives of the plan is social justice for all, high economic growth and national stability. Section B of this chapter provides additional background on the agricultural economy.

1.11 A major strategy of the plan is to relocate manpower and labor to match the development potential for agriculture in the various regions. Towards this end, a bold transmigration program is in operation which resettles people from the densely populated "inner" islands (Java, Madura and Bali) to the "outer" islands, mainly Kalimantan and Sumatra. As a result, more than one-half million hectares of new land has been brought into cultivation each year, with 8 million more hectares planned to brought under cultivation during the current plan period. One major consequence of this ambitious plan has been the attainment of a rice surplus by 1984/85.

## B. The Agricultural Economy

1.12 The agriculture sector is of primary importance to the majority of Indonesians, nearly 80% of whom live in rural areas. Agriculture is the primary source of income for about two-thirds of all rural households and 10% of all urban households.

1.13 There is considerable scope for expanding agriculture as Indonesia has 192 million hectares of total land. Only 20 million hectares of the 70 million hectares considered suitable for agriculture are being cultivated. The Government has accorded high priority to development of the sector to ensure self sufficiency in food and increased human welfare, especially in the rural areas.

1.14 Table I.2 gives production indices for major agricultural products over the 1978-1984 period. The agricultural sector was a growth leader in 1984. Much of these increases were due to the second successive bumper rice crop, and gains in the output of rubber, oil palm, cassava, maize, sugercane and copra. As a result, per capita food availability in 1984 was 141% of that for the 1969-71 period (see also section D below).

Table I.2: Index of agricultural production

| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|
| Food prod'n. (total) | 112.9 | 116.7 | 127.7 | 136.7 | 137.0 | 143.7 | 146.5 |
| Agriculture (total) | 112.6 | 116.6 | 127.0 | 136.1 | 134.8 | 141.6 | 145.9 |
| Crops (total) | 112.8 | 115.1 | 125.0 | 135.5 | 132.8 | 140.1 | 145.4 |
| Livestock products (total) | 113.1 | 131.9 | 145.0 | 153.5 | 160.2 | 163.4 | 163.6 |
| Cereals (total) | 116.2 | 116.7 | 131.4 | 145.6 | 144.4 | 157.4 | 162.6 |
| Food, per capita | 105.6 | 106.9 | 114.7 | 120.5 | 118.6 | 122.2 | 122.5 |
| Agriculture, per capita | 105.4 | 106.8 | 114.0 | 120.0 | 116.7 | 120.4 | 122.0 |
| Crops, gross per capita | 105.5 | 105.5 | 112.3 | 119.5 | 114.9 | 119.1 | 121.6 |
| Livestock products, gross per capita | 105.9 | 121.0 | 130.4 | 135.4 | 138.9 | 139.2 | 136.9 |
| Cereals, gross per capita | 108.7 | 107.0 | 118.1 | 128.3 | 125.0 | 133.9 | 136.0 |

Source: FAO, (1984)



45

C. Livestock in the Indonesian Economy

1.15 There has been a recent increase in interest in the livestock sector. Several factors have played a role:

- Numerous studies have indicated a shortage of draft animals relative to the minimal power requirements needed for adequate land preparation and for expanding the cultivated area (appendix tables 1.1 and 1.2)

- The transmigration programs require additional animals for the provision of traction power, transport and manure (appendix table 1.3)

- Prices for livestock products in general, and beef in partic… have been increasing faster than the general rate of inflat… An expanded supply of animal products is seen as a means of dampening these increases (see section D, below)

- National goals to increase self-sufficiency have resulted in major investments in dairy production and milk marketing to reduce the foreign exchange losses from dairy product imports (see Chapter III and appendix tables 1.4 and 1.5)

- Livestock are being recognized as a key element contributing to rural incomes and an efficient utilization of rural resources

- Increased animal product consumption is an integral part of meeting national nutritional goals

- Indonesia has an exportable surplus of several animal feedstuffs (cassava, rice bran, copra meal, palm kernal meal) and has the capacity to produce exportable surpluses of corn (De Boer, 1984). There is interest in using more of these feedstuffs within Indonesia

- There is increased interest in developing exports of livestock products. (Appendix table 1.16 shows the very marginal contribution of livestock products to Indonesia's exports)

- Farmyard manure continues to play an important role in Indonesian agriculture. Appendix table 1.5 shows the projections of available farmyard manure and compost, while Chapter II presents the results of the ADB-DGLS livestock producers survey, which indicates the high priority most farmers place on manure as a reason for holding animals

1.16 The livestock sector is an important segment within the economy, providing almost all the domestic consumption of meat and eggs, and part of the milk. The sector also provides draft animals for agriculture and transport; sustains a domestic leather industry plus provides additional hides and skins for export; meets a considerable part of the fertilizer requirements of agriculture; acts as a means of saving and capital accumulation; and provides other surpluses for a limited export market. Additional details about the livestock resource base, including data on



46

livestock populations, productivity, and economic role are given in Chapters III and VII.

1.17 A summary of provincial data on agricultural holdings with livestock, based on the 1980 Census of Agriculture, is given in table I.3. Given the diversity of Indonesia and the great differences in rural population densities (Chapter II), the variation in provincial figures for percentages of agricultural holdings with cattle and buffalo is expected. The variation in animals per holding is much less since, even in areas where there are large areas of unutilized land, farm-level constraints on labor, capital, and land quality tend to limit the number of animals individual households can manage.

1.18 Since 1972, total meat production has expanded about 6.5% annually, due largely to rapid growth of the poultry industry and increased beef production (Appendix Table 1.7). Of the total meat production in 1983, about 47% was beef, buffalo and horse meat combined, followed by 34% poultry meat, 9.7% pork, and 9.5% goat and mutton.

1.19 Strong demand for livestock products during the last decade has led to price increases of livestock products. Prices for livestock products have also increased faster than general prices as reflected in the general inflation rate. Dixon (1984) has also confirmed that livestock and fish prices have increased relative to other agricultural products.

1.20 The price effect is also illustrated by livestock's increasing share in the Gross Domestic Product (GDP) derived from agriculture. Livestock's share of GDP derived from agriculture increased from 6.9% in 1978 to 9.2% in 1981 (BPS, 1983). Fish accounted for the major portion, having increased 5.9% in 1978 to 6.7% in 1981. Nevertheless, the livestock industry's contribution to GDP derived from agriculture is underestimated for two reasons.

1.21 Firstly, a number of important products of livestock enterprises do not appear as cash outputs, and therefore are generally excluded from macroeconomic surveys. These include the value of draft power, manure and liquidity (the capacity to produce cash upon demand, and the relative cost of producing it, and the "insurance" livestock ownership confers).

1.22 Secondly, "gross" income is the sole criterion used to calculate the livestock industry's share of GDP. Most livestock enterprises (with the exception of specialized dairy, poultry and pig farms) use very few inputs other than labor. Consequently, the livestock industry's share measured in "value added" might be substantially higher than reported using gross income.

1.23 Meat production trends can be estimated by two methods. First, the production can be derived from livestock population data as presented in appendix table 1.9. The underlying assumption is that animal productivity over the last ten years has remained unchanged. If the assumption accurately reflects reality, then it must be concluded that meat production from ruminants is stagnant.

Table I.3: Distribution of agricultural holding with livestock, based on 1980 agricultural census

| Province | Total agic. holdings | Cattle: Holdings w/cattle no. | Cattle: Holdings w/cattle (%) | Cattle: No. of cattle | Cattle: Ave. no./ holding | Water Buffalo: Holdings w/ buffalo no. | Water Buffalo: Holdings w/ buffalo (%) | Water Buffalo: No of buffalo | Water Buffalo: Ave. no./ holding | Sheep and Goats (S & G): Holdings w/ S & G no. | Sheep and Goats (S & G): Holdings w/ S & G (%) | Sheep and Goats (S & G): of S & G | Sheep and Goats (S & G): Ave. no./ holding |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (000) | (000) | | (000) | | (000) | | (000) | | (000) | | (000) | |
| Aceh | 382 6 | 67.7 | 18 | 207.4 | 3.1 | 68.4 | 18 | 169.4 | 2.5 | 74.7 | 20 | 308.0 | 4.1 |
| North Sumatra | 964.5 | 55.5 | 6 | 158.5 | 2.9 | 59.6 | 6 | 143.6 | 2.4 | 713.5 | 74 | 516.0 | 4.6 |
| West Sumatra | 489.7 | 115.2 | 24 | 191.6 | 1.7 | 65.8 | 13 | 113.8 | 1.7 | 46.4 | 9 | 115.4 | 2.5 |
| Riau | 267.4 | 11.9 | 4 | 32.1 | 2.7 | 9.9 | 4 | 29.7 | 3.0 | 27.8 | 10 | 123.1 | [illegible] |
| Jambi | 225.0 | 17.1 | 8 | 35.5 | 2.1 | 17.6 | 25 | 55.4 | 3.1 | 30.4 | 14 | 117.5 | [illegible] |
| South Sumatra | 531.4 | 51.0 | 10 | 143.0 | 2.8 | 11.9 | 2 | 42.9 | 3.6 | 49.7 | 9 | 186.8 | 3.7 |
| Bengkula | 128.7 | 9.3 | 7 | 27.8 | 2.8 | 9.9 | 8 | 29.5 | 3.0 | 27.1 | 21 | 69.4 | 2.5 |
| Lampung | 711.7 | 90.1 | 13 | 177.1 | 2.0 | 14.9 | 2 | 33.1 | 2.2 | 140.5 | 20 | 468.2 | 3.4 |
| DKI Jakarta | 17.3 | 0.1 | 1 | 0.2 | 2.1 | 0.8 | 5 | 1.6 | 2.0 | 6.0 | 35 | 32.1 | 5.4 |
| West Java | 3442.5 | 83.1 | 2 | 170.3 | 2.0 | 215.4 | 6 | 443.2 | 2.1 | 1,366.7 | 40 | 4,618.6 | 3.4 |
| Central Java | 3433.6 | 753.3 | 22 | 1342.5 | 1.8 | 147.6 | 4 | 327.5 | 2.2 | 1,160.8 | 34 | 3,899.5 | 3.4 |
| D.I. Yogyakarta | 423.8 | 148.9 | 35 | 236.3 | 1.6 | 8.1 | 2 | 17.0 | 2.1 | 164.6 | 39 | 451.4 | 2.7 |
| East Java | 3744.5 | 1784.4 | 48 | 3,423.4 | 1.6 | 73.0 | 2 | 186.7 | 2.6 | 1.077.6 | 29 | 3,185.3 | 3.0 |
| Bali | 330.5 | 203.4 | 62 | 425.6 | 2.1 | 3.1 | 1 | 7.3 | 2.3 | 14.2 | 4.3 | 52.9 | 3.7 |
| West Nusa Tenggara | 373.0 | 120.9 | 32 | 277.0 | 2.3 | 47.0 | 13 | 203.0 | 4.3 | 76.0 | 20 | 288.7 | 3.8 |
| East Nusa Tenggara | 488.8 | 93.6 | 21 | 485.4 | 5.2 | 41.3 | 9 | 156.1 | 3.7 | 104.3 | 23 | 390.0 | 3.7 |
| West Kalimantan | 381.7 | 31.9 | 8 | 87.3 | 2.7 | 0.4 | 0.1 | 1.1 | 2.7 | 14.1 | 4 | 48.6 | 3.4 |
| Central Kalimantan | 144.5 | 5.6 | 4 | 15.6 | 2.6 | 0.7 | 0.5 | 3.7 | 5.6 | 2.5 | 2 | 11.0 | 4.5 |
| South Kalimantan | 308.2 | 20.5 | 7 | 54.8 | 2.7 | 4.0 | 1 | 13.6 | 3.5 | 9.1 | 3 | 40.6 | 4.5 |
| East Kalimantan | 106.3 | 3.9 | 4 | 10.5 | 2.7 | 1.8 | 2 | 5.7 | 3.1 | 5.2 | 5 | 24.6 | 4.7 |
| North Sulawesi | 279.6 | 77.1 | 28 | 202.3 | 2.6 | 0.3 | 0.1 | 6.5 | 1.7 | 21.0 | 8 | 75.2 | 3.6 |
| Central Sulawesi | 200.3 | 57.5 | 29 | 172.2 | 3.0 | 3.1 | 2 | 10.8 | 3.4 | 29.4 | 15 | 127.3 | 4.3 |
| South Sulawesi | 741.9 | 209.8 | 28 | 835.5 | 4.0 | 117.3 | 16 | 340.3 | 2.9 | 114.8 | 15 | 353.8 | 3.1 |
| South East Sulawesi | 138.5 | 19.8 | 14 | 65.0 | 3.3 | 3.0 | 2 | 8.0 | 2.6 | 14.3 | 10 | 46.7 | .3 |
| East Timor | 113.3 | 9.4 | 8 | 39.3 | 4.2 | 8.2 | 7 | 40.2 | 4.9 | 22.5 | 20 | 91.8 | 4.1 |
| Maluka | 186.2 | 9.2 | 5 | 31.7 | 3.4 | 1.0 | 0.1 | 6.7 | 6.4 | .3.5 | 10 | 78.3 | 5.3 |
| Irian Jaya | 157.8 | 3.0 | 2 | 14.0 | 4.6 | 0.2 | 0.1 | 0.3 | 1.7 | 3.9 | 2 | 18.4 | 4.7 |
| Total Indonesia | 18,673.0 | 4,053.4 | 22 | 8,861.9 | 2.2 | 934.5 | 5 | 2,390.9 | 2.6 | 4,735.8 | 25 | 15,761.6 | 3.3 |

Source: National Livestock Census Survey, DGLS (1980)



48

1.24 On the other hand, "meat production" figures show a substantially increased production during the same period (1969 - 1982). This increase can be explained only partly by decreasing animal exports, presented in appendix table 1.15. For example, meat production from goats is reported to have increased by more than 50% during REPELITA III (1979 - 1983, table 1.7) while goat population remained virtually unchanged. Knipscheer, et al., (1984) have attributed this large difference between the reported increase in meat production and in population to a growing awareness of the small ruminant's contribution to the national meat supply. They suggest that meat production from small ruminants had previously been underestimated.

1.25 Meat production for different livestock species is estimated in appendix tables 1.9 through 1.13 using population figures from 1979. Meat from horses, ducks, rabbits, quail, pigeons, and other minor sources has not been included in this analysis.

1.26 Meat production figures are based on the following model:

- total animal population
- percentage adult females
- percentage offspring per adult female
- off-take [(1) x (2) x (3)]
- home consumption [percentage of (1)]
- increase in inventory [percentage of (1)]
- animals sold (4-5-6)
- animals imported/exported by province
- animals consumed per province excluding home consumption (7-8)
- animals consumed per province including home consumption [(9) x (5)]
- average weight of animals sold
- average dressing percentage
- estimated total volume of meat produced per province

1.27 For the poultry and the pig sector, two sets of production parameters were used: "traditional" sector (village chickens and back yard pigs),and the "commercial" sector. The market share of each sector (traditional versus commercial) was based on population data or assumption. As expected, production parameters between the two sectors differ tremendously. Presently, the BPS calculations differentiate only between village chickens (ayam kampung, ayam sayur or ayam buras) and "improved" chickens (ayam ras) but not between local pigs and "improved" pigs. Appendix Table 1.13 therefore yields meat production figures for the pig sector that differ substantially from BPS figures. It should be stressed here that use of the terms "village" or "local" versus "modern" or "improved" breeds does not imply that the higher productivity of these animals results necessarily from genetic improvement. More likely, higher productivity results because farmers using "improved breeds" also use improved management practices. Table I.4 summarizes 1979 meat production as estimated by various sources.

1.28 Meat production figures are calculated in Table I.5 using the above conversion factors for the most recent livestock numbers (1982). Again, these figures differ substantially from DGLS meat production estimates and projections.

1.29 Eggs are an important part of the Indonesian diet. Current estimates by the Dinas Peternakan for egg production and projections show that eggs are a substantial source of prote n, calories and Appendix Table 1.14 also illustrates the growing importance of eggs ...ive to other livestock products, notably meat.

1.30 Skins and hides have traditionally been a relevant export product for Indonesia. In the later years, however, the leather processsing industry in Indonesia has developed rapidly, so that the major part of these by-products are presently processed domestically. Appendix table 1.15 shows the decrease in skins/hides exports, especially for cattle and buffalo hides.

## D. Consumption, Nutrition, Demand, and Prices

### 1. Consumption, nutrition, and demand

1.31 Nationally, Indonesians spent about Rp 131,064 annually per capita in 1981 (BPS, 1983). Of this amount, 61% was allocated for food items on average. However, as 1981 per capita income was higher in urban areas than in rural areas, Rp 200,664 compared to Rp 110,520, rural Indonesians spent a greater share of their income on food. Consequently rural Indonesians spent an average of 66% of their income on food compared to urban dwellers' 52%. A summary of rural wage levels for various locations in Indonesia determined from field visits by study team members is presented in appendix table 1.16.

1.32 Fish accounts for about 60% of the protein in Indonesian's diets compared with 25% from meat. Indonesians obtain three times more protein from meat than milk or eggs. Beef provided more meat protein than any other meat. The annual per capita meat consumption (1983) of 4.32 kg is quite low compared to the other countries in the ASEAN region, suggesting that demand will continue to increase for some time.

1.33 Appendix table 1.17 shows the percentage of average income spent on different food items. Animal protein foods are found in three categories: fish, meats, eggs and milk; miscellaneous food items, and prepared food. A breakdown by income group shows that Indonesians spend a greater share of their total income in each of these categories as their income increases. In other words, as income per capita rises, expenditures on these high quality goods will increase at a faster rate. This is also reflected in the estimates of income elasticities of demand for livestock products. The income elasticity of the demand for a given product reflects the percentage change in demand one can expect from an increase of 1% in income. Several sources provide estimates of income elasticities. Generally these are above 1, indicating that demand for livestock products tends to grow more rapidly than income. Table 1.6 shows that the income elasticities used by DGLS and the World Bank are on the conservative side whereas higher estimates are reported by SUSENAS (1978) and Sabrani (1982).

Table I.4: Estimates for 1979 meat production in Indonesia by source (tons)

| Species | ADB [a] | BPS [b] | DINAS [c] |
|---|---|---|---|
| | Source | | |
| Cattle | 112,581 | 134,055 | 213,700 |
| Buffalo | 39,526 | 35,141 | 64,400 |
| Small ruminants | 64,623 | 61,715 | 52,300 |
| Chicken | 218,071 | (100,300) | 100,300 |
| Pigs | 109,250 | 91,559 | 54,200 |
| Total | 544,051 | 422,770 | 484,900 |

[a] Winrock team estimate (1985)
[b] BPS Yearbook (1983)
[c] Dinas Peternakan "Informasi Data Peternakan, 1983"

Table I.5: Meat production in 1982 and DGLS projections for 1984 (1000 tons)

| | Study team | Dinas (1984)[b] |
|---|---|---|
| beef | 113.56 | 261.6 |
| buffalo | 40.76 | 75.3 |
| sheep/goats | 66.91 | 84.6 |
| chicken | 419.89 | 226.4 |
| pigs | 130.50 | 64.5 |
| Total | 771.62 | 712.4 |

[a] Consultants estimates for 1982
[b] DGLS projections for 1984

1.34 The response of quantity consumed to income is reversed for staple foods such as cereals and tubers. People in higher income categories spend a smaller proportion of their money on these items. These consumption patterns are rather universal and have two important implications:

- demand for fish and livestock products will increase more rapidly than most other food items

- livestock production effectively transfers income from high-income consumers to animal producers

Table I.6: Income elasticities according to source

| Source | Item | Elasticity | Method of Estimate |
|---|---|---|---|
| Sabrani, 1982 | red meat | 2.08 | time series |
| SUSENAS, 1979 | meat | 2.71 | cross-section |
| | eggs and poultry | 2.16 | |
| | dairy | 1.40 | |
| DGLS | red meat | 1.3 | not known |
| | poultry | 1.2 | |
| | pork | 1.0 | |
| | fresh milk | 1.2 | |
| | milk powder | 1.0 | |
| Hedley | total livestock products (urban) | 1.2 | not known |
| | total livestock products (rural) | 1.6 | |
| SUSENAS, 1979 | total livestock products | 2.16 | cross-section |
| World Bank/FAO, 1980 | pork | 1.0 | not known |
| | duck eggs | 1.0 | |
| | beef | 1.2 | |
| | mutton | 1.2 | |
| | poultry meat | 1.5 | |
| | poultry eggs | 1.5 | |

1.35 Another study of food consumption patterns in Indonesia was published by the World Bank (Chernichovsky and Meesook, 1984). Table I.7 gives estimates of proportions of households consuming livestock products in the SUSENAS survey areas as well as total expenditure elasticities of demand (Table I.8). The latter are similar to income elasticities of demand, and also show that the DGLS income elasticities of demand used in Repelita IV projections (appendix table 1.21, bottom) are probably too low. Therefore, effective demand will probably grow faster than that projected and the demand-supply gap will probably grow, resulting in rising real prices for livestock products.



52

1.36 Another feature worth noting in Table I.7 is the very small proportion of Indonesia's population that consumes meat and poultry (22%), eggs (31%), or dairy products (14%), the large rural-urban differences and large differences between expenditure classes.

Table I.7: Proportions of households reporting consumption of food groups based on 1978 SUSENAS survey

| | Meat and Poultry | Eggs | Dairy products |
|---|---|---|---|
| Indonesia | 21.77 | 31.10 | 14.01 |
| Region: | | | |
| DKI Jakarta | 52.56 | 66.73 | 52.31 |
| West Java | 17.64 | 24.27 | 12.30 |
| Central Java | 12.11 | 17.87 | 8.11 |
| DI Yogyakarta | 11.95 | 28.28 | 13.31 |
| East Java | 20.21 | 30.66 | 6.16 |
| Sumatra | 26.54 | 40.93 | 21.96 |
| Bali & NTT | 37.00 | 30.98 | 5.53 |
| Kalimantan | 28.66 | 41.99 | 22.05 |
| Sulawesi | 23.06 | 38.33 | 19.98 |
| Maluku & Irian Jaya | 17.70 | 26.18 | 45.47 |
| Location: | | | |
| Urban | 42.74 | 54.99 | 38.25 |
| Rural | 17.55 | 26.29 | 9.13 |
| Expenditure class: | | | |
| Lower 40% | 6.35 | 14.41 | 1.92 |
| Middle 30% | 16.90 | 29.11 | 8.04 |
| Upper 30% | 45.85 | 53.96 | 35.01 |

Source: Chernichovsky and Meesook, 1984

1.37 Additional information on rural household consumption patterns was provided by the ADB/DGLS survey (see preface). Respondents in the survey were asked what percentage of products consumed was home-produced. Considering the fact that this survey was conducted among livestock holders, the substantial amount of livestock products purchased (appendix tables 1.18 and 1.19) might be surprising. Only a minor amount of livestock products reach the household by barter (appendix table 1.20).

1.38 Appendix table 1.17 gives total and per capita figures on consumption of meat, milk, and eggs over the 1972-1983 period.

1.39 Appendix tables 1.21 and 1.22 give projected per capita and total consumption over the 4th Five Year plan period. Increases in poultry meat, eggs, and milk consumption are much slower than those realized over the Repelita III period. Differences between rates of growth in appendix tables 1.21 and 1.22 are due to population growth.

Table I.8: Total expenditure elasticities of demand for food groups based on 1978 SUSENAS survey

| Expenditure group | Meat | Eggs and Poultry | Dairy Products |
|---|---|---|---|
| Java | | | |
| Lower 40% | 3.948 | 1.143 | 0.076 |
| Middle 30% | 2.162 | 2.871 | 0.076 |
| Upper 30% | 2.534 | 2.544 | 2.203 |
| Outer Islands | | | |
| Lower 40% | 1.332 | 2.110 | 0.719 |
| Middle 30% | 3.112 | 3.621 | 1.856 |
| Upper 30% | 3.148 | 3.050 | 2.779 |

Source: Chernichovsky and Meesook, 1984

1.40 In general, it was felt that consumption levels in appendix table 1.22 would not be met for Repelita IV. Meat production, with the possible exception of poultry, will not expand fast enough because of a combination of technical problems which are exacerbated by government policies towards the sector, and lack of high quality support services for producers. Egg production could expand at the target level if BULOG policies towards soybean meal imports are revised and if the current sluggish demand situation improves. Milk consumption is unlikely to increase at projected levels because high product prices, quality problems, and slow income growth all restrict consumer demand.

## 2. Prices and price trends

1.41 The market for livestock in Indonesia is becoming increasingly integrated. This is also visible in price trends. Rosmijati Sajuti (1984) recently conducted a market study of meat and eggs on Java and Bali. Examining prices over a period of five years in five cities (Denpasar, Surabaya, Semarang, Bandung and Jakarta), he found high price correlations among these cities. Correlation between Jakarta prices and prices in the other cities increases as distance from Jakarta decreases, illustrating the flow of animals from Nusa Tenggara and East Java to Jakarta (See table I.9).



54

1.42 Comparison of locational marketing margins relative to Jakarta prices showed a similar relationship. In a well-integrated market, marketing margins increase as distance from the primary market increases, in this case Jakarta. The Denpasar market margin as a percentage of Jakarta prices (43%) was higher than Surabaya (36%), which is closer to Jakarta.

Table I.9: Price correlations between Jakarta and other cities on Java and Bali, 1979-1983

| | Bandung | Semarang | Surabaya | Denpasar [a/] |
|---|---|---|---|---|
| meat | 0.99 | 0.93 | 0.90 | 0.77 |
| eggs | 0.60 | 0.70 | 0.70 | 0.30 |

Source: Rosmijati (1984).
[a/] Cities are listed in order based on distance from Jakarta. Bandung is closest to Jakarta, and Denpasar is furthest.

1.43 Relative prices among regions suggest that markets became increasingly integrated between 1977 and 1982. For example, appendix tables 1.23 through 1.25 show that between 1977 and 1982 the differences between cattle prices in Jakarta and Nusa Tenggara decreased 19%. The same tables indicate that, in view of the increasing differences between cattle prices in Sulawesi and Jakarta, the potential for export from Sulawesi to Jakarta has increased. Appendix table 1.23 also shows that meat prices have risen much faster than the inflation rate (based on CPI, consumers' price index).

1.44 Two other important conclusions can be drawn from the tables. Firstly, red meat prices approximately tripled between 1977 and 1982, indicating increasing demand on the ruminant sector, especially for large ruminants. Secondly, the price differential between red meat and poultry meat is increasing (see price indexes). These price trends give credence to the demand projections by Sabrani (1979) and Dixon (1984), and also indicates that demand projections for Repelita III were underestimated.

1.45 Regional price series, in actual Rupiahs, are given for beef (appendix table 1.26), buffalo meat (appendix table 1.27), pork (appendix table 1.28), goat meat (appendix table 1.29), live chickens (appendix table 1.30), chicken meat (appendix table 1.31), and eggs (appendix table 1.32 - 1.34).

## E. Government Development Plans and Objectives

1.46 The focus of GOI economic strategy and development planning has greatly shifted from earlier concerns about reconstruction of the economic infrastructure and stabilizing the economy to issues dealing with the generation of high economic growth rates and a more even distribution of benefits arising from rapid growth of the economy. The agricultural sector plays a major role in these plans.

1.47 The basic development objectives of the current 5 year development plan, Repelita IV (1984/85-1988/89), are a more even distribution of the benefits of development, pursuit of social justice, high economic growth and economic stability. Agriculture is to play a major role by increasing output of export crops, generating employment opportunities through transmigration, and expanding food crop areas on the outer islands.

1.48 As mentioned in section A of this chapter, employment generation is a major concern, and the high proportion of the population engaged in agriculture implies that this sector must continue to play the major in generating productive employment for most of the new labor market entrants.

1.49 Specifically, Repelita IV objectives specify the objectives of:

- meeting the needs for food and supply of raw materials to domestic industries
- increasing export earnings
- increasing farmer incomes
- expanding employment and job opportunities
- providing production opportunities to entrepreneurs
- supporting balanced regional and rural development
- increasing transmigration activities

1.50 The overall target for growth in the agricultural sector during Repelita IV has been set at 3% annually. It is proposed to expand and improve agricultural production (crops, fisheries, livestock, plantations, and forestry) through intensification, expansion, rehabilitation and diversification, based on subsectoral and area specific conditions and requirements. Resource conservation and management will be emphasized in all cases. Further, the objective of increased food production will include the expansion of vegetables and animal protein supply, thereby improving the quality of food intake and reducing malnutrition.

1.51 The main objectives for the livestock sector in Repelita IV have been set as:

- to increase farm incomes and employment opportunities through the enhanced production and productivity of livestock

- to increase livestock population and production to meet domestic demand for both animal services and animal products

- to increase export earnings and reduce imports of livestock products

- to meet the demand for draft animals and supply manure for crop production

- to conserve indigenous breeds like the Bali cattle

- to increase the carrying capacity of grasslands through the establishment of better quality forages, thus improving total natural resource productivity and the environment

1.52 During Repelita IV the major targets set for the livestock sector are as shown in table I.10.

1.53 Repelita IV aims to make Indonesia a net exporter of livestock and livestock products within five years. Total import of livestock and livestock products at the end of Repelita IV (1988/89) in terms of value is projected at $71.2 million, comprising $58.6 million of milk powder and $12.6 million of livestock. The corresponding export target is $80 million, of which about $62 million is from export of hides and bones, and the rest from export of livestock. The targets in respect to draft animals and employment are to increase the draft animal population by 224,000 and to create 697,000 additional jobs in the livestock sector.

Table I.10: Repelita IV targets for livestock production

| | Actual Quantity in 1982 | Target for 1988/89 | Annual Per Cent Average Increase (1984/85 - 1988/89) |
|---|---|---|---|
| Livestock population ('000 heads): | | | |
| Large ruminants | 9,247 | 10,046 | 1.0 |
| Small ruminants | 12,122 | 14,002 | 3.0 |
| Pigs | 3,587 | 5,267 | 6.6 |
| Livestock production ('000 tons): | | | |
| Meat | 629 | 893 | 6.1 |
| Eggs | 297 | 419 | 6.6 |
| Milk | 117 | 533 | 33.0 |
| Per capita consumption (kg/annum): | | | |
| Meat | 4.1 | 5.1 | 3.9 |
| Eggs | 1.8 | 2.0 | 4.4 |
| Milk | 4.3 | 5.0 | 3.0 |

Source: DGLS (1983a), Worksheets for Repelita IV

1.54 The Repelita IV objectives and targets in the livestock sector will be pursued through the following programs: (1) importation of selected livestock breeds, an expanded artificial insemination (AI) program and distribution of good breeders, to increase livestock population; (2) improvement and development of animal fodder, feed and nutrition, so increasing livestock productivity; (3) encouragement and assistance to the private sector for livestock breeding and production; and (4) strengthening of support services including veterinary services, extension, pilot schemes/demonstration, credit, and training. For dairy development, the approach will involve the establishment of linkages between producers, cooperatives, and the milk processing and marketing industries.

1.55 Additional details on Repelita IV projections are provided in appendix tables 1.1, 1.5, 1.21, 1.22, 1.35, and 1.36.

F. Long-term Prospects

1.56 The Indonesian economy has slowed noticeably since late 1984 and the current trend towards decreased petroleum prices is causing substantial downward revisions in estimates for economic growth, exports and government revenues. While this has detrimental effects on short-term public investment in agriculture, recent events should serve to again highlight the role of agriculture in the economy and its importance in being generate non-oil exports and sources of revenue. The weakening economic situation will also dampen projected increases in demand for livestock products. However, analysis in this chapter has indicated that income elasticities of demand used in Repelita IV were probably too low and that demand, at constant prices, would probably grow faster than projected based on GOI estimates of 5.5% annual growth in GNP over the plan period.

1.57 The analysis in this chapter has also indicated that growth in rural incomes and rural employment has lagged behind overall growth of the economy. Furthermore, consumption of animal products in Indonesia in general and in the rural areas in particular is very low with the vast majority of households seldom consuming meat, milk or eggs. These factors will also limit growth of primary livestock product demand.

1.58 Demand for secondary products, such as draft power and manure, should grow faster than past trends because of the rapid growth of transmigration programs. Animal manure is being increasingly recognized as a key input in transmigration areas, particularly those characterized by acid, infertile soils. These areas are becoming more common as the prime transmigration sites are being closed to further transmigrants.

1.59 The agricultural economy of Indonesia is large by any standard and produces a highly diversified range of products. This presents a number of problems and also opportunities for increasing animal production. The feed resource base (Chapter IV) is based largely on the crop sector and growth opportunities for crops will generally have a direct impact upon the feed availability to support livestock production (DeBoer, 1984).

1.60 The major areas in which there has been strong commercial market demand and good project opportunities for private investment are in commercial poultry and swine. Little protection is provided to this sector and little is required. Standards of productivity, marketing, and product quality are at, or close to, international standards. The study team strongly recommend that procurement of imported feed ingredients be returned to the private sector because there is no logical economic or technical reason for the current arrangement (see Chapter VIII).

1.61 There are also excellent market opportunities in the more traditional sectors, such as village poultry, pigs, cattle, and water buffalo. A large amount of technical, sociological, and economic information about each of these species is summarized, and there is considerable scope for expanded project activities in each area, and financial inputs can be improved.

1.62 In summary, the overall economic environment is favorable for continued expansion of the livestock sector. Medium-term prospects for general economic growth are favorable, leading to increasing demand for livestock products. Consumption levels of animal products are very low, and well below recommended daily allowances. Continued growth in transmigration programs will require additional animals. Productivity levels for most species have room for tremendous improvement, much of it attainable at relatively low cost. Constraints to rapid growth of the livestock sector include very low purchasing power of the vast majority of the rural population, which will dampen effective demands and market growth, very limited resources for animal production on most farms, traditional husbandry practices which constrain productivity, lack of capital to invest in productivity-increasing measures, and government policies and development strategies which hinder the most efficient use of resources within the sector (Chapter VIII).



59

# II. THE SOCIOLOGICAL SETTING

2.1 This chapter describes socio-cultural characteri: : of Indonesia as they influence livestock production systems. The chap... escribes physical features, the people and their history, demograph:: characteristics and trends, and social organization. The chapter concludes with a discussion of the sociological strengths and weaknesses influencing adoption of improved livestock management practices.

2.2 There have been very few sociological studies on livestock production systems in Indonesia. In addition, the socio-cultural diversity resulting from Indonesia's more than three hundred ethnic groups ·t difficult to generalize. The following discussion relies on a li· review, results of a recent survey of 2700 Indonesian households by the Asian Development Bank and the Directorate General of Livest Services, secondary data, and observations made by members of the study team during extensive field visits.

## A. Location and Physical Features

### 1. Location

2.3 With 13,677 islands, the Republic of Indonesia (ROI) is the world's largest island complex. Its unique physical features have, to a large extent, influenced migration patterns, communication among diverse ethnic groups and other factors, which in turn influence livestock production systems.

2.4 Stretching eastward from the mainland of southeast Asia, Indonesia encompasses nearly all the land area between the Philippines and Australia, excluding only Papua New Guinea, Sarawak, Sabah and Brunei. It borders on the Indian and Pacific Oceans and the South China Sea. It covers nearly 5,600 km from east to west and 1,600 km from north to south. Indonesia's land area covers 1.8 million square kilometers, most of which lies south of the equator. Kalimantan is the largest island area with 28% of the total, while Nusa Tenggara is the smallest with 4.6%.

### 2. Geology

2.5 Geologically, the Indonesian archipelago is one of the world's most complicated structural regions. It consists of two relatively stable blocks of great age -- the Sunda Shelf in the west and the Sahul Shelf in the east -- between which lies a highly unstable area composed of deep-sea basins alternating with blocks that rise above sea level to form islands.

2.6 The Sunda Mountain system consists of two parallel arcs, linked with the Himalayan Mountain system. The outer arc consists of a submarine ridge which in places rises above sea level to form islands. It includes the islands which lie parallel to the west coast of Sumatra, and runs east beyond Java, to form the Sumba, Timor and Tanimbar islands, and then bends sharply to the north through the Kei islands to Seram and Buru. The inner arc is formed by Sumatra, Java and Nusa Tenggara islands from Bali to

Wetar. Bending in a great hook to the north, the inner arc ends at the island of Banda. A map showing the islands is presented in Figure II.1.

2.7 While the islands of the outer arc are nonvolcanic, those of the inner arc are volcanic, with extinct and active volcanoes as well as solfatara and fumarole fields. Active cones continue to produce lava flows and large quantities of volcanic ash.

2.8 Each island is a discrete unit, making it difficult to delineate major physiographic regions for the country as a whole. In general, each island consists of highlands, plains of thin alluvium over the rock of the foothill regions, and low plains of deep alluvium, usually located along the coast. The arrangement of these major components varies, however, from island to island.

### 3. Climate

2.9 Rainfall rather than temperature regulates agricultural activity in Indonesia. Temperatures are nearly constant, differing only a few degrees between the warmest and coolest months, and they range from a daily low of 23°C to a high of about 31°C in the plains and between 18 °C and 27 °C on the interior plateaus. Rainfall, however, varies greatly in timing, distribution and amount.

2.10 Monsoons dominate Indonesia's climate, winds which blow from opposite directions depending on the season. The monsoon pattern varies depending on an area's north-south orientation to the equator, its proximity to Australia, and the position of the intertropical front -- the area of convergence between the southern and northern tropical air masses. During the months of December through February, the west monsoon brings rain to the paddy fields of southern Sumatra, Java and Nusa Tenggara. From June through August, these areas are affected by the east monsoon, which brings dry air from Australia. However, only the Nusa Tenggara islands and eastern Java have a well-developed dry season. By the time the east monsoon has crossed the equator, turning into the southwest monsoon of the northern hemisphere, its winds have become humid and a source of rain. Sumatra and Kalimantan, in close proximity to the equator and distant from Australia, have no dry season, although rainfall diminishes slightly in July and August.

### 4. Soil

2.11 There is a very close positive correlation between the geographic distribution of young volcanic materials, soil fertility, and population density. The best Indonesian soils are those derived from young volcanic basic material; those which come from acid volcanic ejecta are less fertile. Irrigated rice is cultivated on the best soils, supporting high population densities.

2.11 The fertility of Indonesia's soils is also strongly affected by the climate. High temperatures lead to rapid chemical weathering of the parent rock, while heavy rainfall in excess of evaporation results in rapid leaching of the soil. For example, the soils of Kalimantan are subjected



61

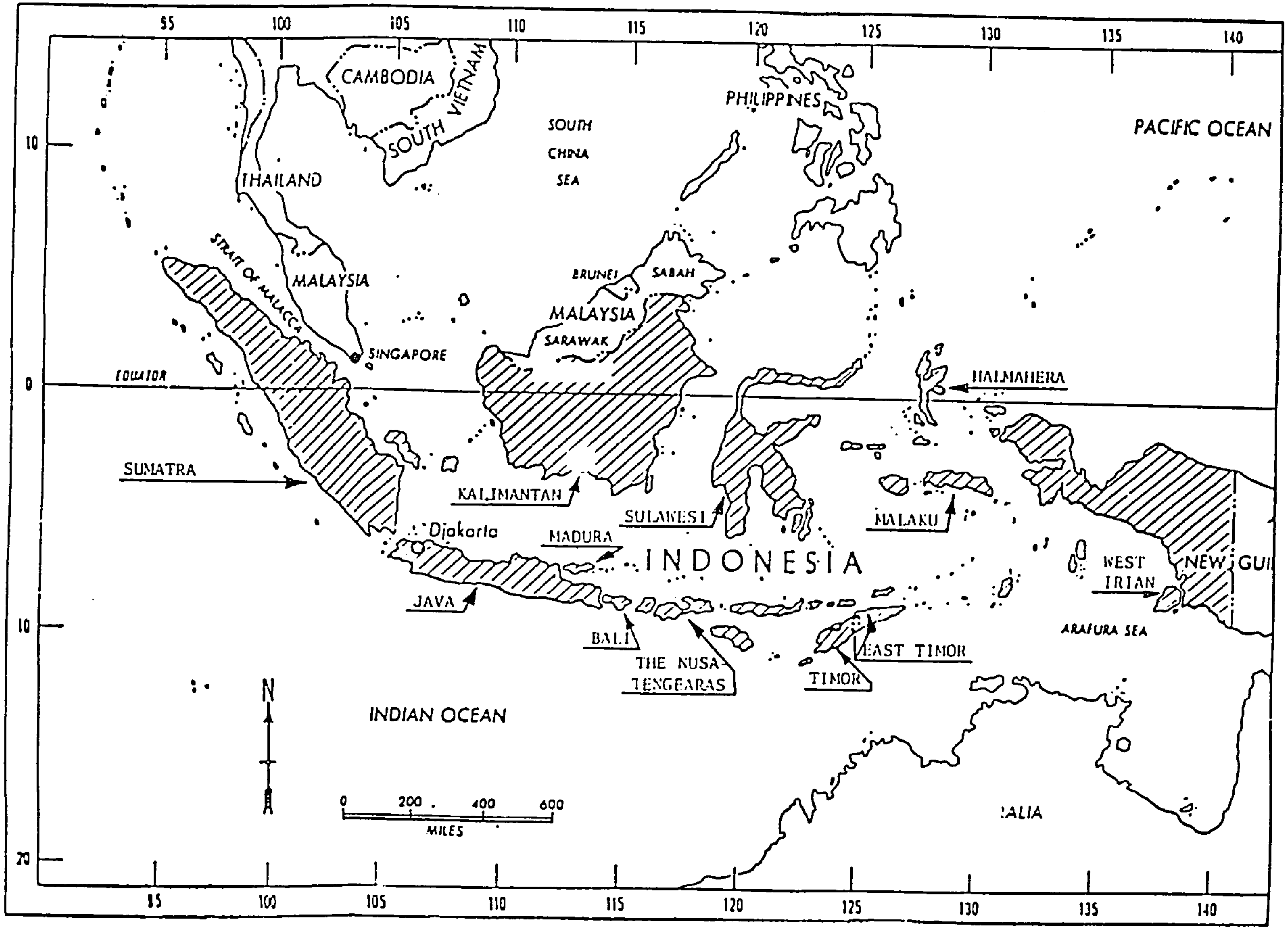



Figure II.1: Map of Indonesia

to constant leaching, and since they are derived from sedimentary rock and have not been renewed by volcanic activity, they are for the most part too poor to support intensive cropping without addition of fertilizers and lime.

5. Seas

2.12 Indonesia's archipelagic structure has deeply affected its economy, history, and culture. The seas both separate and link the islands of the archipelago. Consequently, each island has evolved its own social, cultural, and economic character; and the seas, by preventing mass migration, have enabled minor groups to preserve their cultural and linguistic identity. Indonesia's history and socio-cultural composition are discussed in the next sections.

## B. Historical Perspective

2.13 Despite fossil remains of early man found on Java, Indonesia was apparently peopled by immigrants of Malay origin who migrated from the Asian continent in about the first and second millinnium B.C. Two settlement patterns developed. On the outer islands, the population engaged in trades and fishing, and was clustered along the coasts. Their interiors were sparely populated by shifting cultivators. In contrast, rice cultivation dominated on Java, much of Bali and parts of Sumatra, sustaining dense populations in the interior. Tribal groups dominated in the upland interior areas.

2.14 In the third and fourth centuries A.D., Indian sailors used port facilities on Sumatra, Borneo and Java. This contact resulted in an elaborate "Hinduized" culture in the coastal communities along the main trade routes and in the populous inland agricultural communities of Java. However, Indian civilization was not accepted without change. The more elaborate Indian forms and terminology were used to refine indigenous concepts. In addition, the Sanskrit alphabet brought literacy to the elite, and with it an extensive literature on scientific, artistic, political and religious subjects.

2.15 A series of "Hinduized" kingdoms dominated Java, Bali and southern Sumatra from the seventh century to the end of the thirteenth century. The kingdoms engaged in the international spice trade. By the thirteenth century, trade patterns between Europe and Asia were well-organized. Gujaratis of western India dominated the trade between Molucca and western India, from there Arab traders controlled the routes to the west, bringing the goods to Europe where the Venetians controlled trade.

2.16 Islam first gained a foothold in the northern tip of Sumatra at the end of the thirteenth century, spreading gradually over 200 years or so. Islamic zeal remained strongest in the same northern region of Sumatra, where it had begun, but had no success at all on Bali and some of the more sparsely populated islands of Nusa Tenggara and Sulawesi. The degree to which the new religion displaced previously held beliefs and practices varied among groups and social classes. Islam gained a more devout following among the coastal merchants than among the aristocracy and the Brahmanically-oriented traditional intellectuals.

2.17 By the late fifteenth century, all the maritime powers of Europe were competing for control of the spice trade. The Portugese were the first to exercise control. Despite their brief presence (except on Timor), they introduced Christianity to the archipelago and took control of the spice trade away from Indonesians.

2.18 During the sixteenth and seventeenth centuries, the Dutch focused on the outer island spice trade. Later they devoted their attention to Javanese agricultural production. The Dutch trade monopoly obtained a high market price in Europe by controlling production and paying low prices to producers for forced production of cash crops, ensuring profits for the Dutch East India Company. This discouraged peasants from adopting improved agricultural technologies, and over time widened the disparity between Indonesia's subsistence agricultural economy of peasant Indonesians and the mercantile economy operated by and for the Dutch.

2.19 The Dutch government assumed administration of the company territories in 1800. The British ruled briefly from 1811 to 1816 but the area was returned to the Netherlands with the fall of Napoleon at Waterloo.

2.20 The Dutch government forced farmers to produce indigo, sugar, coffee, tea, tobacco, pepper, cinnamon, palm oil, cloves, cinchona, cotton and cochineal, even rice in some cases, for export. Theoretically, forced cultivation substituted for land rent (a per capita tax in kind). However, land rent was also collected in some areas, and labor on roads and irrigation works was demanded as well. Work for the government sometimes occupied more than 200 days of a villager's year.

2.21 In 1870, the government began to phase out forced production in favor of taxation. The new policy encouraged private investment by Dutch and other foreigners, leading to widespread investment in plantation agriculture. This system brought major changes in the structure of Indonesian life. Wage laborers working on commerical plantations were removed from their homelands, weakening traditional systems of mutual support. Plantation agriculture was not innovative. As a result, Indonesian cultivators did not acquire new skills and improved technologies through their experiences as wage employees. Displaced wage laborers were not the only Indonesians affected. As untilled land came under cash crop cultivation, farmers could no longer move to new areas when the soil became depleted or conditions become too oppressive. Moreover, sugar and irrigated rice require similar soil and moisture conditions. Sugar production quadrupled betwen 1870 and 1900, seriously disrupting rice production in the most densely populated areas of central and eastern Java. In many cases, all lands within a specified radius of a sugar mill were required to produce sugar for sale to the mill at a fixed price. Finally, money indebtedness (partially resulting from the need to pay taxes) resulted in much of the peasant-owned land being brought under the indirect control of foreign investors.

2.22 Beginning in the 1880s, the Dutch began to establish schools for the Indonesian aristocracy. Yet even this group was frequently under- and unemployed. Their discontent led to the beginning of the nationalist movement in the early part of the twentieth century. This movement continued to grow throughout the early part of the century. During the

Japanese occupation, Dutch administrators were imprisoned and replaced in all but the top positions with Indonesians. The Japanese also encouraged nationalist sentiments to varying degrees throughout their occupation.

2.23 The Dutch returned at the completion of the war, and from 1945 to 1950 Indonesians fought for nationhood in battle, through diplomacy and in the United Nations. In 1949, the federal Republic of the United States of Indonesia was formed. This government failed after seven months, and was replaced by the Republic of Indonesia which continues to exist today.

## C. Anthropological Perspective

### 1. Socio-economic diversity

2.24 Today, there are over three hundred different ethnic groups in Indonesia, each with its own cultural identity. In addition to Bahasa Indonesian, more than 250 languages or dialects are spoken in the archipelago. Nearly all the major world religions are represented as well as a wide range of indigenous religions (Geertz, 1967; Cooley, 1968; Koentjaraningrat, 1971). Communities range from small isolated villages to huge modern cities.

2.25 Economic adaptations range from semi-nomadic shifting cultivation to irrigated rice production to highly capitalized plantations producing export crops. Manufacturing occurs in cottage industries, modern factories and industrial complexes. Both itinerant peddlers and sophisticated commercial firms engage in commerce.

2.26 Despite the diversity, some generalizations can be made. Most Indonesians are peasants, i.e. they are small-scale, independent farmers. Nearly all engage in commerce (however little) and have some contact with ideas from the cities (however indirect). Few are so isolated as to be economically self-sufficient or unaware of cultural differences and social change. On the other hand, few are commercial farmers in the sense of systematic production solely for the marketplace. Most are limited resource farmers producing partly for their own household consumption and partly to sell into urban or international market networks. The highly capitalized plantations producing export crops employ only a small portion of the total Indonesian population.

### 2. Three broad socio-cultural groupings

2.27 Indonesia's social and cultural groups have been influenced by the country's physical and ecological characteristics and history. The coastal perimeters of the islands culturally have much in common because of the frequency and ease of contact among them. However the interior island peoples, cut off from one another, display widely diverse cultural forms. The interior regions are of two broad ecological types: areas suitable for wetland rice cultivation and areas unsuitable for wetland rice cultivation. Areas suitable for wetland rice cultivation are those parts where extensive irrigated rice terraces can be maintained -- primarily in the great river plains and the volcanic slopes of central and eastern Java and Bali, and to a lesser extent in scattered pockets on other islands. In other areas, topography, soil or rainfall patterns make wet-rice cultivation difficult, resulting in shifting agriculture or other economic adaptations.



65

2.28 As a result, Indonesian society can be categcrized into three broad socio-cultural types: 1) the strongly Hinduized inland rice cultivators, 2) the trade-oriented, deeply Islamic coastal peoples, and 3) the tribal groups of the mountainous interior regions. The three types are by no means exclusive. They are indistinct conceptual di... 's into which many of Indonesia's three hundred ethnic groups can crude... categorized for the convenience of description. There are several impo... nt groups which do not fit into this scheme. These, notably the Batak, Minangkabau, Minahassans, and Ambonese have undergone rapid and extensive change in the past century.

a. Wetland rice cultivators

2.29 The wetland-rice cultivators of inland Java and Bali com... more than one-half Indonesia's total population. Inland villages are ... and densely populated, and it is here that population pressures ... y becoming unmanageable. Although uniquely Indonesian, the culture ... inland rice-cultivators is still strongly influenced by India of the first millenium. Java's culture is also shaped by Islam, introduced there in the fourteenth century. The inland rice-cultivator's culture stresses formal etiquette and proper recognition of status distinctions between aristocrat and commoner. Spiritual and social refinement are highly admired, and the arts are intensively cultivated.

2.30 Of the two islands, Bali is more traditional. Its indigenous social structure still functions today. The Javanese peasants are "post-traditional." The combined impact of Islam and colonial commerical development broke down much of Java's traditional social structure but did not produce a modern institutional system of the type found in Europe or contemporary Japan. The Javanese community, unlike most other areas of Indonesia, is almost "suburban" in its lack of distinct social boundaries and the near absence of institutionalized groupings. The development of large urban centers on Java has contributed to the process of socio-cultural change.

b. Islamic coastal peoples

2.31 A heterogeneous community of Malays, Javaneses, Makassarese, Moslem Indians, and Arabs as well as Portugese, English, Dutch, Chinese and others -- loosely governed by a local Moslem sultan -- grew up at nearly every harbor in the archipelago. Their cultural similarity results from a common history (participating in the international spice trade of the fourteenth to the nineteenth centuries) and the unifying force of Islam. Outside Java, many of the twentieth century towns have grown up around these former trading kingdoms. Development of the modern governmental apparatus has increased the ethnic heterogeneity and conferred civil servant status on many of the local aristocracy.

2.32 Harbor sultans historically claimed interior tribal groups as subjects (described below) and forcibly extracted tribute from them at times. However, the two worlds -- coast and interior -- had little to do with one another. In contrast, the Islamic market towns of Java, which were founded at an early date along Java's northern coast, had strong and intricate social relationships with the highly-developed civilization of its interior.

### c. Tribal groups

2.33 The tribal groups of mountainous interior regions, simplistically categorized together, include a wide range of cultures, including the Toraja of Sulawesi, the Dayak of Kalimantan, and the Halmahera of Seram as well as the people inhabiting the interiors of Nusa Tenggara and Irian Jaya islands and some communities of Sumatra. Until recently, most tribal societies remained in virtual isolation from the outside world, each developing its own distinctive patterns of life. Most are shifting cultivators of dryland rice or gardeners of sago, maize or root crops. When the opportunity presents itself, they adopt wetland rice cultivation or commercial cultivation. However, many of these peoples inhabit marginal lands which are not suitable for irrigated farming. Kinship ties are stressed by most of these groups instead of territorial or "feudal" political bonds, and they often have large corporate groups of kinsmen which own land, ritual objects or status titles as a unit. The process of administrative rationalization, creating territorial districts headed by civil servants, has substantially altered traditional forms of community.

### 3. Education's influence on change

2.35 Much of Indonesian society retains its traditional form today, although altered to serve changing needs. On the other hand, the colonial experience and the events of the postwar period have set into motion exceedingly important changes which are affecting different segments of society at different rates. One of the most pervasive and potentially powerful forces for change is education, which is rapidly being made available to every Indonesian child, rural as well as urban. Not only are local elementary schools multiplying but their graduates are increasingly entering secondary schools and universities in the urban centers. As a result, peasant villages are increasingly exposed to new ideas and technologies, and perhaps, may be increasingly receptive to adopting them. In addition, Indonesia's general class structure appears to be changing as the ranks of trained white-collar and professional workers increase.

2.36 Educational background influences livestock management practices and adoption of new technology in livestock production and marketing systems also. Statistics are not available showing what percentage of the 113.9 million rural householders have completed primary school. However, just 3.1% of the 28.8 million agricultural workers (including those engaged in forestry, hunting and fishing) over ten years of age had completed primary school in 1983 (BPS, 1983).

2.37 Respondents in the ADB/DGLS livestock sector survey were asked to rate their literacy (table II.1). Nearly one-half rated their own and their spouses' literacy as "just fair". A greater percentage rated their children's literacy good to excellent, reflecting rural households' increasing access to education.

Table II.1: Farmers'rating (%) of family members' literacy

| Family Member | Excellent | Good | Fair | Poor |
|---|---|---|---|---|
| Farmer | 10 | 26 | 48 | 17 |
| Spouse | 6 | 15 | 49 | 29 |
| Children | 14 | 29 | 40 | 15 |

Source: ADB/DGLS (1985)

4. Religious influences on livestock systems

2.38 Each religion's beliefs and ceremonies influence the social behavior of its adherents. Dietary rules have a particularly strong influence on livestock production and marketing systems. Areas with a high percentage of Muslims raise cattle, buffalo, sheep, rabbit, chicken, duck and quail because these animals and birds are permitted by Islam. Islam prohibits pork consumption. Consequently, swine production is more prevalent in Bali, Nusa Tenggara Timur, West Timor, North Sulawesi, and Irian Jaya where Hindus and Christians are more strongly represented. Despite the dominance of Islam, Indonesia has a surprisingly large pig population (3.7 million in 1983), owned primarily by Christians, Hindus and Buddhists.

2.39 Similarly, religious and life-cycle ceremonies influence the livestock production and marketing systems. The use of livestock in life-cycle or religious ceremonies confers considerable social status on a household. Buffalo, pigs, goats and sheep are most commonly used, cattle rarely. Chickens are used only for small traditional parties. Vergouwen (1964) described how buffaloes were slaughtered to celebrate the bestowal of the name of an ancestor on a son in a northern Sumatra family. Tradition dictated how the meat should be divided among relatives, village leaders, the community, musicians, servants, etc, demonstrating and reinforcing the strict social and structural relationships among individuals and groups participating. Other ethnic groups perform similar ceremonies for a variety of events. These have been described by Singarimbun (1975), Danandjaya (1971), Koentjaraningrat (1971), and Ukur and Cooley (1977).

2.40 Ceremonial practices may influence both production and marketing practices. In breeding, farmers may select for traits valued for ceremonial reasons (color, for example). In addition, an animal's ceremonial value may also influence market decisionmaking. For example, field visits showed that tribesmen in Irian Jaya refused to sell their pigs even though they could get a good price because pigs were needed to pay brideprices. However, there was one exception; pigs were sold to finance children's education.

## D. Recent Trends in Population, Settlement and Land Use

### 1. Population Trends

2.41 Indonesia is the fifth most populous nation in the world surpassed only by China, India, the USSR and the USA. The 1961 census showed a population of 97.1 million compared to the estimated 1985 population of 165.2 million, an annual average increase of 2.21%. The GOI projects a 1990 population of 183.4 million (BPS, 1983). Population growth rates vary substantially among provinces. Statistics show that the population growth rates range from 0.92% in D.I. Yogyakarta to 5.58% in Lampung.

2.42 Appendix table 2.1 shows the population density by province in 1961, 1971 and 1980. The 1961 average population density was 51 people per square kilometer, increasing to 62 in 1971 and 77 in 1980. However, national averages are deceptive because the population is highly concentrated in a small area. In 1980, 62% of the total population lived on the island of Java which encompasses only 7% of the land area (BPS, 1983).

2.43 Population density has increased in all provinces during the last two decades. Java has had the highest density followed by Bali throughout the period. However, Java and Bali's population density have increased at a slower pace than other areas. In 1961, Java supported 476 people per square kilometer, compared to an average density ranging from 3 per square kilometer in the Moluccas and Irian Jaya to 63 in Nusa Tenggara. In 1980 Java's population density was 690. In contrast, it ranged from five in the Moluccas and Irian Jaya to 96 in Nusa Tenggara. Transmigration, which is discussed later, is one of the contributing factors to the slower rate of increase on Java and Bali.

2.44 In 1971 there were 24.5 million households in total, increasing to 30.3 million in 1980. The average household consisted of 4.8 individuals in 1961 and 4.9 in 1980. In 1980, average household size ranged from 4.5 in Irian Jaya and West Java to 6.1 in the Moluccas.

### 2. Reliance on agriculture

2.45 The population employed in agriculture, forestry and fisheries has increased in recent years, but not as rapidly as the total workforce (table II.2). In addition, the number of households relying on agriculture has increased in the last two decades from 12.2 million households in 1963 to 17.6 million in 1983. On average, agricultural land expansion has kept pace. The land area controlled by agricultural households has increased from 12.9 million hectares in 1963 to 19.0 million hectares in 1983. The average land area controlled by each agricultural household was about the same in 1973 and 1983, about 1.1 hectares. However, 1983 average land size was smaller in Java than other areas, 0.63 hectares compared to 1.69 hectares in areas outside Java. Ihalauw, et al. (1984) question whether Java's average 0.63 hectares per household is sufficient to support a family. The ADB/DGLS (1985) livestock sector survey found that agricultural households selected for their livestock production activities average 5.64 members. Appendix table 2.2 shows the average breakdown by sex and age. The average age of the heads of survey households is 36 years.

Table II.2: Population of Indonesia (thousands)

| | Population | | Economically Active | | |
|---|---|---|---|---|---|
| Year | Total | Agric. | Total | In Agric. | % in Agric. |
| 1970 | 120,280 | 79,698 | 42,495 | 28,157 | 66.3 |
| 1975 | 135,666 | 84,970 | 46,900 | 29,374 | 62.6 |
| 1980 | 150,958 | 88,847 | 51,567 | 30,350 | 58.9 |
| 1983 | 159,434 | 90,070 | 54,281 | 30,665 | 56.5 |
| 1984 | 162,167 | 90,371 | 55,150 | 30,733 | 55.7 |

Source: FAO (1984). Production Yearboook, Vol. 38

2.46 Table II.3 shows the number of agricultural households, land in cultivation and average size landholdings. The table demonstrates that the number of agricultural households and the total land area controlled by them has increased in the last two decades. Outside Java, agricultural land expansion has enabled the average land area controlled by agricultural households to remain roughly constant over the period. In contrast, the average area controlled by agricultural households on Java decreased from 0.71 ha in 1963 to 0.63 ha in 1983. During the Third Repelita (1978/79 - 1983/84), 275,410 ha of new land was brought into cultivation (Pidato Kenegaraan President Republik Indonesia Soeharto, 1984).

2.47 In 1980, 11.0 million agricultural households controlled less than one-half ha, dropping to 8.7 million households in 1983. Conversely, 17.5 million agricultural households controlled more than one-half ha in 1980 compared to 18.7 million in 1983 (BPS, 1983). However, the number of households with small holdings is greater on Java than other areas (Ihalauw, et al., 1984).

2.48 Respondents to the ADB/DGLS livestock sector survey were asked about their landholdings. (Households were selected because of their livestock production activities. It is assumed that the majority of households owning livestock also own or have access to land. Consequently, survey results cannot be used to generalize about rural households in general.) Of those that own land, ADB/DGLS survey households own 1.76 ha on average. Of those that rent land, survey households rent 0.95 hectare on average. Of those farming communal lands, survey households control 1.49 ha on average. Of those farming village lands, survey households control 0.75 ha on average. Finally, of households farming government

Table II.3: <u>Number of agricultural households and size of land holding controlled in 1963, 1973 and 1983</u>

| | Agricultural households | | Land area controlled by agricultural households | | | |
|---|---|---|---|---|---|---|
| | Households ('000) | Percentage increase in decade | Hectares ('000) | Percentage increase in decade | Average holding (ha) | Percentage increase in decade |
| **Java:** | | | | | | |
| 1963 | 7,935.1 | | 5,647.0 | | 0.71 | |
| 1973 | 8,664.4 | 9.19 | 5,505.2 | (2.51) [a] | 0.64 | (9.85) |
| 1983 | 10,127.6 | 16.89 | 6,359.5 | 15.52 | 0.63 | 1.56 |
| **Outside Java:** | | | | | | |
| 1963 | 4,301.4 | | 7,236.9 | | 1.68 | |
| 1973 | 5,709.1 | 32.72 | 8,663.0 | 19.71 | 1.52 | (9.52) |
| 1983 | 7,501.1 | 31.39 | 12,600.4 | 46.14 | 1.69 | (11.18) |
| **Indonesia:** | | | | | | |
| 1963 | 12,236.5 | | 12,883.9 | | 1.10 | |
| 1973 | 14,373.5 | 17.46 | 14,168.2 | 9.97 | 0.99 | (1.01) |
| 1983 | 17,628.7 | 22.65 | 19,019.9 | 34.24 | 1.08 | (9.09) |

Source: BPS (1983)
a/: ( ) = decrese in percentage



71

lands, survey households control 0.84 ha on average. However, land tenure arrangements vary substantially from area to area. For example, land ownership and rental is most common in the intensive rice production areas of Java and Bali. Communal lands are more common in tribal areas. Government lands are more commonly utilized at higher altitudes.

2.49 The size of landholdings influences a household's ownership, use and management of livestock. Consequently, intervention strategies aimed at increasing livestock production and income derived from livestock production must take into account the vastly different conditions between densely and sparsely populated areas. Government efforts to resettle households from densely populated areas to less densely populated areas with agricultural potential are discussed in the next section.

2.50 Appendix table 2.3 shows that 36.2% of agricultural households in Indonesia are engaged in livestock production. The proportion ranges from 19% in the Moluccas and Irian Jaya to 51% in Nusa Tenggara. Appendix table 2.4 indicates that 27% of agricultural households hold cattle and/or buffalo. Clearly, the small proportion of households owning livestock presents a great potential for government assistance and expansion of livestock production, particularly in transmigration areas where land is more readily available.

3. Sources of income for households with livestock

2.51 The ADB/DGLS livestock sector survey obtained data describing livestock producing households' sources of income and their relative importance. Appendix table 2.5 shows the number and percentage of livestock-producing households engaged in various activities which contribute to household welfare, presumably income-generating activities. Crop production and livestock activities contribute to nearly all households' income (96%). Off-farm employment (30%) and other activities (27%) are the next most frequently mentioned activities. Reliance on off-farm employment varies substantially among areas, ranging from 12% in South Sumatra to 49% in Nusa Tenggara. Similarly, reliance on fishing and trading activities varies substantially among areas. Only 1% of the Irian Jaya households interviewed are engaged in fishing compared to 100% interviewed in the Kalimantan area. The percentage of households engaged in trading ranges from 12% in the North Sumatra and Molucca areas to 40% in Nusa Tenggara.

2.52 While households were selected because of their livestock production activities, cropping activities were ranked very important or important sources of income by 65% of all households interviewed, more than any other income source (appendix table 2.6). Livestock activities were ranked very important or important second most frequently (28%), and other unspecified activities third most frequently (13%).

2.53 Appendix table 2.7 provides insight into the role of livestock in Indonesian farming systems. The importance of the savings function for all species is obvious. The ranking of the draft function for large ruminants and the manure supply function for small ruminants above that of meat production is striking. However, one should note that the savings role of livestock is narrowly correlated with its meat producing role: a more efficient meat producer implies a more efficient savings mechanism.



72

2.54 The relative importance of various income-generating activities varies by area. Cropping activities were ranked very important or important by 98% in Irian Jaya compared to just 31% in North Sumatra. Livestock activites were most frequently ranked very important or important in Kalimantan (78%) and least frequently in South Sumatra (9%). Of the 21% of all households engaged in trading, 38% rank trading very important or important. Households in Nusa Tenggara (NT) engage in trading more frequently than households in other areas (40%). In addition, 84% of NT households involved in trading rank it highly. Similarly, 69% of NT households with off-farm employment rank it very important or important, a greater proportion than households in other areas.

4. Transmigration

2.55 The wide variation in population growth rate and density among provinces has widespread social, economic and political implications for agricultural development in Indonesia, including livestock production and marketing systems. Since 1905, Indonesia has undertaken a variety of programs and projects aimed at resettling households in less densely populated areas. President Soeharto has identified the following primary objectives for transmigration (Pidato Kenegaraan Presiden Republik Indonesia, 1984):

- to overcome problems arising out of unequal population density and distribution of manpower among the various islands of Indonesia;

- to expand the bases for development efforts in general by creating more employment opportunities; and

- to speed up the assimilation process of the nation and to strengthen national defense and security.

2.56 Presidential Decision No. 1/1973 identified Java, Madura, Bali and Lombok as the areas of origin of transmigrants. There are four priority criteria used for transmigrating people out from these islands (S. Ismah Afwan et al., 1984):

- Areas suffering from a natural disaster;

- Areas with critical need such as infertile land, river basin, etc.;

- Areas with an extremely high population density; and

- Areas to be used for development projects such as mines, oil and gas fields, etc.

2.57 There are two types of transmigration. The general transmigration scheme is fully funded by the government. Spontaneous transmigration also occurs. Some spontaneous transmigrants receive government or private foundation funds while others finance resettlement through their own resources. (Budiman, 1984). Appendix table 2.8 shows the number of people and households transmigrated to areas outside Java, Madura, Bali and Lombok from 1905 to 1983/84.

2.58 Transmigration is intended to expand the base of agricultural land in production and to increase agricultural production. Hence, each transmigrant is provided with 2.0 ha of land of which 1.25 ha are cleared by the government, 0.25 ha is used for homesite and garden and 1.0 ha is for phase one agricultural development.

2.59 In order to help transmigrants cultivate their new agricultural land, the government provides draft animals, primarily Bali cattle. According to those participating in the program, draft animals are distributed one year after transmigrants resettle. Draft animals are distributed under a variety of contractual arrangements; however, the "Sumba" contract (described later in this report) is presently the most common. In addition to cattle and buffalo, goats, chickens and ducks also may be distributed to transmigrant households.

2.60 Clearly, access to draft animals for land cultivation influences crop production in transmigration areas. Compared to the Second Repelita, the Third covering the period 1979/80 to 1983/84 showed a 28% increase in the livestock population controlled by transmigrant households. In addition to distributing livestock for draft, livestock development programs in transmigrant areas are also aimed at specialized production.

2.61 Livestock development programs in transmigration areas will be expanded during the Fourth Repelita. About 700,000 households will be resettled in dryland areas and 300,000 households in tidal areas. For transmigrant households resettled on dry land, a total of 385,000 large ruminants and 1,400,000 small ruminants will need to be distributed.

E. Social Institutions and Livestock Systems

1. Credit arrangements: gadohan schemes

2.62 About 36% of all households in Indonesia own livestock of some type. Credit arrangements play a central role in increasing the number of households owning livestock. One means of providing credit for livestock purchase is the gadohan system. Under the gadohan system, livestock are distributed to farmers by government, private donors or other farmers in return for production, offspring or weight gain. A contractual agreement specifies the farmer's repayment obligation.

2.63 The gadohan system was used as early as 1912 in East Nusa Tenggara. The colonial government imported and distributed 10 cows and one bull to village heads for distribution to farmers in Flores, Sumba and Timor. Over time, the ratio of male to female cattle distributed has been changed. With the "Sumba" contract, two cows are distributed for each bull (Metzner, 1978). In addition, farmers may use gadohan schemes to obtain goats, sheep and pigs as well as both imported and indigenous cattle.

2.64 Under the government-sponsored gadohan scheme, livestock are distributed through the Dinas Peternakan, special projects (i.e. IFAD Small holder Cattle Development Project, SESTADP, ADB-1, Provincial Development Programs, etc.) or quasi-government agencies such as Irian Jaya Joint Development Foundation (JDF). A formal gadohan contract is signed between the government and an individual farmer. The formal contract specifies the form of repayment, the repayment schedule, and sanctions. In return, farmers are given an ownership card for the animals received. The farmer's performance in gadohan is recorded and monitored using a card system.

2.65 On a limited scale, private foundations support gadohan schemes. For instance, church-based foundations in cooperation with the Dinas Peternakan implemented a gadohan scheme with a training component, distributing Bali cattle and swine to farmers in Irian Jaya and the Moluccas.

2.66 In some cases, farmers themselves operate informal gadohan schemes, primarily in Java and transmigration settlements. Three different schemes were observed during field visits. In one informal gadohan scheme, the farmer provides a pair of cattle, a male and female, and the plough. The recipient uses the cattle and plough for arable production, and breeds the cattle. The recipient repays the farmer initiating the gadohan scheme one-half of his harvest ("maro hasil"). In another informal gadohan scheme, recipients repay one-half the net profit from the sale of calves ("maro bati"). In the third scheme observed, the recipient gives every other calf to the farmer initiating the scheme ("maro anak").

2.67 In order to make use of the extension services provided by government, farmers are divided into groups of 15 to 20 farmers. A contact farmer is appointed to obtain and convey extension information to the group. Groups may be formed by field or settlement location. (While both arrangements have been used to form farmers groups for livestock production, field visits indicate that groups based on field location are more effective.) Farmers groups are used as the basis of distribution for some gadohan schemes in which the group shares a sire. In addition, farmers groups are used for dissemination of information and demonstration of improved livestock production technologies.

2.68 In some cases, livestock may be distributed through village leaders, increasing farmers' confidence in the distribution scheme. Undang-Undang No. 5/1979 specifies that all villages in Indonesia must have a formal structure with power centralized with the village head. The village head is assisted by several officials. Lembaga Ketahanan Masyarakat Desa (LKMD) or the Village Council is the forum in which village leaders discuss issues and make concensus decisions. The quality of leadership and decision-making depends on the ability and personality of officials in both village government and LKMD.

2.69 Religious or clan leaders, land clearing pioneers, and other early adopters may also play an important role in the success or failure of a project at the village level. Information gathered from the field visits revealed that repayment of gadohan cattle organized by the JDF in Irian Jaya was almost 100% due to the active participation of clan leaders. Another field visit to Alakuang village in South Sulawesi province showed that a Haj successfully initiated a poultry nucleus estate system in early 1980.

a. Experiential/attitudinal implications

2.70 Gadohan distribution schemes must be structured taking into account ethnic, linguistic and cultural factors. In addition to transmigrants originated from Madura, Java, Bali and Lombok, 10% to 15% of



75

the people native to transmigration areas have resettled at newly opened transmigration sites. Indigenous settlers also obtain livestock through gadohan schemes.

2.71 Field observation shows differences in livestock management practices and use of draft animals between the transmigrants coming from Java and Bali and the native people resettled in transmigration sites. The transmigrants from Java and Bali have more experience and skill in managing livestock and using draft animals for land cultivation. These gaps in experience, skill and use of draft animals and manure reflect their different farming systems.

2.72 In slash and burn agriculture and small rubber and pepper estate farming systems of the indigenous transmigrants, farmers depend on the whim of nature. Farmers minimize inputs, including labor because of high production risk. As a result, large ruminants do not play an important role in their arable production activities. Animals generally are not kept as a source of draft power or as a source of manure. Animals are primarily a social status symbol and a form of savings to meet big expenditures such as building a house, children's education, marriage of family member, burial ceremony, etc. Consequently, animals must fend for themselves for the most part.

2.73 In contrast, farmers practicing intensive arable systems (e.g. irrigated rice production) employ livestock management practices appropriate to their situation. In addition to their social and economic functions, animals are used for draft and their manure is used as fertilizer. As a result, better animal feeding must also be provided and more labor is required from the farmer. For example, large ruminants may be tethered. Farmers have to cut and carry grasses to feed their animals.

2.74 A case study obtained during field interviews illustrates the effect of a transmigrant's attitude towards adopting improved management practices. During the team's field study trip to Southeast Sulawesi cattle were observed freely grazing in the open fields while comparable areas nearby were planted in crops. The cattle owner was asked why he let his animals graze in the open fields rather than planting the open fields in crops (and gathering forage for the cattle). His reply reflects an attitude which must be taken into account when structuring livestock development programs. He said: "Sir, the animal has four legs. Why should I put effort into cutting and carrying grasses to feed them when the animals can use their own feet to find grasses for themselves?"

2.75 When farmers transmigrate, they bring with them their experience, skills and attitudes about how to raise crops and rear livestock. These attitudes influence their willingness to adopt improved technologies. It appears that transmigrant settlers are generally more willing to adopt improved management practices. The indigenous settler's farming systems seem to be more rigidly guided by customary law.

b. Ecological implications

2.76 Another case study obtained during field interviews illustrates the importance of ecological factors in structuring gadohan distribution schemes. A spontaneous transmigrant settled in a swampy area of Jambi province and owned 1.0 ha consisting of the homeyard and a farm planted in coconut trees and paddy. He received Madura cattle through a gadohan scheme in 1983. Despite his cropping activities he keeps the cattle for their manure and savings only, because they cannot be used as draft animals in swampy areas. Moreover, mosquitoes are a serious problem for cattle. The owner built a closed stable with good ventilation to alleviate the problem, demonstrating the high value transmigrants place on livestock. During the night he smokes the stable to drive the mosquitoes away from the cattle. Our field observation showed that this practice is widely adopted among the transmigrants living in that swampy area. However, perhaps swamp buffalo would be more suitable for distribution in swampy areas.

c. Cultural implications

2.77 The study team visited a village in Southeast Sulawesi province where indigenous settlers were also involved in the Southeast Sulawesi Transmigration Area Development Project (SESTADP). A group leader indicated that 150 ploughs had been distributed to the indigenous farmers but only six farmers ploughed. He explained that the cattle distributed to the indigenous settlers were trained for ploughing by transmigrants from West Java, Central Java and Bali. These animals were trained and commanded in the Sunda, Java and Bali dialects, languages not spoken by the indigenous settlers. The indigenous settlers were unable to command their animals using words understood by the cattle. As a result the distributed ploughs were seldom used in the fields.

2. Land control: ownership and tenure

2.78 Limited arable land and rapid population growth have resulted in increasingly complex land ownership and tenure problems in Indonesia, particularly on Java. In addition, high population density increases interdependence among households, resulting in complex economic and social relationships governing livestock ownership, use and management.

2.79 In both Hindu tradition and Islamic law, an individual controlling a plot of land is never considered an owner ( Hanafi, 1984). During the kingdom period, a cultivator was obliged to share the harvest with the king or his families (Roll, 1980). During the colonial period, the king-feudalistic system evolved into a village-feudalistic system. The colonial government used village officials to collect agricultural commodities from farmers (Burger, 1977). After independence, village officials continued to regulate land tenure at the village level.

2.80 Farmers may control (own), rent or share-crop land, or obtain land through a combination of arrangements. Those with ownership-control may sell their land to others or rent it out for a season ("jual oyotan" or "ungsuman") or for a number of years ("jual tahunan").

2.81 Share-cropping is widely found, especially in Java. There are several kinds of share-cropping. In the "sromo" type, the cultivator pays a down payment to the land owner and provides all inputs himself in order to obtain the right to cultivate the land. In other forms of share-cropping, the cultivator provides only the labor. Other inputs are provided by the landowner. Depending on the social relationship between the cultivator and landowner, the harvest is shared on one-half basis



77

("maro"), one-third ("mertelu"), one-fourth ("merapat") or even-one fifth ("merlima") basis.

2.82 In addition to land controlled by individual households, the village may also control land for use by poor villagers, village officials and retired village officials and for generating funds to support local government. In areas outside Java, land also may be collectively owned by a kinship group.

2.83 Land tenure arrangements influence a farmer's willingness to invest in agriculture and adopt new technologies. Moreover, collective ownership of communal lands is often believed to lead to overgrazing and lack of pasture improvement.

3. Labor arrangements

a. Division of family labor

2.84 In swidden and shifting farming systems, land clearing, fencing, etc. is conducted by adult male members of the household. In addition, males are responsible for collecting firewood and ensuring the household's security. Cultivation is the responsibility of adult females. While females are responsible for caring for swine and poultry, adult males and school-age boys assume responsibility for large ruminants that are left free to graze.

2.85 Similarly, male household members are responsible for land preparation in rainfed and irrigated farming systems. Adult males and school age boys care for large and small ruminants. Adult females plant, weed and harvest arable crops, and assist males in feeding stabled animals. Females care for poultry.

2.86 In commercial poultry and swine production, the head of household generally assumes the role of manager. Male family members and paid laborers provide labor. Female involvement in commercial operations is minor.

2.87 Labor requirements vary substantially depending on management practices. Similarly, family labor available for livestock management and maintenance depends on family size, age and sex composition and the opportunity cost of labor. Social roles constrain the involvement of women and children. Frequently, nonfamily labor is required. The next section describes patron-client relationships used to secure nonfamily labor.

b. Household labor and expenditures: food, fuel, durables

2.88 The ADB/DGLS livestock sector survey collected data demonstrating use of household labor to obtain food, fuel, and household durables including a family's house and furniture. Appendix table 2.8 shows the source of households' food supply. The majority of grains, vegetables and fruits consumed are produced by the consuming household. About 70% report producing over one-half of the grains, vegetables and fruits consumed by the household. About 30% report purchasing over one-half of the plant foods consumed. While households report purchasing animal products more frequently (38% purchase over one-half), 44% indicate producing over one-half of the animal products consumed by the household. In contrast, nearly 75% of all households report buying over one-half of the fish consumed. Only a small proportion of households obtain food through exchange, barter, gifts, hunting or gathering. The vast majority (95%) use wood for fuel. Fuel is obtained primarily by gathering (75%).

2.90 About one-half the households interviewed erected their homes using primarily household labor. Furniture, on the other hand, is more frequently purchased (55%).

#### c. Patron-client relationships

2.91 Patron-client relationships are common in rural Indonesia. In crop production, nonfamily members provide labor in return for a share of the harvest (*bawonan*) (Utami et al., 1978). In addition, patron-client relationships in livestock production were observed during field visits to several provinces. Relatives or neighbors of the owner, the patrons cares for livestock, collecting feed and/or feeding the animals. In return, the client shares in the production. Patron-client relationships also exist in draft arrangements. It is the patron's social obligation to plow. In return, the client is obliged to provide labor in the future.

### 4. Livestock marketing: village collectors

2.92 The role of the village collector is an important one. He collects animals from farmers and sells them outside the village. (See Chapter VI for a more detailed discussion.) Farmers may also use village collectors as a source of credit, using their livestock as collateral. Nevertheless, the relationship is not necessarily an exploitive one as often assumed (Soedjana et al., 1984; Danamik et al., 1984). Firstly, farmers often have access to more than one collector. Secondly, as members of the same community, the long-term interests of village collector and farmer coincide. One study found that the village collector was a member of the Village Council, and that the role of village collector was respected in the community. The same study showed that 78.8% of the 33 village collectors interviewed established some kind of working relationship with farmers to determine selling prices and working capital needs. Only minor conflict was observed (Fakultas Ekonomi Univ. Kristen Satya Wacana, 1984).

## F. Strengths and Weaknesses

### 1. Strengths

2.93 Improved transportation and transmigration has increased population mobility to new areas which has led to new social roles and organizations. Shifting population has also increased demand for draft animals, as well as other types of livestock in order to increase income.

2.94 The experience acquired raising livestock using traditional systems provides a basis for introducing new livestock management practices.

2.95 Religious and ceremonial practices must be taken into account in recommending changes in existing farming systems. However, attitudinal change does occur, as the example of the pig farmer selling pigs for his children's education indicates. Any attiyudinal change provides a basis for instigating further behavioral change, not only introducing new kinds of livestock but promoting more complex management practices.

2.96 The decreasing size of landholdings and increasing complexity of land tenure arrangements on Java encourages making livestock an attractive alternative for generating income among small farmers.

2.97 Education is important in determining the level of various social roles performed by members of a community. Most of those living in rural areas have no more than a primary school education. Adoption of improved livestock production practices is highly influenced by livestock farmers' low level of education.

2.98 Village government and Village Council are formal social organizations which also affect the implementation of development programs. Due to the centralization of power in the hands of village heads, his skill, ability, leadership and personality influences the success of livestock development programs.

2.99 In addition to family labor, the patron-client relationships can be utilized to generate sufficient labor to take care of animals. Moreover, patron-client relationships expand the number of villagers who know how to rear livestock.

2.100 Furthermore, "gadohan" schemes and the use of farmers group based on common field location seems to encourage expansion of livestock ownership and production in many village communities.

2.101 Sound social relationships among livestock farmers and village collectors ensure market outlets for a farmer's livestock production. Finally, informal leaders, because of their respect in the community, may encourage participation in livestock development programs.

2. Weaknesses

2.102 Traditional experience is often limited to one type of livestock. This may hinder efforts to introduce other kinds of livestock into the community. Additionally, the low level of education among the livestock farmers necessitates more effort and investment for training and extension.

2.103 Small size of landholdings and complex land tenure arrangements may hinder small livestock farmers from obtaining sufficient feed for their animals and limit the number of livestock a family can raise. Shortcomings may also arise due to weakness in community and farmers' group leadership and decision-making.

2.104 Finally, an informal leader who becomes too influential and obtains a wide power base in a community may pose an unacceptable threat to the formal community power structure. Conflict among formal and informal leaders discourages livestock development.

### 3. Some thoughts for the future

2.105 Generally the sociological environment and social organizations provide a sound basis for the development of Indonesia's livestock industry. Therefore, the following matters need to be considered before new programs are developed.

2.106 Introduction of new kinds of livestock into a community needs sufficient preparatory training in order to give community members basic knowledge and skill.

2.107 In order to obtain support from the village formal structure, their involvement in the preparatory training seems to be crucial for the community.

2.108 Attitude changes provide a sound basis for long-lasting behavioral changes. For this reason, livestock programs must be implemented in stages beginning with types of livestock which require only limited skill and simple management practices.

2.109 To speed up the development process in livestock production, consideration must be given to encouraging greater involvement of the private sector at the village level.

2.110 Additional extension services must be provided to the indigenous people in transmigration areas in order to enable them to compete with the better experience, skill and technology possessed by the transmigrants.

2.111 For example, the distribution of cattle to both the indigenous settlers and the transmigrants does not necessarily mean that changes in farm practices automatically will follow. Indigenous farmers accustomed to non-permanent farming systems use extensive farming methods, minimizing labor and other inputs. To fully utilize the gadohan animals, indigenous settlers must first become familiar with permanent cultivation practices. These behavioral changes must be based on attitudinal changes in order to ensure long-term commitment to change on the part of farmers. Having achieved this, then another step can be taken, i.e., to introduce animals for draft and manure purposes. As a first step, perhaps domestic cattle and buffalo that have been fully adjusted to the local environment can be introduced. Simultaneously, new livestock management practices can also be introduced. By so doing, social roles related to livestock production and use will evolve in stages.

2.112 Recognizing the great differences in experience and skill in raising livestock, thorough consideration must be given to extension strategies, policies and methods in order to better fit the needs of a particular village community.

2.113 Social organizations that have proved effective in expanding livestock production should be encouraged and continuously improved.

# PART II. THE RESOURCE BASE FOR ANIMAL PRODUCTION

## CHAPTER III. THE ANIMAL RESOURCE BASE

### A. Animal populations and their contribution to the national economy

3.1 Livestock play an important and integral role in the rural economy of Indonesia. Table III.1 shows livestock populations by species and province. Cattle and buffalo are kept as a source of draft power for cultivation and transportation. Landholdings are too small, generally ranging from 0.4 to 3.0 ha. for widespread mechanization. Cattle and buffalo provide nearly 70% of the draft power in Indonesia (while about 30% manually prepare and cultivate their holdings). However, mechanization is increasing in some parts of the country because of acute labor shortages during periods of peak labor demand. Daily wage rates for draft cattle and buffalo are presented in appendix table 3.1. The value of draft cattle to the economy is estimated at more than US $ 237 million per year (appendix table 1.2). Draft requirements through 1988 are projected to increase at an annual rate of 1.12% (appendix table 1.1).

3.2 Smallholders also keep farm animals as a source of manure for fertilizer and energy. The value of manure was estimated at US$ 493 million in 1982 (appendix table 3.2). Manure production is projected in appendix table 1.5.

3.3 Farmers also accumulate capital through their livestock. The value of livestock has appreciated faster than other assets, making livestock a convenient means of "saving." Finally, livestock are kept for recreation in some areas -- racing bulls, and fighting cocks and fighting sheep.

3.4 While smallholders produce a substantial portion of the meat and animal products consumed in Indonesia, specialized commercial operations also produce broilers, layers, pigs, dairy cows, and beef cattle.

3.5 It is estimated that the livestock sector contributes about 2.4% of the national GDP and 9.1% of the national GDP derived from agriculture. In 1983, 671,000 tons of meat, 316,000 tons of eggs and 143,000 tons of milk were produced in Indonesia (appendix table 1.7). Livestock raw material exports amounted to 9.9 million kg valued at US$36.8 million in 1984.

#### 1. Beef/draft cattle and buffalo

3.6 Smallholders and commercial producers together held 6.8 million beef/draft cattle and 2.4 million buffalo in 1984 (table III.2). The importance of beef/draft cattle and buffalo to smallholders is discussed above. Medium to large-scale ranches specialize in rearing and fattening cattle in areas with less population pressure and sufficient forage. In addition, a few large commercial feedlots have been developed close to urban markets.

Table III.1: Indonesian livestock population by province, 1979

| Province | Species of livestock | | | | | | |
|---|---|---|---|---|---|---|---|
| | Dairy Cattle | Beef Cattle | Buffalo | Goats | Sheep | Pig | Horse |
| D.I. Aceh | 226 | 170,339 | 183,766 | 118,189 | 44,311 | 9,083 | 12,869 |
| North Sumatra | 5,837 | 143,733 | 140,455 | 164,316 | 31,285 | 639,839 | 11,593 |
| West Sumatra | 945 | 159,646 | 95,679 | 70,984 | - | 31,953 | 5,819 |
| Riau | 40 | 10,966 | 11,929 | 62,391 | 1,808 | 29,620 | 11 |
| Jambi | 17 | 18,384 | 27,719 | 44,332 | 15,368 | 4,216 | 401 |
| South Sumatra | 308 | 89,181 | 47,135 | 106,677 | 6,747 | 36,992 | 2,031 |
| Bengkulu | - | 15,041 | 27,746 | 30,705 | 2,978 | 54 | 157 |
| Lampung | 129 | 76,490 | 31,165 | 160,655 | 25,845 | 32,568 | 453 |
| Sumatra | 7,582 | 683,780 | 565,604 | 758,249 | 128,342 | 753,325 | 33,334 |
| DKI Jakarta | 4,122 | 609 | 4,211 | 21,688 | 5,931 | 50,778 | 1,446 |
| West Java | 16,240 | 121,668 | 495,323 | 1,263,765 | 2,049,833 | 19,749 | 16,955 |
| Central Java | 27,735 | 1,007,547 | 319,819 | 2,282,427 | 1,006,937 | 69,262 | 34,240 |
| D.I. Yogyakarta | 1,753 | 186,741 | 16,993 | 353,256 | 94,644 | 6,264 | 1,773 |
| East Java | 34,544 | 2,491,464 | 221,885 | 2,206,560 | 683,341 | 22,284 | 51,609 |
| Java | 84,394 | 3,808,029 | 1,058,231 | 6,127,696 | 3,840,686 | 168,337 | 106,023 |
| West Kalimantan | 132 | 58,769 | 426 | 25,133 | - | 312,995 | - |
| Central Kalimantan | 39 | 13,928 | 1,162 | 5,093 | 397 | 42,692 | - |
| South Kalimantan | 94 | 25,729 | 12,109 | 15,077 | 4,523 | 1,157 | 1,576 |
| East Kalimantan | 14 | 6,358 | 5,964 | 9,796 | 503 | 40,872 | - |
| Kalimantan | 279 | 104,784 | 19,661 | 55,909 | 5,423 | 397,716 | 1,576 |
| North Sualawesi | 227 | 159,717 | 573 | 48,471 | 72 | 130,616 | 13,776 |
| Central Sulawesi | 27 | 114,065 | 9,526 | 68,304 | 8,997 | 40,840 | 5,253 |
| South Sulawesi | 914 | 542,523 | 394,446 | 167,879 | 6,022 | 151,122 | 159,232 |
| Central Sualwesi | - | 16,547 | 6,412 | 26,095 | 7,204 | 1,568 | 3,241 |
| Sulawesi | 1,168 | 832,852 | 410,957 | 310,749 | 22,295 | 324,146 | 181,502 |

(continued)

Table III.1: (Continued)

| Province | Species of livestock | | | | | | |
|---|---|---|---|---|---|---|---|
| | Dairy Cattle | Beef Cattle | Buffalo | Goats | Sheep | Pig | Horse |
| Bali | 256 | 364,954 | 9,104 | 23,605 | 65 | 583,766 | 2,127 |
| NTB | 90 | 141,293 | 202,435 | 98,968 | 31,131 | 15,772 | 77,206 |
| NTT | 247 | 413,956 | 147,373 | 225,181 | 47,419 | 696,738 | 192,164 |
| Bali & Nusa Tenggara | 593 | 920,203 | 358,912 | 347,754 | 78,615 | 1,296,276 | 272,164 |
| Maluku | - | 14,885 | 23,058 | 80,835 | 1,564 | 38,415 | 2,427 |
| Irian Jaya | - | 12,359 | 42 | 14,671 | 1,806 | 342,659 | 2,665 |
| East Timur | - | 36,226 | 26,434 | 27,801 | 7,819 | 23,005 | 14,800 |
| Maluku & Irian Jaya & East Timur | - | 63,470 | 49,534 | 123,307 | 11,189 | 404,079 | 19,892 |
| Indonesia | 94,016 | 6,413,118 | 2,462,899 | 7,723,664 | 4,086,550 | 3,343,879 | 614,491 |

Source: DGLS. 1980. National Livestock Survey.

## 2. Dairy Production

3.7 While reliable milk production data are not available, it is estimated that 144.6 thousand tons of fresh milk was produced in 1983 from about 182,000 dairy cattle. About 90% was produced on Java. In order to encourage milk production, dairy cooperatives have been organized to collect milk from small dairy farmers, pool, pasteurize, package and market it to urban consumers.

## 3. Goats

3.8 The most common goat species is Kambing kacang, which is used for meat and hides. Kambing kacang is used for meat while the Etawah is used primarily for meat and milk. Goat is the most numerous small ruminant. There were 7.9 million goats in Indonesia in 1984 (table III.2). Goats are an important source of farm income for smallholders, particularly landless farmers.

## 4. Sheep

3.9 There were only about 4.8 million sheep in Indonesia in 1984 (table III.2). The most common breeds are the Javanese thin-tailed and the East Java fat-tailed sheep. Sheep are slaughtered for meat. In some areas they are raised for sheep fighting and, in rare cases, a small carpet wool trade.

Table III.2. Livestock population and productivity, 1974/76 to 1984 ('000 heads)

| | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Horses | 625 | 658 | 660 | 527 |
| Cattle | 6,211 | 6,594 | 6,650 | 6,800 |
| Buffalo | 2,381 | 2,513 | 2,500 | 2,391 |
| Pigs | 2,724 | 3,587 | 3,600 | 3,620 |
| Sheep | 3,253 | 4,321 | 4,300 | 4,790 |
| Goats | 7,252 | 7,891 | 7,900 | 7,910 |
| Chicken (million heads), village chickens | 98 | 197 | 132 | 133 |
| Ducks (million heads) | 14 | 24 | 17 | 17 |
| Beef & veal: | | | | |
| No. slaughtered | 763 | 820 | 830 | 862 |
| Carcass weight (kg/Animal) | 156 | 156 | 157 | 157 |
| Meat production ('000 mt) | 119 | 128 | 130 | 135 |
| Buffalo: | | | | |
| No. slaughtered | 216 | 217 | 217 | 219 |
| Carcass weight (kg/Animal) | 160 | 160 | 160 | 160 |
| Meat production ('000 mt) | 35 | 35 | 35 | 35 |
| Mutton & lamb: | | | | |
| No. slaughtered | 1,746 | 2,200 | 2,400 | 2,350 |
| Carcass weight (kg/Animal) | 10 | 10 | 10 | 10 |
| Meat production ('000 mt) | 17 | 22 | 24 | 24 |
| Goat: | | | | |
| No. slaughtered | 3,147 | 3,700 | 3,800 | 3,800 |
| Carcass weight (kg/Animal) | 10 | 10 | 10 | 10 |
| Meat production ('000 mt) | 31 | 37 | 38 | 38 |

(continued)

Table III.2. (Continued)

| | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|
| Pig | | | | |
| No. slaughtered | 1,884 | 2,290 | 2,300 | 2,325 |
| Carcass weight (kg/Animal) | 40 | 40 | 40 | 40 |
| Production ('000 t) | 75 | 92 | 92 | 93 |
| Poultry | | | | |
| ('000 t) | 108 | 198 | 191 | 195 |
| Meat production | | | | |
| Total ('000 t) | 401 | 528 | 527 | 537 |

Source: FAO (1984). Production Yearbook

5. Pigs

3.10 Indonesia is predominantly Muslim, yet it has a surprisingly large pig population. In 1984 there were 3.6 million pigs (table III.2) held primarily by Christians, Hindus, ethnic-Chinese, and some indigenous people. Pig production is largely commercial.

6. Poultry

3.11 Chicken production is sharply divided into two subsectors. Kampung chickens, the local birds, produce about 25% of the chicken eggs while improved hybrids produce the remainder. There are about 133 million kampung chickens, 28.9 million improved layers, and 34.1 million improved broilers in 1984. The duck is perhaps the most under-rated animal resource in Indonesia. In 1984 the duck population was 17 million.

3.12 Poultry meat accounts for about 34% of total meat production. Poultry and eggs contribute about 50% of the total per capita consumption of livestock and poultry products (excluding milk). Recognizing the poultry industry's potential for quick growth, its important contribution to per capita consumption of animal protein and its ability to generate employment, the GOI is encouraging and supporting the development of small-scale poultry operations in rural areas.

3.13 The GOI is keenly aware of the importance of the livestock sector as a renewable supplier of animal protein for human consumption and raw materials for industry, draft power, and manure for fertilizer. In addition, the livestock industry has the potential to generate employment, increase rural income and productively utilize land resources. Indonesia's primary objectives for the development of the livestock industry are set out in Chapter I, section C:

B. Characteristics of Indonesian livestock species

1. Large ruminants: beef/draft animals

3.14 With the exception of several large GOI and a few private cattle/buffalo ranches, almost all of the estimated 9.2 million draft/beef animals are kept in the smallholder sector. These animals are firmly integrated into the economic structure of the limited resource farm and into village life.

3.15 The majority of cattle and buffalo are found in the densely populated areas of Java, Madura, Bali and Lombok where more than 60% of the Indonesian people reside. In both the densely populated areas and the outer islands (with the possible exception of South Sulawesi where a few smallholders keep beef cattle), cattle and buffalo play a similar role.

3.16 For the most part, limited resource farmers minimize the cost of raising cattle and buffalo, purchasing few if any cash inputs. Consequently, the primary cost of maintaining large ruminants is labor. Labor requirements vary substantially depending on whether cattle are allowed to graze or are kept in confinement.

3.17 Indigenous Indonesian cattle and swamp buffalo are small, slow-growing animals. Age of first calving is late in comparison to similar animals in the temperate zones, and the calving intervals, with the possible exception of Bali cattle, run from 18 to 24 months or more. Many smallholders keep their draft/beef animals in covered pens and bring feed to them in order to conserve the manure. Others tether their animals in grazing areas during the day and confine them at night. Alternatively, children or older people may herd animals during the day. In some areas, animals are permitted to run free in designated areas during the cropping season and are permitted to graze harvested crop areas for crop residues during the dry season. Feeds vary depending on soils, rainfall, farming systems and other factors. The feed resource base is discussed in chapter IV.

3.18 There are three major breeds of indigenous cattle used for draft/beef in Indonesia -- Ongole, Bali, and Madura. In addition, the less well-known Aceh breed is found in the district of Aceh. Swamp buffalo are also used for draft power and beef in lowland areas and the Central Sumatra uplands. Table III.3 shows how the cattle population (including dairy cattle) is distributed among breeds.

Table III.3: Distribution of cattle breeds in Indonesia, 1984

| Breed | Estimated Population |
|---|---|
| Ongole | 4,400,000 |
| Bali | 1,000,000 |
| Madura | 300,000 |
| Aceh, N.Sumatra | 400,000 |
| Grati | 80,000 |
| Total | 6,180,000 |

Source: Camoens (1985), personal communication

3.19 Cattle also have been imported from Australia during the last 10 years, primarily crosses of *Bos indicus* and *Bos taurus*. Purebred *Bos indicus* (often called Brahman) have been imported for mating. There is also interest in the "Droughtmaster", a one-half Brahman, one-quarter Hereford and one-quarter Shorthorn cross used for meat production on large ranches. Specialized beef producers supplying the Jakarta market also use a Friesian breed called "Grati."

a. *Bos indicus (or Ongole)*

3.20 Ongole cattle fall into two categories: Sumba Ongole (S.O.) and Peranakan Ongole (P.O.). The S.O. were imported from India to the small Island of Sumba in 1914 and have been kept as purebred *Bos indicus* on the island's ranches since that time. The S.O. have not had a large impact on Indonesian cattle gene pools because of their limited numbers. However, there is renewed interest in the S.O. among the livestock development centers, particularly in NTT.

3.21 The Peranakan Ongole (P.O.) represent a cross of *Bos indicus* with native breeds. Most are found on the island of Java. P.O. found on Java are smaller than the purebred *Bos indicus* or Sumba Ongole found on Sumba ranches.

3.22 Both exhibit the characteristic hump found in *Bos indicus* cattle. The S.O. have a white hair coat while the P.O.'s hair coat varies from white to almost black. In addition, some P.O. have red spots on their hair coat. Udders and teats are small and poorly developed in both breeds, making them poor milkers.

b. Bali cattle

3.23 Bali cattle resulted from the domestication of the wild Banteng, probably beginning in prehistoric times. They are classified as *Bibos sundaicus*. The hair coats of the cows, steers, and calves are reddish. Male hair coats turn black when the animal reaches puberty at 12 to 24 months. Both sexes have a distinct black line along the back, white areas on the hind quarter that extend along the belly, and socks running from the hoof to just above the hock. In addition, there are white hairs inside the ears, around the muzzle, and on the tail. The animal has small, erect ears that extend straight outward. Their horns are small and tend to grow in a semicircle extending outward and backward on the same plane. There is no hump, but the males have a distinct cervical crest. They are watchful and alert. Udders and teats are small and poorly developed, making them poor milkers.

3.24 Bali cattle will mate with the *Bos indicus* cattle found in Indonesia. Crossbreeding is common in some areas, e.g. South Sulawesi. However, the male offspring is infertile. Therefore, backcrossing of females with either P.O. or Bali bulls is necessary.

c. Madura cattle

3.25 The Madura is of unknown genetic origin although it appears to be a cross of Bali and the indigenous Madura cattle, possibly the P.O. It has even been suggested that some *Bos taurus* genes could be present in the Madura breed. Arab traders may have brought cattle from other sources to Indonesia, adding these to the mixture.

3.26 The hair coat runs from brownish-fawn to red with somewhat lighter areas around the muzzle, legs, and tail, indicating some Bali genes for color markings. The Madura, like Bali cattle, have small ears that extend straight outward. They have a broad-based hump which is forward of the shoulders. As with the other indigenous breeds, the udder and teats are small and poorly developed, making the Madura poor milkers. The Madura breed is among the smallest of breeds.

d. Aceh cattle

3.27 Aceh cattle are found in the special district of Aceh. It is a very small animal that appears to be resistant to high temperatures and local Indonesian diseases and parasites. Adult females weigh about 150 kg while adult males can weigh up to 300 kg. It is as small or smaller than the Madura breed and has to be used in pairs for draft power.

e. Swamp buffalo

3.28 Swamp buffalo are found in the swampy areas of Indonesia, particularly in rice fields where the land is heavy and difficult to plow. The animal is deep-bodied with movements that are slow and sure, making it valuable for plowing heavy soils. Mature males weigh about 600 kg while females weigh 500 kg. Skin color in both is grey at birth, turning slate blue or dark grey with increasing age. Hooves and horns have the same color. A few white animals are found, but the frequency is not known. The white buffalo is used in the Toraja burial ceremony and sells for a much higher price than gray animals.

3.29 The swamp buffalo has a large belly which, combined with its short body, gives it a "pot-bellied" appearance. Many make the mistake of equating this appearance with good body condition. The neck is long, and the withers are quite prominent. The forehead is flat, the orbits prominent. The face is short while the muzzle is wide. The legs are short and thin, while the shoulders are well-developed and powerful. The hind quarters are poorly developed, reducing its carcass merit.

3.30 Heat tolerance is only fair. In direct sunlight, both the respiration rate and body temperature rise rapidly, and distress occurs. However, heat tolerance increases when swamp buffalo can immerse their bodies in water at least once daily. In swampy areas they do well and appear to be more disease resistant than cattle.

### f. Brahman Crosses

3.31 Brahman cross cattle were developed in northern Australia for commercial ranching purposes. They were obtained by mating purebred Brahman bulls (*Bos indicus*) to (usually) crossbred females of equal Hereford and Shorthorn genes, producing animals that contain about one-half Brahman, one-quarter Shorthorn and one-quarter Hereford genes. However, various mixtures of these are found in cattle imported to Indonesia.

3.32 The cross exhibits hybrid vigor for growth and resistance to several parasites and diseases and have performed well in the hot areas of northern Australia and the southern areas of the United States. In addition, they are larger than the local breeds. However, good nutrition and management are required to realize their growth potential in Indonesia. Conditions for this are not yet present in most parts of the country, particularly in the transmigration areas of Kalimantan, Sulawesi, Irian Jaya, the Moluccas and Sumatra.

3.33 Several large ranches have imported these animals. With good nutrition and management under ranch conditions, the Brahman crosses make excellent mothers because they are good milkers. In addition, their reproduction rates are satisfactory under ranch conditions.

### g. Grati Cattle

3.34 The expanding Jakarta feedlot industry is importing the young purebred Friesian bulls or crossbred animals used in the dairy industry in order to meet increased demand for better quality meat by the hotel and restaurant trade, as well as, the upper middle income classes in the larger cities. "Grati" is used to describe these crossbred Friesian cattle which range from about 75% to almost 100% Friesian genes. The original animals were imported from Holland in the early 1900's, primarily to East Java.

3.35 Feedlots purchase the bulls when they are about 6 months of age, weighing about 200 kg, and feed them a ration composed of chopped elephant grass, maize, rice bran and a protein-mineral supplement. Gains of about 0.70 kg per day are obtained (Gunawan, personal communication) over a 360 day feeding period, achieving weights of about 450 kg at 18 months.

## 2. Beef/draft animal productivity

### a. Ongole

3.36 Comparative data describing the (S.O.) and the (P.O.) are presented in appendix table 3.3. These data suggest that S.O. could be used to upgrade the P.O. However, the S.O. are adapted to the dry and hot conditions of Sumba and may not adapt well to the wet humid tropics of other areas of Indonesia such as East Kalimantan.

3.37 This discussion focuses on the Peranakan Ongole (P.O.) since the number of Sumba Ongole (S.O.) is limited. The P.O. are raised on Java in significant numbers. While the P.O. grows faster than the Bali, Aceh, or Madura cattle, it does not fatten as readily when mature. As a result, it does not carry as much excess fat which can be used in times of nutritional stress. Adequate feeding is necessary at all times in order to obtain high fertility rates. The study team interviewed farmers in Central Java, who, by superior feeding and management practices, obtained one calf each year. When farmers in the Gunung Kidul area in the D.I.Y. Yogyakarta used Ongole cows as draft animals, bodyweight losses up to 30 kg over a 3 months period were observed. These cows will not breed during periods when energy is insufficient. However, adequate energy intake during work periods will rectify this problem.

3.38 Field observations by Ramm et al. (1984) raise concerns about the suitability of P.O., given East Kalimantan's feeding conditions and existing management practices. Moreover, team members received reports that transmigrants in other areas prefer Bali cattle to the P.O. because of their higher reproduction rates, resistance to ticks, and ease of handling.

### b. Bali Cattle

3.39 The GOI has established a Bali cattle development project. Appendix table 3.4 exhibits the sex distribution of the Bali cattle on the island of Bali. The ratio of adult males to adult cows is 1:2.6, narrow by any standard. There are several possible explanations:

- Farm units in Bali are small, and farmers may prefer to have a breeding bull on the farm;
- Bulls are used for draft purposes in Bali; or
- There may be illegal slaughter of females in Bali.

3.40 Appendix table 3.5 presents data comparing weight by age for Bali cattle under the Bali Cattle Development Project, an Artificial Insemination Center and farmer management. Appendix table 3.6 shows that Bali cattle have excellent carcass traits. (Further data on carcass traits are presented in order to show the comparative performance of cattle and swamp buffalo, and these data are presented below under the section on comparative performances.)

3.41 Calving percentages reported for Bali cattle are fairly high for Indonesia. Study team members traveled extensively in Kalimantan, Sulawesi, Irian Jaya, Maluku, NTB, and NTT, interviewing smallholder transmigrants and indigenous farmers. In every area, smallholders associated high reproductive rates with Bali cattle. Most preferred this breed when receiving cattle under the Sumba contract that requires the return of two young animals (18 to 24 months of age) within five years. Clearly, smallholders associated reproductive performance with breed. Under existing smallholder management practices, Bali cattle may reproduce better than other breeds. However, reproductive performance is not necessarily breed specific and is affected by many factors including:

- body condition score;
- level of work performed;
- ratio of bulls to cows;
- use of strategic feeding;
- parasite and disease loads; and
- other factors.

3.42 In addition, highly seasonal breeding is reported. From August to January, 72% mate. Calving takes place from May to October. Sumadi et al. (1980) observes that poor nutrition at certain times of the year causes low body condition scores, effectively reducing periods of fertility. These observations confirm the importance of good body composition scores on reproductive performanace, an important factor in temperate zone cattle.

3.43 Reksohadiprodjo (1980) reports that the weight for age found in Bali cattle kept under large ranching conditions in South Sulawesi was less than that found in Bali cattle on Bali. He also reports that Bali cattle purchased from Bali smallholders and shipped to South Sulawesi did not handle well in the cattle yards and in ranching operations. Under ranch management, Bali cattle did not calve as frequently as reported by smallholders. They observed high post-natal calf mortality in range-born Bali calves, up to 25% to 30%. Also, post-weaning losses in Bali calves were high. In a personal communication, Turnour (1985) explained that Bali cattle become extremely nervous and suffer general physical stress unless handled daily. Bali cattle also suffer high juvenile mortality, up to 80% without frequent handling. Consequently, Bali cattle are not the animal of choice for commercial ranching. It is risky to relate reproductive efficiency with the Bali breed without determining why the breed seems to reproduce better than other breeds under smallholder management.

c. Madura Cattle

3.44 Currently, there is much interest in further study of indigenous Indonesian cattle. Siregar et al. (1984) reported the performance data shown in appendix table 3.07. These data confirm the previous observation that this is a small breed. In addition, Ramm et al. (1984) observed that Madura cattle are not as adapted as Bali cattle to the conditions on smallholder farms, particularly in transmigration areas. Comparative data are presented in the next section.

d. Aceh Cattle

3.45 These cattle are found primarily on the northern tip of Sumatra. While the Aceh are few in number, there is interest in preserving the breed. It is a small animal. Outward appearances and field observation by those familiar with the breed indicate that the mature animal fattens readily when fed a good diet and is able to use stored fat in times of feed shortage. This is an asset, permitting the animal to withstand periods of feed shortage and recover quickly upon realimentation.

3.46 Little comparative research has been conducted evaluating the Aceh. Consequently, data are being collected describing the breed and assessing growth and other production parameters (appendix tables 3.8 and 3.9).

e. Swamp buffalo

3.47 Appendix table 3.10 lists available literature describing the Malaysian swamp buffalo which is very similar to that found in Indonesia. Robinson (1977) surveyed selected provinces of Indonesia collecting data describing swamp buffalo herd structures and production parameters (appendix tables 3.11 and 3.12). Ratios of females to males were highest in Central Java and Central Kalimantan while the narrowest ratios were found in Bali, Central Sulawesi and South East Sulawesi. In Bali, male buffalo are used for draft while in Central Kalimantan young bulls are sold for meat at about two years of age. Selected productivity data gathered by the study team is compared with Thai data in appendix table 3.13.

3.48 The swamp buffalo has characteristics that make it the animal of choice in swampy areas. However, its use should be confined to areas where greater power is needed. Swamp buffalo carcass traits do not compare favorably with other draft/beef animals (appendix table 3.14). As indicated earlier, the swamp buffalo is strong in the shoulders and weak in the hind quarters. Carcass results, particularly the ribeye, confirm this. Of course, this is not a critical deficiency in areas where animal protein is in short supply and little premium is paid for hind quarter cuts. More importantly, the swamp buffalo dresses out at a lower percentage than other large ruminants, 46.3% versus 50.3%. On the other hand, offal is in such great demand in Indonesia, that this substantial difference is not as important as it would be in areas where there is little demand for offal.

f. Brahman-crosses

3.49 Brahman crosses from Australia are larger than the P.O., Aceh, Madura or Bali cattle. In East Kalimantan, Ramm et al. (1984) found that the hybrid vigor resulting from crossing *Bos taurus* with those of *Bos indicus* resulted in faster growth rates and larger animals. However, they reported that the Brahman-crosses were not as heat tolerant as Bali cattle. In a farm survey, German workers found high fertility rates in Bali cattle, intermediate in P.O., and low in Brahman-crosses.

3.50 Data describing the performance of Brahman-crosses in comparison to indigenous cattle under a variety of management conditions are presented in the following section. Under ranch management, the larger, fast-growing brahman crosses may be the most commercially viable breed, especially in areas where live animals are shipped to Jakarta for slaughter, and shipping costs are charged on a per animal basis regardless of size.

3. Comparative performance of beef and draft animals

3.51 DGLS (1977) summarizes characteristics of indigenous Bali, Madura and P.O. cattle based on field observation and research results (appendix table 3.15). Appendix table 3.16 presents comparative data describing breed performance for Bali, Brahman crosses, P.O. and swamp buffalo in East Kalimantan (Ramm et al. 1984). This excellent study and its conclusions about the suitability of different breeds for smallholder farmers in East Kalimantan confirm the observations of the study team. Under transmigrant management practices, the small Bali cattle appear to be superior to P.O. and Brahman crossbred cattle, primarily becaouse of their higher reproductive rates. Ramm, et al., were not impressed with the performance of Madura cattle kept under transmigrant management. To support their conclusion, they explain that a herd of 1500 Madura cattle imported in 1968 has been reduced to 500 animals at present. However, the reduction in herd size resulted from the interaction of many factors not necessarily related to breed. Therefore, use of these data to describe the breed should be undertaken cautiously.

3.52 Moran (1979) fed indigenous cattle and swamp buffalo of comparable physiological age a high-concentrate ration (appendix table 3.17). As expected, daily gains were related to ultimate body size of the mature animals. Grati gained at the fastest rate followed closely by the Ongoles and swamp buffaloes with Bali and Madura cattle being the slowest of the group. Madura cattle are the smallest, and their daily gains were about 10% lower than the Bali cattle.

3.53 A comparison of weights at different ages of indigenous cattle and swamp buffalo compiled for a study by the World Bank and FAO is shown in appendix table 3.18 These data were used to calculate the average daily gains shown in appendix table 3.19. When mature, Grati cattle and swamp buffalo males weigh about 500 and 600 kg, respectively. Daily gains at all stages (birth to 1 year, 1 to 2 years and so on) favor these animals, followed by the P.O., then the Madura. These data illustrate the effects of relative size on growth rates, an important factor when meat production is the primary objective.

3.54 As expected, feed intake favored the Grati when expressed either as kilograms of dry matter eaten per day or as a function of surface area. Other cattle also followed the expected pattern. The swamp buffalo, however, consumed less feed daily, yet this animal also fits the expected pattern when expressed as a function of surface area. Cattle fit the expected trend for feed efficiency, but the swamp buffalo did not. The conversion of feed to gain for buffalo was about 10% better than the Grati and about 7% better than the Ongoles. Organic matter digestibilities were similar among all animals and offer no explanation for the differences in the conversion of feed to gain. However, dressing percentages and carcass measurements explain the differences in part. The swamp buffalo is inferior in all carcass measures. The swamp buffalo's dressing percentage is fully 18% lower than Madura cattle and 10.5% lower than Ongole. Measuring ribeye size, the Madura, Bali and Grati cattle are in a class by themselves, while the swamp buffalos are by far the poorest and the Ongoles being intermediate. Muscle to bone ratios clearly show the Madura cattle are strongly muscled followed by Bali, Ongole, Grati and the swamp buffalo.

3.55 As pointed out earlier, the swamp buffalo has strong front quarters and weak hind quarters. For production purposes, this animal must be evaluated on characteristics other than feedlot performance and carcass characteristics. The swamp buffalo is adapted to swampy conditions found in many parts of Indonesia, and this comparative advantage makes it the most desirable animal in these regions, especially for draft power.

3.56 When indigenous cattle are given superior nutrition for show ring purposes, all breeds have greater genetic potential for growing and fattening than is exhibited under smallholder feeding and management practices. Selected measurements of animals placing first, second and third in two cattle show ring contests are presented in appendix table 3.20. In a 1978 judging contest at Kartosuro, a Bali bull weighed 610 kg at 5 years. This animal was excessively fat. At the same contest, the champion P.O. weighed 751 kg at 4 years. In contrast, this animal was not excessively fat. The champion Madura bull weighed 495 kg at 3 years, and was well muscled as might be expected of a bull being prepared for the bull races on Madura.

3.57 Clearly, the data indicate that indigenous cattle have genetic potential for faster growth rates than normally seen in these cattle under smallholder management. Similarly, the good results obtained in Indonesian feedlots when "American-type" feedlot rations are fed to indigenous cattle (Freisian bulls, Ongole bulls, Brahman-crosses) supports the conclusion that indigenous cattle perform well when fed adequate rations. These results also support the rationale that feeding is perhaps the primary constraint limiting cattle and swamp buffalo production and performance in Indonesia.

### 4. Large ruminants: dairy cattle

3.58 The dairy cow population is made up almost exclusively of purebred and grade Holstein-Friesians. The GOI has a program of artifical insemination using imported and domestic frozen semen from Holstein-Friesian bulls. Import programs from 1978-83 brought 179,000 dairy cows into Indonesia (see Chapter VI, "Marketing" for a more extensive discussion of dairy cattle imports), largely from New Zealand and Australia for distribution to smallholder farmers through the KUDs (described in chapter VI). A total of 55,000 are targeted for import during Repelita IV.

3.59 The dominance of the Holstein-Friesian dates back to the pre-Independence days when the Dutch developed a dairy industry on Java. In the minds of the Indonesian milk producers today, only Holstein-Friesians are equated with milk cows and no other breeds (Jersey, Guernsey, Brown Swiss, etc.) are considered. Considering the feed requirements for the large bodyweight of the Holstein-Friesian ( > 500 kg mature bodyweight) and its intolerance to heat and humidity, the dominance of this breed may be a source of inefficiency in the dairy production sector. On the positive side, a concomitant beef-fattening industry has developed among smallholders using the Holstein-Friesian bull calf produced on local dairy farms. These calves have shown hardiness and a rapid rate of growth under typical smallholder confinement feeding systems. They produce the kind of lean carcass and high yield Javanese butchers prefer.

#### a. Breeding and selection

3.60 Breeding of dairy cows on Java is done by artificial insemination. Semen is provided by the DGLS. Breeding services are either provided by the DGLS or by the KUD to which the farmer belongs. In the past, a great deal of Holstein-Friesian semen was imported from Australia, New Zealand, Japan and the U.S. The Indonesian government, with technical and financial assistance from the Government of New Zealand has established two bull studs: at Lembang in Central Java and at Singosari in East Java (described in appendix VI.A). Lembang has the Holstein-Friesian bulls while Singosari produces frozen semen from Bali, Ongole and Brahman cattle.

3.61 The small herd size of the typical Javanese dairy leaves little room for selection on the female side. All heifers must generally be raised as replacements. No studies of replacement rates have been done to date but visits with farmers indicate that culling for low production is secondary to culling for loss of production due to mastitis and reproductive failure. Female calves are sold only rarely. In addition, there is not a systematic milk recording scheme in place. Some more progressive farmers weigh milk periodically in order to adjust feeding rates but these records are not collected by the KUDs or provincial Dinas. Apparently there are plans being developed to institute a national or provincial milk-recording scheme, but to date it has not been executed.

3.62 Given that the majority of dairy cows are bred artificially using semen coming from a single bull stud (Lembang), tremendous potential exists for selection on the male side. Interviews with the management of the Lembang station, KUD officials, and farmers indicate that the genetic quality of the bulls being used to produce semen at Lembang is not known. The assumption is that imported Holstein-Friesian bulls will have a positive effect on milk production by F1 and higher grade daughters because they are coming from populations with high average milk yields (U.S., New Zealand, Japan, Israel, etc.). This may or may not be valid given the heritability of milk production (25%). It will become less valid as daughter populations increase, and decisions must be made for selection of future sires to be collected at Lembang. At this time the only systematic decision being made is to rotate bulls used in a specific region every 1 to 3 years in order to avoid inbreeding. Farmers, and to a certain extent officials in charge of the AI program, have little to say in the selection of bulls. The use of semen from proven sires available elsewhere is recommended.

b. Calving and calf-rearing practices

3.63 Calf management practices are comparable to those seen in other countries. Calves are navel-dipped with iodine at birth and given colostrum by suckling for several days. Milk feeding is generally for three months and averages 2 liters per day. Calves receive cut-grass and a supplement of either rice bran or mixed concentrate. Bull calves may be sold at birth or raised to weaning depending upon what the dairymen perceives to be to his economic advantage in holding the calf during the milk-feeding period. Bull calves are generally not held on the dairy, but the dairyman may retain partial ownership of the calf in a share-fattening scheme with other farmers. This involves the dairyman supplying the calf, and the calf-raiser supplying feed and labor until the calf is marketed at 12 to 18 months. The sale price of the fattened calf is then dividied in some way which considers the farmer's labor and feed input costs (e.g. marobati system, see Chapters II and VIII. This is a common arrangement in Central Java where dairymen in the highlands supply calves for fattening on grass, crop by-products, and rice bran in lowland villages.

3.64 Heifer calves are usually reared by the dairyman. Some dairymen, especially those with limited housing who wish to expand their herds beyond two or three adult cows, may contract out heifer raising to farmers with greater feed resources. In this arrangement, the heifer is returned bred or already calved out, and the farmer-raiser receives a fee or the first calf dropped by the heifer.

3.65 Heifers are usually bred artificially if they are at the dairyman's farm when they come in heat. Heifers contract-raised by farmers may be bred to local bulls with the resulting calf retained by the farmer or sold and the profits shared with the dairyman. No study has been made on age at first heat and first calving, but interviews with dairymen, Dinas Peternakan and KUD officials indicate that first calving occurs at from 30 to 40 months of age depending upon management post-weaning.

c. Management practices

3.66 Feeding management of lactating cows: The basic diet for dairy cows in Java consists of cut forage and either rice bran or a commercial concentrate mixed by the KUD. The most common grass used for feeding is *P. purpureum*, but others, including *Setaria sphacelata*, *Brachiaria decumbens* and *Cynodon plectostachyos* may be used. Cut grass from established plots (usually 0.25 to 0.5 ha) may be supplemented with vegetative crop by-products such as stovers from corn and peanuts, and fresh sweet potato vines. Grass and weeds cut from roadsides and fallow paddy complete the forage part of the diet. In recent years, development programs have begun introducing the use of *Leucaena leucocephala* as a high protein forage source. Leaves and young branches from trees which form fence posts are being increasingly used to feed dairy cows. Awareness by the dairy farmer of the problems with leucaena mimosine content limits its use as a supplemement.

3.67 Dairymen interviewed in Central and East Java indicated a feeding rate of 40 lbs of fresh forage and 5 kg of concentrate or rice bran per head per day. The concentrate is supplied by KUDs or purchased locally. A typical concentrate is copra meal, rice bran or wheat middlings, corn, and minerals. A major effort in reducing feed costs and improving feed quality has been undertaken by the Cooperative League of the USA (CLUSA) in Central Java. This effort has shown that there is a large potential to reduce feed costs per liter of milk produced and substantially increase feed productivity. These rations have been developed by compiling a list of some 300 possible feedstuffs and then using a specially constructed linear program software package to calculate these rations by microcomputer. An example of the computer output generated is shown in Appendix 3.A. The importance of this breakthrough should not be underestimated because these data are for lowland conditions. Upland results are expected to be much better. Also, farmers in C. Java are receiving Rp 225/liter farmgate prices because much of the milk has to be sent by truck to Jakarta, while West Java farmers are receiving 22% more per liter.

3.68 Housing and equipment: Milk production from dairy cows in Java is typically based on confinement housing and feeding. Little or no land is available for grazing but some land is generally set aside to plant grass for cutting, usually *Pennisetum purpureum* (*rumput gadjah*). Housing consists of a small shed with a dirt floor, a wood feed bunk, and a separate compartment for the calves and heifers. In few cases are concrete floors and feed bunks found. Equipment is limited to plastic or tin milk buckets, 20 liter cans (supplied by the KUD or GKSI), grass cutting tools and possibly a rubber or plastic hose. In the majority of cases running water is not available, and water for washing and for cattle must be hand-carried.

3.69 Milking Management: Milking is all done by hand twice daily. Udders are washed with a bucket of water and towel or, if running water is available, with a hose. Drying of udders is done with a damp or dry rag. No teat dip is used on the average farm, and udder sanitation is rudimentary at best. The result of this is the higher rate of blind quarters found by KUD government veterinarians as the age of cows increases. Incidence and effect on milk yield for a sample of Java dairy herds is given in Chapter V, table V.6. Milk is collected by the KUD twice daily. It is stored by the dairymen in 10 or 40 liter cans and placed by a roadside or carried to a central collection site. In no farm visits to dairymen was equipment such as milk strainers or sanitarized solutions for milk cans seen.

3.70 Milk yield. As mentioned above, systematic national milk recording schemes are not yet in place. Apparently, no localized data on milk yield has been developed by universities in a research mode or by KUDs. Interviews with KUD and DGLS officials and with farmers consistently indicated an average daily lactation yield for high-grade Holstein cows of 10 kg over 240 to 270 days for a total yield of 2,400 to 2,700 kg. Cows which average below 10 kg are considered candidates for culling. Cows are generally milked to the point where production declines to 2 or 3 liters.

3.71 A recent study by DGLS provides a sample of yields from the major producing areas (appendix table 3.21). These results are supported by a major 1983 study by Gadjah Mada University ("The Impact of Imported Dairy Cattle on Prospects for Development of Animal Production by Small Farmers and Development of Village Dairy Co-operatives in Central Java"). A survey in 1982 covered 600 recipients of imported dairy cattle. Forage consumption was about 40 kg/day and barely covered maintenance. The feeding of concentrates was also sub-optimal ranging from 2.5 kg/day to 4.1 kg/day. Drinking water was seldom provided ad-lib but was usually mixed with the concentrates, and the amount provided was inadequate. Average production/day ranged from 3.9 to 6.8 liters. Lactation levels per year ranged from 1824 to 2599 liters.

3.72 An estimate of the production cost structure was provided by the South Bandung Dairy Cooperative based on 1983 data. This is shown in appendix table 3.22.

3.73 Health problems and treatments: These are discussed in detail in Chapter V and summarized again in Chapter IX, which deals with development strategies and projects for dairying. These problems have not received adequate attention and are one of the reasons for low productivity and poor milk quality.

### 5. Small ruminants

#### a. Population and distribution

3.73 It is estimated that about 20% of all farms in Indonesia have sheep and/or goats, a higher proportion than large ruminants, commercial poultry, or swine (Knipscheer *et al*., 1983). The small ruminants in Indonesia consist of goats and sheep. Households use goats and sheep for a variety of purposes including:

- Source of meat
- Source of milk (from Ettawah goats and their crosses)
- Source of manure
- Wealth accumulation
- Cultural and religious functions
- Carpet wool (sheep)
- Recreation (Garut sheep are used for sheep fighting

3.74 Sheep and goats are widely distributed throughout Indonesia but are heavily concentrated in only a few provinces on Java. Appendix table 3.23 summarizes recent data on small ruminant numbers and the number of households keeping small ruminants.

3.75 The small ruminant population has remained relatively stable over the past 50 years. However, the goat population increased somewhat during REPELITA III, probably in response to a general increase in relative prices for red meat and the rapid increase in transmigration resettlements where goats are often an important source of supplementary income (Mink, 1980; Levine and Karo-Karo, 1985).

#### b. Breed Descriptions

3.76 The major goat breeds are Kacang and grade Ettawah. The Kacang (peanut) goat, the most numerous breed, is found throughout Indonesia. It is small with no uniformity of color. The base colors are black and brown with many variations in between. The ears are small, and both males and females have short horns that slope backwards.

3.77 The grade Ettawah resulted from a cross of pure Ettawah (the Jamnapari from India) and local breeds. The animal has large horns and medium to long pendulous ears. The hair coat is usually brown containing both white and black spots. It is much larger than the Kacang. The Ettawah is a good milk producer which but milk is rarely consumed by the smallholder's family. It complements farming systems generally found in the upland areas where upland rice and secondary crops comprise the usual crop mix.

3.78 There are three breeds of Indonesian sheep: Javanese thin-tailed, Priangan, and the fat-tailed sheep. The Javanese thin-tailed sheep constitutes 50 to 80% of the sheep in Central and West Java. It is small, and its tail does not reach its hocks. The ewe is usually polled, while the ram has closely curled horns. Even though some observers list the Priangan as a separate breed in Indonesia, there is doubt about whether or not it is a breed separate from the Javanese thin-tailed (Mason, 1975). Therefore, only two breeds are considered for the purposes of this discussion: the Javanese thin-tailed and the East Java fat-tailed sheep.

3.79 The fat-tailed sheep were brought to Indonesia by Arab traders who settled on the coastal areas of East Java in the 19th century. Mason (1975) points out that the name "domba" used in Indonesia for sheep comes from "dumba" which in Persian means tail. (This is a term used to refer to the fat-tailed sheep in Iran, Pakistan and Afganistan.) Most of the sheep in East Java are fat-tailed, while they constitute only about 50% of the sheep in Central Java. Their wool color is white, but some have brown patches. Ewes and rams are hornless; however spurs may appear on some rams. Ewes are medium sized and semi-lop. Some earless sheep occur, apparently the result of a recessive gene.

c. Production

3.80 Knipscheer et al (1983) conducted surveys on small ruminants in Indonesia and the following results were obtained:

- About 19.3% of the farming households in Indonesia keep small ruminants

- About 5.5 million small ruminants are slaughtered in Indonesia each year, an important source of meat

- The small ruminants enterprise is an important employment and income generating activity for the rural poor, many of whom are landless

- Offtake, as measured in kilograms of liveweight production over kilograms of liveweight, varies from 45 to 60%, suggesting that an offtake of 50% is reasonable under Indonesian conditions

- The reproductive performance of female adults averages about 1.1 lambs or kids per year, well below their genetic potential of an estimated three lambs or kids per year

3.81 The Small Ruminant-CRSP program, supported by USAID and AARD and carried out by a number of U.S. cooperators, has collected comparative performance data on sheep and goats. Comparative body weight data are shown in appendix table 3.24 for small ruminants on excellent planes of nutrition.

3.82 Knipsheer, et al. (1983) found that flock composition in three locations of West Java varies considerably (appendix table 3.25). The relatively low percentage of young stock for Cirebon goats is explained by the high rate of kid disposal. The high percentage of young stock in Ciburuy results from higher reproductive performance. Based on overall offtake rates, Knipscheer et al. (1983) expect about one-half of the small ruminant population to consist of adult females. Low reproduction rates are probably due to breeding management. Most farmers do not have their own males. Moreover, opportunities for mating are restricted when animals are kept in covered pens.

3.83 A comparison of goat production traits found in different areas of Indonesia is presented in appendix table 3.26. High kid mortality is apparent in all areas and may be seasonal. The Forage Station Center in Banjar Baru kept their goats on slatted floors and noted higher kid mortality during the rainy season. Their observations concur with earlier reports from Java. Similarly, lamb mortality is high in all areas covered. Production data describing sheep are presented in appendix tables 3.27 and 3.28.

e. Contribution to smallholder income

3.84 Knipscheer et al (1983) estimated average gross income from goat production and its contribution to household income in West Java. The study stratified farmers based on overall economic status where strata I and II were classed as destitute, stratum III as poor and strata IV and V as not poor. Appendix table 3.29 reproduces the estimates made for three different agro-ecological regions. Comparisons are made for small ruminant holders only.

3.85 Goat production's relative contribution to farm income varies depending on income-producing potential of the land holding. Since the proportion of farmers holding small ruminants is about twice as high in upland areas, the overall share of village income generated by small ruminants is much greater in upland areas. In another study of a more prosperous agricultural area in North Sumatra, Levine and Karo-Karo (1985) estimated contributions to gross income by various farm enterprises (appendix table 3.30). Not surprisingly, the small ruminant share of total village gross income was low (0.25%) in areas where estate crops are important. Other kecamatans in the area have large areas of lowland rice and significant income from estate and other perennial crops. Similarly, the share of gross income derived from small ruminants was low, between 0.6% and 1.02%.

3.86 Assumed reproduction rates, repayment methods for goats obtained under gadohan schemes, management practices, and feed rations all strongly influence the net income from goat production. The following paragraphs summarize reports that consider the effects of these factors on farm income from small ruminant production.

3.87 Goat distribution is an important component of transmigration schemes. A total of 1800 goats were distributed to 686 participants in 25 locations between 1980/81 and 1982/83. One study of transmigration villages in the middle Mahakam river area of East Kalimantan constructed a farm budget for a typical recipient of goats. This budget is based on the very optimistic assumption of an eight month kidding interval or three litters every two years. Appendix table 3.31 presents those income estimates.

3.88 Appendix table 3.32 also summarizes current or estimated net returns to goat producers obtaining goats from distribution schemes. The more recent recipients have not yet had time to sell animals, so their income projections are based upon anticipated animal repayments. The projections are consistent with reports on the South Kalimantan Livestock Development Project sponsored by ADB where the distributed animals were



101

seldom in good enough condition to return offspring within the first year of the project. As a result, farmers consistently fell behind on repayment, becoming increasingly in debt to the revolving fund (Ital Consult, 1984). Appendix table 3.32 also summarizes the impact of repayment method on net returns to goat production per farmer recipient.

3.89 Finally, a study of six specialized small ruminant farms illustrates the income generating potential of larger farms employing higher levels of management and feeding protein concentrates available locally, in this case soybean waste (ampas tahu) from soybean curd manufacturers. Appendix table 3.33 summarizes production parameters and input-output data for these specialized producers. Access to soybean waste is one key to the economic success of five of the six specialized producers. Appendix table 3.37 presents representative budgets adjusted on a "per adult female" basis. Specialized producers obtain much higher profit per animal than traditional smallholders even in areas where soybean waste is available. Smallholder returns per animal are similar to those estimated for East Kalimantan (appendix table 3.31) and about 50% of the profit per animal estimated in Lombok (appendix table 3.32).

3.90 Consequently, small ruminants should be capable of producing net profits, after accounting for all costs, of between Rp 20,000 and Rp 40,000 per breeder per year if surplus animals are sold upon reaching maturity. Clearly, animals held beyond maturity as accumulated capital or "savings" will not generate comparable net profit per animal.

g. Preference for goats

3.91 Farmers seem to prefer goats over sheep. Sheep appear to be a carrier or causative agent of malignant catarrhal fever, which causes high death losses in Bali cattle. Consequently, keeping sheep in close proximity with Bali cattle is not recommended. Bali cattle are in such great demand in Kalimantan, Irian Jaya, Sulawesi and other eastern islands that sheep probably should not be distributed in these areas at all.

6. Poultry

a. Chickens

3.92 The indigenous chickens of Indonesia consist of essentially two kinds, the "kampung" and the "kedu". Both are descendants of the red jungle fowl. The red jungle fowl can still be seen in isolated areas on several of the larger islands, such as Sulawesi and Sumatra. The kampung chicken has a varied plumage of white, brown, grey and black, and many resemble their wild ancestors. The kedu chicken is either black or white with a green metallic sheen. It has a black comb when young, which turns red at the age of about 6 months. The kampung has either single or rose combs in which the comb color, as well as the ear lobes and wattles, are red. Both breeds are "semi-domesticated" and are alert and aggressive, being able to run at good speeds and fly for short distances.

3.93 The native chickens are kept under "open range" conditions, which is often referred to as the "traditional" management system. Hens lay from 10 to 12 eggs and brood them for hatching. Young chicks are left with the hen until marketing. Feed for the chickens consists of insects, ants, worms, grain and household wastes, all of which are obtained by scavenging. The rough rice ("gabah") left to dry on fiber mats near the house is also a favorite source of feed.

3.94 In some areas, particularly in an old transmigration area near Ambon in the Malukus, study team members found that farmers were crossbreeding their kampung females with the imported purebred or hybrid males that are the foundation of the commercial poultry industry. The performance of these crossbred birds (egg number, weight, hatchability, etc.) was found to be intermediate between the kampung chicken and the imported hybrids.

3.95 Hybrid chickens ("ayam ras") were originally obtained by importing parent stock from Australia, Europe and the United States to establish breeding units in Indonesia. Many of the larger feed manufacturing companies on Java and Sumatra operate poultry breeder flocks and market day-old chicks of both the layer and broiler types. Because it feels the development of breeding units is at an advanced stage in Indonesia, the Government of Indonesia (GOI) has decreed a ban on the importation of parent stock effective in 1986. The importation of grandparent foundation stock will, however, continue to be permitted. In their travels, study team members found both commercial broiler and layer units were modern in all respects(e.g. housing, use of commercially formulated complete feeds, veterinary care and general management). As a result, rates of gain, feed conversion and other production parameters are similar to those found in any major poultry producing country.

3.96 In the interest of promoting poultry production for smallholders, the GOI has decreed a limit for production unit sizes of commercial flocks. Broiler units will be limited to 750 birds marketed per person weekly and layer flocks to 5,000 hens per person. For this purpose, the Poultry Nuclear Estate scheme (PIR) has been established in which producers are organized into groups ("kelompoks") and are provided credit by the Indonesian People's Bank (Bank Rakyat Indonesia, BRI) for buildings, flocks and initial operating costs. The key to the operation of these small units is the privately owned poultry shop, which serves groups of farmers with day-old-chicks, feeds, vaccines and medicines, and, in many cases, credit. Many PIR poultry shops also purchase eggs and broilers from participating producers for distribution to retail or wholesale customers. In some isolated areas where the PIR scheme has not yet been initiated, some private poultry shops are playing roles similar to those in the PIR scheme. Many of these extend credit to customers, in some cases with no interest being charged.

3.97 On Java, some large feed mills are using a "modified vertical integration" arrangement with poultry producers, a scheme in wide use in the U.S. In this scheme, feed mills furnish birds, feed and medicines on credit to producers who provide housing and labor. When the broilers are sold, there is an agreed-upon plan for the sharing of the proceeds. This agreement takes into account an interest rate for the credit extended by the feed mill.

3.98 The commercial poultry industry has been the fastest growing segment of the livestock sector of Indonesia. It accounts for a major proportion of the eggs and broiler meat consumed by the population, especially in the cities. The proportion of eggs supplied by the kampung chicken has declined since a large proportion of the eggs laid are used for replacement purposes, primarily as a result of the high mortality rates in young chicks. Kampung eggs and meat, however, still command a higher price in the market due to consumer preference for the darker yolk and stronger-flavored meat of the native bird.

### 1) Estimates of productivity for Indonesian chickens

3.99 Study team members in farmer interviews found that, on the average, the kampung hens kept under the traditional form of management usually lay 10 to 12 eggs over a 15 to 18-day period. The hen broods the "clutch" of eggs for 21 days. In general, the kampung hen repeats this cycle 3 times per year, producing about 30 to 36 eggs per year. The Dinas Peternakan of Central Java estimates an average of 40 eggs per hen per year for kampung hens in that province (Buku Informasi Jawa Tengah, Unggaran 1984). Study team members found that many farmers consume or sell about 50% of the eggs produced and permit the hen to hatch the remainder, usually obtaining a hatchability rate of about 80%. In general, the mortality of young birds from hatching to 6 weeks of age is 60% or more. Therefore, of the 15 eggs the hen is left to brood, nine will hatch, of which 20% or more will die from various causes between six and 20 weeks, leaving seven chicks surviving from three clutches per year. A farmer with five mature hens and a rooster would produce only 35 chickens yearly for marketing or use as replacements. Simple budgets for the kampung chicken enterprise on mixed crop-livestock farms in Indonesia are presented in Chapter VII.

3.100 Ramm, et al., (1984) collected production data on kampung chickens in five transmigration villages in East Kalimantan. The figures reported in appendix table 3.35 are considerably higher than those reported above. These workers also found that the hens produced three clutches per year with an average of about 12 eggs per clutch. Due to much lower mortalities (only 28% up to 20 weeks of age), the returns to the farmers were more than twice those found by the study team. It is possible that the villages in East Kalimantan had an effective vaccination program for Newcastle Disease, the principal cause of chick mortalities in kampung flocks.

3.101 Kingston and Cresswell (1982) made an intensive study of five West Java villages and found much higher egg production figures, 80 or more per hen per year, than have been reported by other workers. Their results are shown in appendix table 3.36. These higher production figures could have resulted because of their short egg production recording period, only six months. Given the low nutritional levels that are characteristic of the traditional kampung chicken production systems, it is doubtful that sustained production of an egg every 4.5 days (the rate required to produce 80 eggs/year) could be acheived. Also, if a hen requires 18 days to lay 12 eggs, 21 days for hatching, and at least 25 to 30 days for mothering the young (a total of about 70 days), it would be possible to produce only six clutches per year. Therefore, the figure of 80 eggs per hen per year is too high for general usage for all Indonesia.

3.102 Kingston and Cresswell (1982) also presented data on the changes in chicken population in the five Javanese villages (appendix table 3.37).

These data are considered to be preliminary observations on the productivities of kampung chickens, however, the study was quite intensive and covered over 1600 birds in the five different villages. The composition of the flocks within the villages are 65% adults, 9.7% from 0 to 6 weeks and 23.3% from 6 to 20 weeks of age. The percentage of hens in the adult population was about 75%. The fate of the adult population over a 12 month period is of great interest. Mortality in the adults was only 1.2% (0.01% per month) while thievery amounted to 14.4% (1.2% per month); the study team found that thievery was even a larger problem in Irian Jaya. Therefore, only 51.4% of the original adults were surviving at the end of the year. The greatest consumption of adults took place during the great Islam feast day, Lebaran, during which 12.9% of the losses were due to the selling of adult chickens in the market, while 35.1% was due to local consumption; these were the major losses of the adult flock. While the adult chickens that were sold or consumed added to the available finances or nutrition of the family, they represent a reduction of the breeding population, thereby reducing future production.

3.103 The study team's interviews and observations were not intensive enough to determine flock composition and consumption patterns to the degree reported above. However, general observations tend to fit the above patterns, although feast days other than Lebaran would also play a role in the consumption pattern. Analysis of the mortality data obtained by Kingston and Cresswell (1982) are exhibited in appendix table 3.38. They found that 68% of the chicks hatched died during the period from 0 to 6 weeks with deaths dropping after that period. These data indicate that one of the greatest steps to be taken in improvement of the Kampung chicken enterprise would be to reduce death losses during this early period. They reported growth data which agree quite well with the data collected by Hardjosubroto and Supiyono (1972, appendix table 3.39). Adult birds weighed about 1 kg at 20 weeks which was about 60% of that of improved hybrid layers kept in confinement and fed a high energy diet for 20 weeks. In a growth study, Cresswell and Gunawan (1982) found that the growth rates of all kampung chicks were low with one, the "melung," being higher than the others (appendix table 3.40). Unfortunately, neither egg nor broiler-type hybrid chicks were used in this trial. The data confirm, however, previous comments on the size and rates of growth for these chickens.

3.104 Cresswell and Gunawan (1982) also studied kampung chickens fed adequate diets under confinement. Every strain of kampung chicken laid fewer and smaller eggs than the hybrid (Shaver Starcross 579) and required 1.33 to 2.63 times the feed per gram of egg produced. These results emphasize the unsuitability of the kampung chicken, as it exists in its unselected state, for intensive, commercial egg production.

3.105 The observations on the kampung chicken's potential as n source of both meat and eggs prompt one to consider the following priority constraints on village chicken production:

3.106 Productivities of the hybrid chickens used in Indonesia do not differ widely from those obtained anywhere in the world where intensive management involving the use of balanced rations is practiced. Hybrid layer and broiler chicks are produced by breeder farms on Java and Sumatra and shipped to growers in almost all the provinces of Indonesia. Many of the breeder operations are owned by corporations which also manufacture compound poultry feeds (see Chapter IV, Section D, "Commercial feed industry"). Poultry shops in provinces outside of Java and and Sumatra receive commercial feeds in 50 kg bags shipped from Jakarta and Surabaya. Large commercial growers nearby to the cities with feedmills receive their feeds directly from the plant or buy high-protein concentrates and mix their own rations using corn, rice bran and sorghum that they purchase or grow themselves.

3.107 Conversion rates for these commercial operations are comparable to those in other countries with modern poultry production sectors. One difference in Indonesia is the demand for a smaller broiler weighing only 1.2 to 1.6 kg as opposed to 1.8 to 2.0 kg. Hybrid broilers reach these weights at 5 to 6 weeks as opposed to the 6 to 7 week period necessary to raise broilers to the heavier weights in the United States and Europe. Feed conversion ratios (kg of feed required per kg of gain) for birds slaughtered at these weights are on the order of 2 to 1. For egg operations, feed conversion (grams of feed per gram of egg produced) is on the order of 2.6 to 3.1. Operations visited by the study team were obtaining egg production rates of over 70% in birds in their first year of production dropping to 50 to 60% during the second year. Many producers keep their layers for two years.

### 2. Ducks

3.108 The breeding of ducks and the production of duck eggs are important smallholder enterprises in Indonesia. They are principally practiced in the irrigated regions of Java, Bali and NTB and the swamps of Kalimantan. The basic objective of duck production systems is to produce market duck eggs by grazing ducks on recently harvested rice paddies where weeds, fallen rice, snails and insects can form a large proportion of the flock's diet. Supporting activities include the production of fertile eggs to be hatched into ducklings. This is usually not carried out by market egg producers. Recent intensification projects and PDP credit schemes involving duck egg production have tended to promote the combination of the three activities for a single producer. Production systems are differentiated by differences in several components of the egg production system. These include the herding management of the production flock, the market for the eggs (sold as fresh eggs, as 18-day incubated or for hatching) and the source of young ducklings (raised vs purchased). Producers involved in the system usually are engaged in one of three highly specialized activities: producing market eggs, producing hatching eggs or hatching eggs and selling young ducklings. Recent intensification projects and PDP credit schemes involving duck egg production have tended to promote the combination of the three activities by a single producer. The primary product of duck production systems is the egg marketed as fresh, salted, or as a fertilized egg for hatching purposes. In Bali, some duck eggs are sold by traditional hatchers after 18 days of incubation for consumption of the duck embryo. Culls, old laying ducks and males, all by-products of the egg production system, are marketed for meat.

3.109 Positive returns to labor and management in duck production enterprises are a function of two principal factors:

- Availability of easily exploitable feed resources, especially rice padi grazing, sago palm, small fish and snails from nearby rivers, and high quality rice bran (less than 12% fiber).

- Absence of life-threatening pesticide residues which poison the foraging duck, especially the young ducklings

3.110 Several provinces of Indonesia have livestock development projects funded by the Provincial Development Program (PDP) that include the introduction of market egg production from ducks or expansion of the existing egg production sector. These are principally Aceh in North Sumatra, South Kalimantan and Nusa Tenggara Barat (NTB). In these projects farmers receive a small flock of ducks, sufficient feed to carry them to producing age and a grant of sufficient capital to construct simple housing for them. The agreement with the producer calls for credit to be repaid "in kind" with a number of ducks within a specified period of time. These ducks are then used to establish new producers in the same region. The underlying objective is to create a self-sustaining, income generating enterprise and to spread duck production within a given PDP target area.

3.111 These programs have met with variable success. Surveys by Page, et. al. (1983) and Levine (1984) indicate that productivity of introduced flocks is directly dependent upon the management ability and entrepreneurship of the farmer involved. In Central Lombok, producers who invested their own capital in feed concentrates after the PDP-supplied feedstuffs ran out, received a return of up to Rp 250,000 for an investment of Rp 100,000 which resulted in a production average of 200 eggs per duck per year (Levine, 1984). Farmers who failed to adequately feed their flocks either passed out of the business or struggled along at a very low level of production.

a. Duck breeds and breeding

3.112 Several egg-laying breeds of duck have been developed and are associated with specific regions of Indonesia. Examples are the "Tegal" duck of Central Java, the "Mojosari" of East Java and the "Alabio" of South Kalimantan. An introduced breed, the Khaki Campbell, was developed in England from the Tegal and other breeds. It has been introduced to a limited extent in Indonesia and has been used extensively in performance and reproductive studies at the Balai Penelitian Ternak (BPT), Ciawi. Mojosari ducks have been distributed to several provinces outside of Java as part of transmigration and PDP projects.

3.113 Hetzel (1984) compared egg yield and production efficiency in Tegal and Khaki Campbell ducks under intensive management at the BPT. A summary of the results are shown in appendix table 3.41. Performance by the Tegal ducks was significantly lower than the other three breeds with peak weekly productions of 82, 84, 66 and 86% for Alabio, Bali, Tegal and Khaki Campbell ducks, respectively. Interestingly, under intensive management, which included a 16-hour daylength created with artificial lighting, ducks began laying as early as 15 weeks of age, and all ducks reached 50% laying rate in less than 6 months. Tegal ducks were the first to reach sexual maturity. This may have accounted for their lower total performance. Alabio ducks were the slowest to mature. Tegal ducks consistently produced heavier eggs, but the total egg mass to 68 weeks was significantly lower than the other three breeds. All Indonesian breeds exhibited two periods of decline in egg production over the 68-week trial period during which they went into a full or partial molt. The first decline in egg production occured in December with the onset of the rainy season and high humidity. The second decline was in March and April when the weather changed from the wet to the dry season. Hetzel cites reports by Chavez and Lasmini (1977) who saw similar correlations between time of year and egg production in Indonesian breeds of ducks. In a later study by Hetzel (1983b) crosses between Tegal and Alabio ducks laid nearl, 24% more eggs than did straight-bred Tegal ducks.

3.114 Hetzel (1983a) also compared growth and carcass composition of Alabio and Tegal ducks and their crosses. Tegal drakes grew faster at earlier ages but weighed the same at 8 weeks of age and were significantly lighter than Alabio drakes at later ages (appendix table 3.42). Feed conversion ratios and carcass weights did not differ significantly between the two breeds and their crosses. Carcasses of Alabio ducks were fatter, contained less protein, and had a lower proportion of breast meat at a given weight and age than did Tegal ducks.

3.115 Within a breed, region or farmer group there exists no rational selection program with clear-cut goals for production improvment. No production recording scheme exists among producer groups or on the part of the GOI. Males (drakes) at the village level are not selected on the basis of any type of pedigree production history. Interviews with producers in the Kendall region of Central Java indicated that selection criteria for Tegal drakes were totally phenotypic with the selection of young drakes 4 to 6 months old for service in breeder flocks being based on their aggressiveness and general appearance. Whether these factors are correlated with egg production in offspring based on the historic experience of market egg producers is not known.

3.116 Muscovy ducks are found throughout Java and many of the outer islands. In market egg producing areas, they often serve as brooders for the eggs of commercial egg-laying breeds. They are also maintained as household scavengers and to supply eggs and meat in the village.

b. Hatching systems

3.117 One component within the duck market egg production system that differs from system to system is the method used to hatch fertile eggs to produce ducklings. Three basic methods can be identified:

- Traditional heated rice hulls - (Bali, South Kalimantan)- This is a very labor-intensive method which involves incubating fertile eggs in heated rice hulls. Eggs are placed in bamboo baskets set in clay and covered with rice hulls which have been heated in the sun or over a fire. The eggs are uncovered and turned daily.

- Hatching with muscovy ducks - (Central Java) - Hatchers maintain 5 - 10 muscovy ducks for the purpose of incubating fertile eggs. Each duck can hatch out 3 clutches of 15 to 20 eggs each in succession before molting. A variation of this method has been used in Sumbawa where kampung chickens are used in place of muscovy ducks.

- Kerosene-heated incubators - (Kec. Mojokerto, East Java) - The Mojosari duck producers of Kec. Mojokerto have designed and built a simple incubator which can hatch 300-400 eggs at a time and is heated by a kerosene burner. These incubators are built by village carpenters and have been sold all over the duck-producing areas of Indonesia, especially those where Mojosari ducks have been introduced.

c. Herding management

3.118 Herding management is a component of the duck production system. The majority of ducks maintained by smallholders in Indonesia are herded in order to allow selective grazing of fallow fields, river and pond banks, and swamps. Herding management is designed to make maximum use of inexpensive feed resources for the production of duck eggs. Because labor is a major input into the herding subsystem, the way ducks are herded depends not only on the availability of surface area for duck grazing but also on who herds and what the real and implied costs of his or her labor are. For West Java, Petheran and Thahar (1983) have described four systems of herding ducks (appendix table 3.43). Flocks that travel all year, or full-time for part of the year following harvests tend to be larger than those that are penned at night at the owner's home for part or all of the year. The difference is probably related to the intensity of agriculture in the area (length of fallow for rice fields), to the area available for the housing of the ducks at the owner's home, and to payment arrangements with the herder who often receives a share of the flock's production. In regions with more concentrated sources of duck grazing, such as the swamplands of South Kalimantan, ducks are kept close to home for the majority of the year. In Central Java, however, rice cropping is intensive, and fallow periods are short, forcing duck flocks to move over large distances to find feed.

d. Representative production systems for ducks

3.119 Extensive herding for commercial market egg production (Kendal, Central Java) Tegal ducks in the region around Kendal in the north of Central Java are traditionally herded from field to field following the rice harvest. This system is also characteristic of the region south of Jogyakarta. Flocks are highly specialized. A "hatcher" buys eggs from a "breeder" who maintains a flock of 80 to 100 laying hens which graze rice fields around the village. This is supplemented with rice bran and sago palm pith. Most hatchers have long-term contracts with specific breeders in order to assure a constant supply of quality hatching eggs. Hatchers pay breeders Rp 150 per egg and hatch them under muscovy ducks. An average hatcher has 7 to 10 muscovies. Each muscovy will incubate 25 to 30 tegal duck eggs, her own eggs having been removed and sold. This process can be repeated for three consecutive periods before the muscovy molts. The ducklings, or "bayah," are raised to 4 weeks of age in cages. These cages are floated in rivers for a part of each day to teach the ducklings to swim. At night the cages are hung up, and the ducklings are fed a mash consisting of good quality rice bran, broken rice, and chopped worms, as well as eels and shrimp heads when they are available. The whole family provides labor in collecting the feedstuffs from rivers and rice paddies. The ducklings are removed at one month of age and herded in nearby paddies.



109

3.120 From the hatcher, the 4- to 6-month-old ducklings are sold for Rp 2,750 to 3,000 to market egg producer/herders who move the flocks of 100 to 150 layers following the rice harvest. The ducklings are produced on a schedule so as to have them 6 to 7 months of age at the commencement of the local rice harvest. Beginning at this age, the ducks will produce for 3 months, molt for 1 to 1.5, months and produce for two-month periods up to age 30 months. The estimated laying rate is 80% for young flocks (age 6 to 18 months) and 60% for mature flocks.

3.121 Male ducklings are raised to 6 months of age by the hatcher and sold as meat for Rp 1,500. Culled layers 18 to 30 months of age sell for Rp 1,250. A typical flock of 150 layers has only 2 or 3 males whose principal function is to keep the layers together when the flock is driven.

3.122 Duck herders are known to travel 300 to 400 km during a production period of as much as a year in Central Java and around Jogyakarta. The flock is corralled at night in a plastic and bamboo enclosure. Eggs are collected in the morning and sold to village traders. The ducks are fed a small amount of grain in the evening in the belief that this will cause them to coordinate their laying in the early morning hours. Herders may or may not have to pay fees to landowners or local village authorities for grazing rights.

3.123 A major limitation to this system is the periodic poisoning encountered by herders due to pesticide residues in the paddies. This is an especially acute problem in young ducklings.

3.124 Semi-intensive commercial market egg production - Central Java, NTB - A variation of the extensive herding system described above is being promoted in the Kendal area by the Dinas Peternakan of Central Java and as part of the Provincial Development Program in NTB. In this modification the activities of the "breeder", "hatcher" and "herder" are combined with a smaller flock of 50 layers being maintained and fed in confinement. Muscovies are still used to hatch ducklings and immature ducks may be herded in a manner similar to the previous system. Costs for feed ingredients and prices for products are shown in appendix table 3.44. In this system, feed for the confined laying flock becomes a major input in terms of labor cost and purchased ingredients. A producer in Wieri, Kec. Kendal, was feeding his flock on a mixture of rice bran (7 kg per day at Rp 50 per kg), small fish (4 kg per day at Rp 150 per kg), and water weeds (0.7 kg per day at Rp 25 per kg). The total feed costs per day for the laying flock totaled Rp 967.50. Current production for the mature flock was 25 eggs per day (50% laying rate). An enterprise budget for this system is shown in appendix table 3.45. Assuming an average net production of 120 eggs per layer per year after hatching needs and home consumption are met (this is low to moderate for Tegal ducks) and a sale of 24 cull ducks per year at Rp 1,250, the total income for the 50-duck flock is Rp 630,000. No value is assigned to the value of male ducklings sold nor the manure produced by the flock.

3.125 Non-labor costs include a fixed cost for housing assumed to be Rp 50,000 amortized over 5 years. The flock is replaced every 2 years though this may be stretched to 2.5 years. A market value for locally produced 6-month old ducks of Rp 3,750 each is used to calculate replacement costs for producers who hatch and raise their own ducklings. If feed costs are



110

assumed to average Rp 1,000 per day for the 50-duck flock, fixed and variable costs total Rp 468,750 per year resulting in a net return to the farmer for his labor and management of Rp 161,250.

3.126 Intensive commercial duck egg production - Kec. Hulu Sungai Utara, South Kalimantan - An intensive duck egg production system with Alabio ducks is described by Vondal (1983) for Kecamantan Hulu Sungai Utara in South Kalimantan. The intensive system described by Vondal differs from that of Kec. Kendal in two basic components. First, in South Kalimantan specialized farmers rear young ducklings purchased from hatchers at age 1 to 10 days and sell them to market egg producers at age 6 months (or somewhat earlier). Some more skilled market egg producers will economize by purchasing young ducklings and raise them themselves. The market price for 1- to 10-day-old ducklings in 1982 was quoted at Rp 500-600 each, as opposed to Rp 4,000 for a 5- to 6-month-old duck ready to produce eggs. Second, laying ducks are kept caged and concentrates are purchased to supplement locally available feed resources such as fish and snails.

3.127 In this system, the feeding of young ducklings involves various combinations of purchased inputs, primarily consisting of commercial concentrate duck feeds and vitamin-mineral pre-mixes which are combined with locally available sago palm, snails, small fish, rice and rice bran. Young ducklings are fed rice bran and/or chopped sago, and fresh cooked fish, and/or chopped snail meat. This may be supplemented with small amounts of cooked rice and mineral-vitamin mix. At 2.5 to 3 months of age, the diet of the immature ducks is changed to either rice bran or chopped sago, or a combination of the two. All other ingredients are eliminated, but ducks are allowed to forage in the surrounding swamps during the day and are caged only at night. At 6 months of age, the Alabio ducks are permanently caged and egg production begins. Chopped snails and cooked fish (either fresh, dry, or in combination) are restored to the ducks' diet mixed with rice bran. This basic diet is supplemented by swamp plants and packaged vitamin-mineral pre-mix.

3.128 Greater economic efficiency is acheived in the intensive system by harvesting a greater amount of the feedstuff fed to the duck flock rather than purchasing it. This involves a substantial input of family labor. Catching fish during the day and harvesting snails at night may be done by an older male family member. The wives and older children prepare the feed in the morning. The women sell the eggs in the local village markets.

3.129 Many families are reported by Vondal to manage two flocks of different ages in order to insure a continuous cash flow from the sale of eggs. This may not be possible for the farmers who must plant and cultivate rice during the dry season from May to November. Appendix table 3.46 from Vondal's study compares non-labor cash costs for purchasing a flock of 3-day old ducklings versus purchasing 6-month old ducks ready to lay eggs. While the cost of the older flock is 26.8% higher than the duckling flock, the decision whether or not to raise ducklings or buy older birds is largely based on the availability of labor and the producer's estimate of his skill in raising young birds.

3.130 Santoso and Suradisastra (1979) analyzed costs of production and returns on labor and investment for Alabio duck market egg operations of up to 100 ducks (scale I) and 100 to 200 ducks (scale II) in kabupaten Hulu Sungai Utara, South Kalimantan. Nineteen and 28 operations were monitored, respectively. The production rates of 47.3% for scale I producers and 55.2% for scale II (appendix table 3.47) reported by them are lower than those reported by Vondal (1983), Robinson, et al. (1977) and others; however the flocks being recorded by Santoso and Suradisastra may have been in an advanced stage of maturity.

3.131 In appendix table 3.48 are reported monthly non-labor production costs including feed, replacements, housing and equipment. Small scale I producers had higher costs for all factors, clearly indicating that size has a substantial effect on market egg production. This effect is carried through when monthly returns for labor and management are compared in appendix table 3.49. Small scale producers had a net income after non-labor costs of only Rp 60.2 per duck compared to Rp 502.9 for larger scale producers. Santoso and Suradisastra conclude that the lower performance of the smaller scale producers is due to the greater percentage of of immature birds in the their flocks (28.2% vs. 10.1% for the larger flocks) which leads to higher feed costs per unit of production.

3.132 Hetzel and Gunawan (1984) compared two systems of market egg production with ducks, extensive and intensive, at Karawang, 70 km east of Jakarta. Two extensive producers (E1 and E2) herded Tegal and Tegal X Alabio ducks on harvested paddy. The same breeds plus Bali and Khaki Campbell ducks were fed various combinations of rice bran, corn, prawn heads, oil meals, shell grit and whole paddy in two intensive systems (I1 and I2). Results for egg production to 80 weeks of age are shown in appendix table 3.50. In general no significant difference was seen in the age of maturity (age at which 5% production was reached) between breeds or between production systems. Only the Tegal ducks in I2 showed any difference in peak production. Peak production was reached at a later stage in the extensive system than in the intensive. This result, plus a wider fluctuation between peak and molt production in the extensive compared to the intensively managed ducks was attributed to the inconsistency in feed availability for the herded ducks. The Indonesian breeds went into a molt in early January (E1 and E2) or late December (E1, E2 and I1). All ducks in I1, except the Khaki Campbells, started to molt heavily in the end of November. This late November/early December molt and decline in production is similar to that found by Hetzell (1984) for Indonesian ducks managed intensively at Ciawi. That report postulated that changes in rainfall and humidity levels triggered molting in Indonesian ducks. It is most likely that both climatic and nutritional factors contribute to the molting .pa phenomenon. As Khaki Campbell ducks at I2 did not molt and decline in production while the Indonesian breeds did, a genetic effect is also a possibility.

3.133 Feed costs and gross margins were recorded for all breed groups in the four flocks (appendix table 3.51). Results showed that feed costs per duck were lowest for the extensive systems (E1 and E2). Feed costs were highest, and gross margins (income over feed costs per duck) were lowest for I2 except for the Khaki Campbell ducks where production was highest. Prices received for Khaki Campbell and Bali duck eggs, both of which are white, were 20 to 30% lower in the marketplace than the prices received for the green eggs of the Tegal and crossbred ducks.



112

7. Miscellaneous species

a. Swine

3.134 About 90% of the people of Indonesia are Muslims resulting in a small demand base for pork. The demand situation is not expected to change in the future. For this reason, the number of pigs in Indonesia is only about 3.6 million head. The greatest number are found in Bali, NTB, NTT, Sumatra, Kalimantan and Sulawesi. Because of the small demand base for pork and the tendencies of both large and small producers to maintain excess numbers of breeding sows, the demand-supply equilibrium is often out of balance. When supply is high and the price low, many producers delay the mating of their sows until the excess supply is diminished. Then mating is resumed in an attempt to take advantage of increased prices. Several producers interviewed by the study team indicated that timing of the supply-demand relationship so as to obtain higher prices for pork is more important for success than good production practices. During periods when sows are not being mated, they are fed economical rations at low maintenance levels in order to maintain them in good breeding condition at the lowest cost.

1) Uses of Swine

3.135 Pigs, like large and small ruminants, are a source of income on mixed farms of non-Muslim smallholders and for small and large specialized commercial swine producers. The latter are found principally around the large cities and market their product to the Christian Chinese populations. Pigs on small farms also have an important role in providing manure for home gardens and in some cases for the production of biogas.

3.136 In some social groups, such as those found on Irian Jaya, the socio-cultural role of the pig is of greater importance than its role in providing food and income. Pigs are slaughtered for group celebrations (selamatan) such as religious holidays, weddings and birthdays. They are often the principal medium of exchange for bride price. The more pigs a man has, the more wives he is able to afford, resulting in a greater number of children and higher social standing. In many of these societies, no income is derived from the pig production activity. Despite the predominant socio-cultural role of pigs in Irian Jaya, some clan members have developed small-scale commercial production units.

2) Breeds and Productivities

3.137 Rollinson and Nell (1974) discuss swine production potential in Indonesia along with the different breeds found in the many islands. There appear to be three recognized breeds of swine as follows:

- The Java pig that results from the crossing of European breed boars with the indigenous sows. The original stock was fat and slightly swayback. They wore a heavy mane of bristles on the neck and had a long snout. However, one rarely sees the native pig now because successive mating with European boars has produced offspring which closely resemble the European breeds.



113

- The Bali pig is of the Chinese type exhibiting an extreme swayback condition. The bellies of pregnant sows usually touch the ground. The Bali has black and white skin with many folds. It is a slow-growing pig that matures early and produces a small and fat carcass with a low percentage of lean meat.

- The Sumatra pig is probably dervied from the East Indian pigs and is related to the feral pigs still found in the jungle. This pig has black hair and short ears.

3.138 Swine production on Java is for the most part in the hands of producers who maintain herds of several hundred sows. Large-scale producers are also found around Medan on Sumatra. These producers operate input-intensive production units which have adopted most of the modern equipment and management technology developed in Australia, Europe and the United States and have acheived production efficiencies (e.g., kg pork produced per sow, feed conversion ratios) which do not significantly differ from their counterparts in those countries. The breeds used are principally Duroc, Hampshire, Yorkshire and Landrace (Large White). Foundation breeding stock is imported largely from the United States, Japan and Australia. Their locations around large cities allow them to take advantage of agro-industrial by-products such as rice bran and soy curd waste ("ampas tahu"). This lowers the cost of feeds. Their locations also allows for direct marketing which reduces their susceptibility to fluctuations in the supply-demand cycles and their effects on pork prices.

3.139 On the outer islands, pig production is largely in the hands of smallholders whose management practices are "traditional". Pigs in most cases are scavengers of the available wastes from the household or marketplace. On Bali, pigs are maintained in pens and fed on diets of rice bran, copra meal, and waste fruits and vegetables. In some areas of other islands, such as Irian Jaya, pigs are kept in fenced pastures near the home where they graze on the native grasses and legumes, and are fed root crops twice daily. Pig producers in Irian Jaya grow two varieties of sweet potatoes, one for the pigs and one for family consumption. The pigs' sweet potato diet is often supplemented with waste vegetables (cabbage, carrots, etc.) and fruit (papaya, mango). In all cases, such "village" pigs are slow-growing and yield fat carcasses that are low in lean meat. This is a result of the lack of selection for production characteristics and diets low in protein. Farmers who opt for improved production generally acquire exotic breeds such as the Hampshire "Saddleback" or the Landrace. Introduction of these breeds may actually result in reduced productivity because of the larger size of the exotic breeds and the lower reproductive efficiency relative to the native pigs.

3.140 A summary of production characteristics of Indonesian pigs is found in appendix table 3.52. Production data on commercial units on Java, Sumatra, NTT and the Malukus are included with traditional farms. All commercial units that were surveyed were using either high-grade or purebred pigs and were obtaining similar production efficiencies.

3.141 There have been very few studies on swine production in Indonesia. However, development projects are underway on NTT and the UPT station in North Sumatra has initiated studies on swine used in that province.



114

C. Survey results

1. Draft power

3.142 The ADB/DGLS survey asked about modes of cultivation for each of the major crops. The farmer was asked to specify if the mode of cultivation was used totally, mainly, sometimes, or never for a particular crop. Survey results are summarized below, using averages for all provinces:

Table III.4: Percent response for mode of cultivation by crop [a]

| Mode | Response | Rice | Peanut | S. Pot. | Soybeans | Corn | Cassava |
|---|---|---|---|---|---|---|---|
| Manual: | Total | 72 | 78 | 72 | 52 | 51 | 72 |
| | Mainly | 21 | 15 | 16 | 37 | 34 | 21 |
| | Sometimes | 4 | 7 | 10 | 11 | 10 | 5 |
| | None | 2 | 0 | 2 | 0 | 5 | 2 |
| Tractor: | Total | .2 | 0 | 0 | 8 | 5 | 3 |
| | Mainly | 0 | 0 | 0 | 1 | 1 | 0 |
| | Sometimes | 7.4 | 0 | 0 | 9 | 4 | 7 |
| | None | 92.4 | 100 | 100 | 82 | 90 | 90 |
| Animal: | Total | 5 | 26 | 0 | 20 | 13 | 5 |
| | Mainly | 9.5 | 7 | 14 | 28 | 22 | 10 |
| | Sometimes | 20 | 9 | 20 | 17 | 17 | 20 |
| | None | 65.3 | 58 | 66 | 35 | 48 | 65 |

Source: Tabulated from ADB/DGLS survey.
[a] Totals do not add due to rounding errors, incomplete responses and missing data.

3.143 As this table indicates, the use of draft animals varies widely among crops. This was confirmed by the team's field observations, which also found draft animal usage less than anticipated. Over one-half the farmers for 4 out of the 6 crops listed in Table III.4 never used draft power.

2. Manure

3.144 Chapter II indicates that a major reason farmers hold animals is for the production of manure. Average quantities applied for some of the major crops in the ADB/DGLS survey are given below (kg/ha/crop):

| | |
|---|---|
| rice - 358 | peanut - 798 |
| cassava - 275 | soybean - 565 |
| corn - 282 | sweet potato - 106 |
| cloves - 1190 | coffee - 97 |

### 3. Herd/Flock composition and productivity estimates

3.145 This section synthesizes data obtained from several sources, including the ADB/DGLS survey, national livestock census estimates and other authors' estimates. Population estimates upon which parameters were calculated were average numbers of stock per category (adult males, adult females, young stock), rather than the initial inventory of animals. Estimates of purchases/gifts, deaths, sales/barter/gifts, and consumption were assumed to represent transactions over the past year. These were expressed in percentage terms.

3.146 The summary parameters are provided in table III.5 for cattle, water buffalo, sheep, goats, and pigs. The figures for poultry were not consistent and must have reflected the inclusion of a few large commercial units which distorted the figures.

3.147 Cattle: It is estimated that about 65% of the total families surveyed had cattle. Since this percentage is much higher than the agricultural population as a whole (22% from table I.3), it is concluded that the survey was not a random survey of all agricultural households, but instead was a survey of livestock producers. This undoubtedly pushed some of the other percentages higher than those that would have resulted from a census survey of agricultural households in general. The high percentage for cattle is also a result of more government involvement in cattle projects than with other species. Since the enumerators were government officials, some bias would be expected towards cattle producers and towards farmers involved with government projects.

3.148 Figures on average head per farm with that species and class of animals showed beginning (approximately one year ago) numbers of adult male cattle at 1.39 head, female adult animals at 1.56 head, and young stock at 1.18 head. Ending figures (numbers at time of survey) for adult males were 1.31 head compared to 1.50 for adult females and 1.62 for young stock. Differences between beginning and ending stocks were not consistent with numbers of animals added to the total through purchasees and birth and numbers subtracted through sales, consumption and deaths. This was true for all species and categories.

3.149 Purchases as a percent of total animal numbers was implausibly high for all species and classes as well, and for adult animals exceeded the percentages of animals sold by wide margins in every case. This may be due to farmers associating the enumerators and the survey itelf with the government and with taxation; thus the tendency to underreport sales (and income).

3.150 Cattle mortality rates and birth rates seem reasonable based upon results of other published data and upon the team's field observations. The 24% of total animals held as adult males reflects the use of these animals for draft purposes is some regions, as well as the holding of these animals as a store of wealth and for the production of manure.

3.151 Water buffalo: The survey percentage of farmers holding water buffalo (15%) is also much higher than the census figure of 5% (table I.3) due to the factors cited above. Even a larger proportion (28%) are held as adult males, reflecting the concentration of buffalo in districts where wet



116

Table III.5: Estimated herd/flock parameters based on ADB/DGLS Survey data

| Item | Cattle | Water buffalo | Sheep | Goats | Pigs [a] |
|---|---|---|---|---|---|
| Approximate % of survey farms with that species [b] [c] | 65 | 15 | 10 | 22 | 13 |
| **Adult males** | | | | | |
| Ave. beginning no./farm | 1.39 | 1.36 | 1.23 | 1.88 | 1.02 |
| Purchases as % animal nos. | 71 | 62 | 98 | 52 | 58 |
| Mortality rate (% ending no.) | 6.3 | 7 | 23 | 14 | 17 |
| Sales as % animals nos. | 24 | 37 | 25 | 33 | 19 |
| Home cons. as % animal nos. | 6 | 1.8 | 33 | 7 | 18 |
| Ave. ending no./farm | 1.31 | 1.11 | 1.58 | 1.74 | 1.01 |
| % of total animal nos. | 24 | 28 | 23 | 22 | 11 |
| **Adult females** | | | | | |
| Ave. beginning no./farm | 1.56 | 1.58 | 2.07 | 2.14 | 2.01 |
| Purchases as % animal nos. | 67 | 57 | 102 | 38 | 35 |
| Mortality rate (% ending no.) | 3.1 | 5.5 | 6 | 5 | 19 |
| Sales as % animal nos. | 9.3 | 16 | 21 | 20 | 21 |
| Home cons. as % animal nos. | 3.3 | 0 | 1 | 0.1 | 8 |
| Ave. ending no./farm | 1.50 | 1.50 | 2.01 | 2.34 | 1.94 |
| % of total animal nos. | 49 | 47 | 40 | 51 | 27 |
| **Young stock** | | | | | |
| Ave. beginning no./farm | 1.18 | 1.08 | 1.93 | 2.26 | 5 |
| Purchases as % animal nos. | 39 | 37 | 19 | 28 | 84 |
| Birth rate as % adlt females | 41 | 24 | 95 | 50 | 4.44 |
| Sales as % animal nos. | 20 | 8.5 | 26 | 36 | 99 |
| Mortality rate (% ending no.) | 8.1 | 14 | 25 | 18 | 40 |
| Home cons. as % animal nos. | .01 | 0.57 | 19 | 13 | 6 |
| Ave. ending no./farm | 1.62 | 1.46 | 2.43 | 2.43 | 6.45 |
| % of total animal nos. | 27 | 25 | 37 | 27 | 62 |
| Mortality rate, all classes | 5.3 | 8.5 | 17 | 10.6 | 32 |

Source: ADB/DGLS (1985)

[a] For pigs, average litter size of surviving pigs was 4.44 on an annual basis.

[b] Calculations are based on the numbers of farms with animals in that particular class.

[c] These percentages are only approximations. Counts were taken by class of animals only with the result that there was no way of calculating how many farmers held more than one class of animals.

rice cultivation predominates and where buffalo are utilized as draft animals. Home consumption of buffalo meat is very low over all classes. The birth rate is much lower than cattle, reflecting the fact that there is a higher proportion of males in the survey population, the lower reproduction rates cited for buffalo in many articles, and the heavy use of females for draft power, which reduces their birth rate. Young buffalo mortality rates are almost double those of cattle, highlighting another area where buffalo productivity could be improved.

3.152 Sheep: The percentage of survey households with sheep (10%) is much lower than the national figure for sheep and goats (combined) of 25% (table I.3). This reflects the fact that the survey covered an equal number of farms in each province while most of the sheep are concentrated in just a few provinces on Java. Average numbers per holding are also smaller than in table I.3, probably reflecting the same factor as above. Reproduction, calculated as lambs born on survey farms during the past year divided by the average numbers of ewes held, was 95%, reflecting the prolificacy of the major Indonesian sheep breeds and the intensive management applied to sheep. As noted in other parts of this chapter, however, there is considerable scope for improvement of reproduction and animal health in small ruminants, and a good research base to support these efforts. The percentage of males is also much higher than needed for reproduction, and reflects the "store of wealth" function. Home consumption as a % of animals in that category range from 33% for adult males to 1% for adult females.

3.153 Goats: The proportion of farms holding goats is closer to the combined figure for sheep and goats in table I.3, and reflects the much wider geographical distribution of goats in Indonesia. Average numbers per holding are also higher than for sheep, but mortality rates for each class are lower, as is the reproduction rate. Home consumption percentages were much lower than those for sheep. The high mortality rates for young stock and low reproduction rates imply significant increases in productivity should be possible.

3.154 Pigs: Comparable data were not available from table I.3. The figure in table III.5 for percent of survey farms with pigs seems far too high. Differences between percent of stock purchased and sold are also implausible. Mortality rates are high, but consistent with the team's field observations of traditional pig production systems. Litter size seems too low based on our field observations where figures of 8 born and 6 surviving were commonly mentioned.

3.155 Other estimates: The discussion in this chapter provides numerous estimates of reproduction by breeds and species, as well as some mortality figures for different classes within species. Estimates from the Bureau of Statistics, based on the 1980 Census of Livestock, provide the the coefficients shown in Table III.6. The estimates in Table III.6 are somewhat more optimistic of mortality rates than the ADB/DGLS survey results (Table III.5).

3.156 Finally, the Repelita planning exercises have used gross productivity estimates to determine probable increases in animal populations. Figures for Repelita III are given in Table III.7.

Table III.6. Herd structure of Indonesian livestock populations by age and sex

| Species | < 3 yrs. | | 3 - 6 yrs. | | > 6 yrs. | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female | Total |
| Cattle | 5.5 | 6.4 | 8.6 | 13.2 | 17.2 | 47.0 | 31.3 | 68.7 | 100 |
| Buffalo | 5.1 | 6.4 | 8.0 | 14.3 | 17.9 | 48.4 | 31.0 | 69.0 | 100 |
| Sheep & Goats | 8.1 | 11.9 | 7.1 | 16.1 | 11.3 | 45.6 | 26.5 | 73.5 | 100 |
| Pigs | 13.9 | 15.9 | 16.1 | 12.2 | 19.7 | 22.7 | 49.7 | 50.3 | 100 |

Source: Taken from ADB Draft Appraisal Report of II Kalimantan Livestock Development Project. Original table derived from DGLS (1983), Informasi Data Peternakan.

D. Outputs from the livestock sector, including impact on output by changing selected herd/flock parameters

3.157 The main outputs from the livestock sector were described in Chapter I, Part E. The survey results presented in Part C, above, gave additional farm-level details about farmers use of manure and draft power. The estimated production and value of farm manure is given in appendix table 3.2. Using the ADB/DGLS survey data, production relationships

Table III.7. Projected population coefficients under Repelita III

| Type of Livestock | Deaths | Births | Slaughter | Population increase |
|---|---|---|---|---|
| Beef cattle | 1.6 | 17.6 | 15.0 | 1.0 |
| Buffalo | 2.2 | 12.3 | 10.0 | 0.0 |
| Goats | 4.7 | 56.7 | 50.0 | 2.0 |
| Sheep | 4.7 | 56.7 | 50.0 | 2.0 |
| Pigs | 16.2 | 73.2 | 55.0 | 2.0 |
| Horses | n.a. a/ | n.a. | n.a. | 0.0 |
| Dairy cattle | 10.0 | 30.0 | 15.0 | 5.0 |
| Local chicken | n.a. | n.a. | 150.0 | 5.0 |
| Layer chicken | n.a. | n.a. | 100.0 | 9.0 |
| Ducks | n.a. | n.a. | 100.0 | 6.0 |
| Miscellaneous birds | n.a. | n.a. | n.a. | n.a. |

Source: ADB Draft Appraisal Report of II Kalimantan Livestock Development Project

a/ n.a. = Data not available determine coefficients between animal stocks (measured in animal units) and selected variables were estimated as well as between crop yields and selected variables thought to influence crop yields.

### 1. Livestock output regressions

3.158 The animals on each survey farm were aggregated into animal units using water buffalo = 1.0, cattle = 1.0, sheep/goats = 0.1, poultry = 0.01. It was assumed that total animal units held per farm was a function of the region (the same 10 regional groupings were used as in the earlier analysis of the survey results), the available labor for livestock production, farm size, total adult family members, and area planted in corn (as a proxy for fodder crops, since maize stover is an important roughage for ru...nants in Indonesia). The observations were provincial means for each variable giving 24 cases. The regression coefficients are given below:

| Variable | Coefficient | Std. Error | t-value |
|---|---|---|---|
| Region (dummy variable) | 9.0817 | 5.2119 | 1.742* |
| Livestock labor | -0.0396 | 0.2097 | -0.189 |
| Farm size | 0.1831 | 0.3230 | 0.567 |
| Adult family members | -0.0025 | 0.0181 | -0.137 |
| Corn area | 0.2959 | 3.5938 | 0.082 |
| Constant | 6.6275 | | |

$R^2$ = 0.5958
* Significant at 85% level of probability.

3.159 These results indicate that other factors than those included in the regression are more useful in explaining variation in livestock units held per farm. The results also would have been improved if we would have been able to easily access the original data, so we could have used individual farm observations rather than provincial means as the unit of observation. Unfortunately, we had neither the time nor the raw data at headquarters to enable us to carry out this analysis.

### 2. Rice yield production functions

3.160 This regression model had rice yield as a function of region, adult family members on the farm, rice area, fertilizer (in kg) applied to rice, and manure applied for rice production. Results are given below:

| Variable | Coefficient | Std. Error | t-value |
|---|---|---|---|
| Region (dummy variable) | 1828.5 | 851.8 | 2.147* |
| Adult family members | 2.77 | 2.4 | 1.143 |
| Area planted in rice | 2932.66 | 1284.3 | 2.284* |
| Fertilizer applied to rice(kg) | 1.17 | 3.8 | 0.305 |
| Manure used for rice prod. | -2633.7 | 0.89 | 0.634 |
| Constant | -2633.7 | - | |

$R^2$ = 0.6951 * significant at 90% level.

3.161 The variables found to contribute significantly to rice yield were region and area. Aggregation of the data was a problem and would



120

account for lack of significance of variables such as fertilizer and manure inputs into rice production.

### 3. Corn yield production functions

3.162 The regression model had corn yield as a function of region, adult family members, corn area, fertilizer applied to corn, and manure applied for corn production. Since corn was not an important crop in some regions, these regressions had a large number of missing observations. Results are presented below, where average corn yield per ha is the dependent variable.

| Variable | Coefficient | Std. Error | t-value |
|---|---|---|---|
| Region | 228.99 | 311.46 | 0.735 |
| Adult family members | -1.03 | 1.55 | -0.664 |
| Corn area | -35.42 | 343.34 | -0.103 |
| Fertilizer for corn prod. | 1.14 | 0.70 | 1.633* |
| Manure used for corn prod. | 0.47 | 0.43 | 1.091 |
| Constant | 403.47 | | |

$R^2$ = 0 5792 * significant at 85% probability level.

### 4. Potential impact of increased productivity on livestock output

3.163 In Chapter VIII it is stressed that a major policy implication of this study is for GOI and donor agencies to focus their efforts on increasing the productivity of the existing livestock resource base. Data reviewed in this chapter indicate that levels of productivity are low. Table III.6 indicates that 47% of female cattle are over 6 years old, 48% of female buffalo are 6 years old or over, and 46% of female small ruminants are 6 years old or over. This implies that far too many animals are held to ages where they are of declining productivity or are producing no offspring at all.

3.164 This is due to three factors: current government policy which forbids slaughter of female animals unless certified as "nonreproductive", widespread use of females for draft power, and use of animals as a store of wealth. From this study, it was impossible to determine the relative strengths of each of these on the livestock population structure, but the first step in a rational livestock development strategy would be a culling program that would free resources for the more productive animals. The increasing price of meat will help with this problem, but government policy must stop focusing on numbers and focus instead on output and incomes. Redistributing animals, the focus of several current projects, will have little overall impact because numbers of animals involved is small and there is no evidence that the productivity of redistributed animals is higher than it was in the area of origination. In fact, chapter VIII presents results which show poor productivity of redistributed animals.

3.165 To get rough estimates of the impact on production from increasing the productivity of the existing stock of animals, calculations based upon figures in table III.2 have been prepared.



2

3.166 For cattle, if FAO figures from 1984 are used, the population is 6.8 million head, of which 60% (table III.6) are females 3 years or over in age, or a total of 4 million adult females. A 1% increase in the annual calving rate would add 40,000 animals to the population. With an average slaughter weight of 157 kg/animal, this would add 6280 tons to the annual meat supply. Current figures for 1984 show 862,000 slaughtered, so this 1% increase in reproduction, assuming 90% survival of offspring, would represent an increase of 4.2% in cattle slaughtered and in meat supply as well.

3.167 For buffalo, comparable FAO figures are 2.4 million head, of which 63% are females 3 years or older, a total of 1.51 million breeding cows. A 1% increase in calving rate would add 15,100 new calves. At a 90% survival rate, 13,600 calves could be grown out and slaughtered. This is an increase of 6.2% in total slaughtering.

3.168 For small ruminants, 12.7 million head, with at least 61% in the breeding age, a 1% increase in the lambing/kidding rate would provide 77,470 more young animals. At an 80% survival rate, 3.3% more animals would be slaughtered.

3.169 Similar calculations can be carried out showing the major impact on meat supply that could be achieved by reducing mortalities, culling unproductive animals, increasing slaughter weights, and decreasing the time between birth and slaughter weight.

3.170 These calculations would also support our arguments (Chapters VIII and IX) that efforts should be concentrated on programs to improve productivity of the current stock of animals, and large scale importation and redistribution programs are not cost effective.

3.171 Another simple herd simulation exercise highlights the constraint of low productivity in meeting sector goals. The 1984 estimated levels of per capita consumption of beef from cattle and buffalo was 2.16 kg or about 346,000 tons of meat. Use 160 kg per animal slaughtered implies total slaughterings of 2.16 million head rom a total herd of about 9.1 million head, or an extraction rate of almost 24%. By contrast, Repelita III used 15% extraction rates for cattle and 10% for buffalo. The above calculation also implies widespread slaughter of female adult animals.

3.172 Continued increases in human population growth and income growth will put even more pressure on the national population of animals, particularly if the real price of meat continues to increase.

## E. Strengths and weaknesses

### 1. Draft/beef large ruminants

#### a. Strengths

3.173 Indonesia has about 9.2 million large ruminants that are closely integrated with smallholder food crop farming systems. Not only are these animals integrated with crop production, but they play a role in the socio-cultural activities of these farmers. For these reasons, they are accorded as good care as these people can provide in keeping with their knowledge of animal needs.

3.174 Indonesia possesses a wealth of genetic resources in both cattle and swamp buffalo. Cattle breeds range from the very small Aceh and Madura breeds to the large Friesians that are used for milk and beef, but not for draft. Intermediate are the Bali cattle, which in reality is Bibos sundaicus, Ongole (Bos indicus) and Brahman crosses. This wealth of genetic resource, which provides both "adapted" cattle and swamp buffalo, has not really been exploited because it remains untested in regard to quantitative measurements to determine how good or how poor performance is in comparison to the world's gene pool. Nevertheless, it represents a great asset that needs to be tested. Preliminary tests on specific breeds, which show wide variations in performance when specific productive traits are studied, indicate that rapid genetic progress could be obtained if selection pressure were applied for such traits.

3.175 In general, reproductive performance in Indonesian cattle is poor. However, the Bali cattle stand out when this trait is considered over a wide range of smallholder conditions of feeding and management. The Sumba distribution plan is spreading cattle to the transmigrants all over Indonesia. Most transmigrants want to receive Bali cattle under this scheme. Many Indonesians believe that reproductive efficiency in Indonesia is related to Bali cattle through a specific trait.

3.176 The swamp buffalo are well-adapted for draft purposes in the swamps and heavy soils of Indonesia. This animal's large size, plodding nature, large feet, extra strength, and temperament suits him for these areas. Also, the swamp buffalo is better adapted to meat production systems in the swampy areas. This is an unique asset.

3.177 The Brahman crosses appear to have characteristics that may make them the animals of choice for ranching under conditions that are developing in South Sulawesi and are expected to develop on other outer islands.

3.178 The young Friesian bulls from the dairy industry appear to be the ideal animal for feedlot fattening operations that are developing around the large cities such as Jakarta and Surabaya. This animal, when placed in the feedlot at about 6 months of age weighing about 200 kilograms, gains at a rate of about 700 grams/day over a 12-month feeding period. At a weight of 450 kilograms, he furnishes a carcass that is suitable to meet the hotel, restaurant and upper middle class meat demand. The demand for such beef is increasing at a rapid rate in these cities.

3.179 Further work by feedlot operators and the results of research also demonstrate that the Ongole animals, if placed in the feedlot at 1 year of age weighing about 200-250 kg, will gain at a rate of about 680 grams/day and will weigh about 450 kg after being fed for 1 year. This animal, too, has a desirable carcass.

3.180 Research work on Bali bulls indicates that these animals also have the ability to grow rapidly and fatten when fed highly-concentrated diets. However, this animal is small; thus at a liveweight in excess of about 300-350 kg, it becomes too fat. This animal could be used in the feedlot if slaughtered at an earlier age and lighter weight. Additional research is needed on this point, but it is estimated that feeding should stop when the animal reaches about 300 kg of liveweight. The Bali animals have more desirable carcass traits than other indigenous animals of Indonesia. These traits would make the Bali carcass desirable anywhere.

3.181 The outer islands of Indonesia, which constitute 93% of the land mass but only 35% of the population, have the land area necessary for rapid expansion of the beef cattle/buffalo industry. If capital, land tenure charges, and experience in handling animals under more extensive conditions were available, this area would offer great potential for development.

3.182 Due to the establishment of several large ranches on Sulawesi, Kalimantan, and Sumatra, Indonesians are gaining some experience in the keeping of cattle under ranching conditions.

b. Weaknesses

3.183 The close association of the draft/beef ruminants with smallholder farmers in the production of food crops and in their socio-economic activities has advantages and weaknesses. About 65% of the large ruminants, as well as 65% of the people of Indonesia, live on Java, Bali, Madura and Lombok, which comprise only about 7% of the land mass. Many of the weaknesses of the industry are associated with this great concentration of people and animals.

3.184 Feed supply consists mainly of crop residues, which are coarse feeds low in digestible protein and energy. Also, these are in short supply. Feed and nutrition are probably the first limiting constraints on draft/beef large ruminant productivities.

3.185 Reproduction rates on the draft/beef large ruminants are low, probably the result of the following:

- Feeding and nutrition
- Low body condition scores of females and males at breeding times, probably a nutrition and parasite load effect.
- Level of work performed during potential breeding periods.
- Ratio of bulls to cows.
- Management factors

3.186 There is a lack of general knowledge by smallholders of the needs of animals for supplementary feed and water. Even though water is usually in plentiful supply, Indonesian smallholders do not provide supplementary water as needed for productive animals. If judicious uses were made of crop residues, legume crops and residues, higher productivities could be obtained.

3.187 The swamp buffalo, the largest of the draft/beef animals, has the poorest reproductive performance, as well as the poorest carcass traits, of all the indigenous animals in this category.

3.188 The knowledge-base for feeding, breeding, and keeping productive animals healthy is in a poor state of development in Indonesia.

3.189 The lack of capital, of a land tenure system that would promote animal ranching schemes, and of experience in ranching are all constraints in the development of ranching schemes where there is adequate land but few people.

3.190 Knowledge of the productive potential of the various breeds of animals and of the cost of environmental changes needed to maximize their production potentials is lacking in Indonesia. For this reason, the design of cost effective production programs is more difficult in Indonesia than in many other countries.

3.191 The lack of practical production experience in the professional leaders in the livestock sector results in less than adequate training programs for producers, processors and distributors of animal products.

3.192 The total infra-structure for draft/beef animal production on the outer islands, where there is potential for ranching, is much less than adequate.

3.193 The predominant role of the private sector in the production and marketing of these species should be maintained, and the focus of any project activities should be on cost reducing strategies to lower marketing costs and improve general levels of animal nutrition and animal health for village based systems. Due to the precarious financial position of most producers, only very low cost strategies should be considered for most smallholders.

### 2. Dairy Large Ruminants

3.194 Strength and weaknesses: The planning and implementation of the dairy development program, even with all the pr blems we have cited, again represents the considerable implementation capacity of the GOI. However, like most other programs reviewed, follow-up has been inadequate on the production side and productivity is at very low levels. These low productivity levels from cows with a reasonable genetic potential represents a gap that should be filled. The above sections make some suggestions about where to start. The first project proposed in Chapter IX should be able to take a more in-depth look at these problems and issues. It would be more cost effective to channel some of the resources targeted for dairy cow imports towards doubling or tripling production levels of existing animals.

3.195 Numerous weaknesses also are evident in milk marketing. High handling/marketing costs reduce prices paid to the farmer and reduce incentive to improve productivity. They also increase consumer costs and reduce growth in demand. Poor product quality was also shown to influence consumer demand for fresh and pasteurized liquid milk products. Only by a concerted effort to tackle problems on both the production and marketing/consumption side will the industry be able to improve its efficiency enough so that it will cease to be a drain on the national budget and will be able to provide a product of reasonable price and quality to an expanding population of dairy product consumers.

3.196 Although the prices for dairy products in Indonesia are relatively high by international standards (see Chapters III and VI for details) and very high relative to Indonesian income levels, the industry has grown because of the stimulus afforded by increasing the effective rates of protection provided to the producers and by large investments of public funds at every stage of the production, collection, and distribution chain. While GOI has legitimate reasons to promote the industry on both economic and social welfare grounds, we feel that there are more cost-effective means by which to establish a more viable and cost-effective industry, and to better attack the current technical problems which plague the industry (See Chapter III). These approaches and recommendations are developed in more detail in Chapter IX.

3. Small Ruminants

Strengths

3.197 Since about 20% of the farms in Indonesia already have sheep or goats on them, some Indonesian farmers have experience in raising small ruminants under the traditional systems of management.

3.198 Although small and slow-growing, small ruminants appear to be adapted to management and environmental conditions in Indonesia. Due to the limited supply and poor quality of feeds offered, the small size is probably the result of an adaptation mechanism, and thus is an advantage under these conditions.

3.199 Indonesian small ruminants will breed year-round which gives them a distinct advantage over the seasonal breeding patterns found in temperate zone small ruminants. Therefore under fair management and feeding three lamb/kid crops can be obtained over a two-year period. With excellent feeding and management along with early weaning of the young, two crops per year is possible.

3.200 Small ruminants have developed some resistance to local diseases and parasites. Also low-cost strategies to control diseases and parasites are under study.

3.201 "Sate kambing" is a favorite dish all over Indonesia. Therefore, there is always big demand for lamb/kids for that purpose and high seasonal demand at Muslim holidays.

3.202 Small ruminants are kept by many landless peasants as a supplemental source of income. This provides a cash flow that is necessary for the purchase of essentials.

Weaknesses

3.203 Productivities of small ruminants are low in Indonesia and the constraints appear to be:

- Small size and slow-growth of sheep/goats.
- Low reproduction rates, probably caused by poor

feeding and low management condition. The shortage of males on smallholder units is always a factor.

- Good animal health practices such as providing clean water and parasite control appear to be minimum.
- High mortality rates in both young goats and sheep.

3.203 Even though the genetic potential of both sheep and goats in Indonesia appears to be much higher than the present growth rates and other productivity traits, there have been no long-term controlled studies designed to characterize the breeds present in Indonesia. Such studies should be initiated as soon as possible.

3.204 Under traditional conditions of management, farmers sell their small ruminants when money is needed for religious and/or social family functions. Therefore, attempts to maximize returns from the growing of small ruminants appear to be minimal. As the religious feasts are known well in advance, extension workers could provide help to farmers in order to obtain maximum weights of their animals for the great feasts, such as Ramadan.

3.205 Feed is undoubtedly the greatest constraint of small ruminant production. Both the quantity and the quality of feeds could be improved by intensive GOI educational programs and by a small subsidy to get farmers started in feeding improvements for small ruminants.

## 4. Poultry

### Strengths

3.206 There are large populations of chickens and ducks throughout Indonesia. Therefore, most farmers have experienced in the traditional management of these birds.

3.207 Indigenous ducks, though an unselected population for egg production, are producing eggs at high levels of production.

3.208 When placed in confinement and fed an adequate ration, the Tegal duck appears to have high egg-production potential, perhaps equal to other breeds that have had a long history of selection pressures for egg production.

3.209 Indigenous poultry appear to be adapted to the present traditional management systems found in Indonesia even though the price paid for this in mortalities of the very young is quite high. Nevertheless, they have survived and furnish a large quantity of meat for Indonesian consumers.

3.210 Indonesian people prefer the meat of Kampung chickens to that of ayam ras, the imported hybrid chickens that are grown under modern conditions of feeding and management. The level of fat in the carcasses of the kampung chicken is low, and this, as well as taste, appears to be a reason for its preference over hybrid chickens.

3.211 The commercial chicken industry in Indonesia is thriving. It is built on the importation of hybrid chickens, both layers and broilers, along with scientific systems of feeding, housing, health care, processing, and marketing. There is a solid infrastructure in place to support this thriving industry.

3.212 Commercial units have also developed in the duck industry, primarily in egg production. However, it is less capital intensive and has smaller units. In many cases, these smaller units are using the less costly inputs of local feed resources (fish, shrimp, snails, etc.) as their protein source. Also, some duck raisers are using sago palm as an energy source. An infrastructure for duck production, although smaller and less sophisticated than that for chicken production, is developing.

3.213 The GOI has taken an active interest in the poultry industry as an income generator for small farmers. It is now extending credit and help to small farmers that have an interest in raising poultry. The Poultry Nucleus Estate Scheme (PIR) is in place and is built around the privately-owned poultry shop. This active participation has both advantages and disadvantages in regard to the prices of poultry products for the consumer.

Weaknesses

3.214 The kampung chicken industry is built around the idea that chickens are scavengers for the household. Therefore, it represents a low input industry in regard to "cost" items. In spite of the use of apparently low-cost inputs, the industry is wasteful of resources:

- Chicks scavenge some high cost human food items.
- Mortality rates of chickens in this scheme is excessive, especially in the period from 0 to 6 weeks of age.
- It is not run as a business, therefore the villagers have no concept of strategic inputs. For example, by confinement, feeding and vaccinations, the high mortality rate experienced during the first 6 weeks after hatching could be avoided or lessened.

3.215 It appears the genetic potential for both meat and egg-production in the Kampung chicken is very low. Therefore, it could require years of research to make it comparable to other genetic resources already available in Indonesia.

5. Miscellaneous animals

Strengths

3.216 Indonesia has both indigenous and imported swine industries in place. Both meet certain needs. Indigenous swine production is in the hands of smallholders where it is a low-cost limited-output industry. In most cases, the swine in this industry play an important role in the socio-cultural activities of the people. Efficient production of meat is secondary to these needs. The modern swine industry is efficient and is comparable to that found in other countries.

3.217 The presence of swine in the country has resulted in a level of expertise in swine production adequate to respond to the needs of certain segments of Indonesian society.

3.218 Even though only a small segment of the total population, which is 90% Moslem, consumes pork, that segment is willing to pay good prices for pork of good quality.

3.219 The horse population is small but plays an important role in certain segments of the indonesian society, especially as power for taxis in areas where roads do not permit motorized vehicles.

3.220 The horses (ponies), are hardy and appear to be well-adapted to the environment.

3.221 Turkey, geese, Japanese quail and other birds , such as the morning dove, are present and meet certain needs of a very small segment of the Indonesian society.

3.222 Rabbits have only recently been introduced to Indonesia but are quickly finding a useful role in the production systems of limited resource farmers. The feed requirements are low and can be met on the farms. At this stage, it appears that most rabbit meat is consumed by the households on the farms rather than being sold in the marketplace. Because the animal protein consumption of the villagers is so low, this industry appears to offer a prospect for improving the diets of those people.

Weaknesses

3.223 The research, extension, and production-oriented people in the DGLS and the provinces, in reality, have spent very little effort in studies on swine production, genetic potential, health programs and the like. The industry has more or less developed on its own. Fortunately, the large producers have imported technology along with breeds.

3.224 The indigenous swine breeds are small and slow-growing animals that produce fatty carcasses with little lean meat.

3.225 Smallholders have very little, if any, knowledge of the operation of a swine industry that would emphasize efficient production.

3.226 The ponies present in Indonesia are small and would appear to offer very little potential for draft purposes such as pulling plows for land cultivation. However, it would not take a long time to initiate an effective upgrading program for size if these animals are to find wider use in draft purposes.

3.227 The experiences in rabbit-growing by extension personnel appears to be limited so far to rabbit promotion endeavors of Christian Missionary groups.

3.228 Given the potential productivity of both the native and improved chicken there appear to be no good reasons for an extensive program to promote the productions of geese, turkeys, quail, and doves.

# CHAPTER IV. FEED RESOURCE BASE

## A. Agricultural Resources and Their Contribution to the Animal Feedstuff Base

### 1. Land use classification

4.1 Out of approximately 130 million hectares of arable land, croplands cover some 29 million hectares. Approximately seven million hectares are planted to perennial crops, nine million are dryland and eight million are wetlands (including rainfed) suitable for rice. Secondary crops including maize, cassava, soybean, peanut, sweet potato and mungbean, cover more than 5.0 million hectares. In addition, 2.5 million hectares of home gardens are devoted to vegetable and horticultural crops and 0.5 million hectares are planted in vegetables (chili peppers, shallot, onions, cabbage, potatoes, etc.) and fruit crops (banana, mango, citrus, papaya, pineapple). Appendix tables 4.1, 4.2 and 4.3 show harvested areas, yields per hectare and total production of the major food, vegetable and estate crops for the years 1974-1976 and 1982 through 1984.

### 2. Soils

4.2 The Soils Institute, a branch of the Agency for Agricultural Research and Development (AARD) located at Bogor, surveys and maps soils. Indonesia's soil classifications follow the FAO system which is an international scheme developed in 1974 for the FAO-UNESCO Soil Map of the World. For the most part, Indonesian soils fall into the following categories:

- Red-yellow soils including podzols, ferrasols, and ferraginous soils: These are distributed most widely in Indonesia, covering about 51 million hectares or about 27 percent of the country's land area. Approximately 75 percent of the soils in Sumatra and Kalimantan fall into this category. These soils are of low fertility, poor structure and easily erodible. However, the soils are suitable for rice and secondary crop production where water is available.

- Higher fertility andosols of volcanic origin: These soils account for about 1.3 million hectares in North Sumatra and over extensive areas of Java.

- Regosols of recent volcanic origin: These soils are less fertile than the andosols described above. They cover about 170,000 ha, mainly in Java and Bali. They are permeable because of sandy and loamy texture. As a result, cropping is limited to the rainy season.

- Hydromorphic and alluvial soils: These soils are suitable for arable production when well-drained; however many are waterlogged.

4.3 The transmigrant farmers assigned to the red and yellow podzolic soils, such as occur in parts of Sumatra, Sulawesi and Kalimantan, are less



130

fortunate than those on the more fertile andosols and regasols of volcanic origin. The red and yellow soils are inherently less fertile and more acidic than the loam and sandy- or clay-loam soils of the lowlands. They are more difficult to cultivate and manage. Not only will rice yields be lower, but the production of native and naturalized grasses and other materials for feedstuffs will also be lower. The basic ration of cattle in these areas is cut-and-carry forage, often transported long distances even after improved grass species are established.

4.4 Detailed soil maps are available for Java and the larger islands, but soil surveys and classifications have not been completed for all of the smaller islands.

4.5 On the outer islands, soil surveys are an integral part of developing transmigration strategies at both the macro- and micro-levels of planning. To a large extent, these surveys determine where transmigration sites will be located and aid planners in the identification of areas best suited for rice and secondary crop production. In S.E. Sulawesi several agencies collaborated in identifying land most suitable for rice production based on soil surveys. These included the Directorates of Livestock Services and Crop Production Services, the Regional Planning Board, Home Affairs, and the Bank of Indonesia.

3. Land use patterns

4.6 Land use patterns by province are shown in appendix table 4.4. In general, flat lowlands are devoted to rice production while drylands located at the higher elevations are used for secondary crop production. Much of the land area devoted to rice is double-cropped. Villages are concentrated in the more fertile lowland areas, consistent with both the agrarian nature of the country and small scale of agricultural production. This is particularly evident on Java, Bali and Lombok and in Lampung and parts of South Sulawesi.

4.7 A comparison of physical land feature and land use maps indicates that slope limits land use more than any other single factor. In some regions, lack of rainfall becomes the over-riding factor such as in the dry climate of East Timor and parts of West Timor.

4.8 Land use in Java, Bali and Lombok differs substantially from that of the outer islands. The scarcity of forests found on these three islands compared to predominance of forest lands on the outer islands reflects the high population density and intensive land use.

4.9 Provincial land use maps disclose cultivation patterns which are closely linked to population density. Where population is sparse, (e.g. parts of Kalimantan, Sumatra, Sulawesi and Irian Jaya) shifting cultivation is still practiced. Extensive grasslands of "imperata" (*Imperata cylindrica*, "alang-alang in Bahasa Indonesia) in South Sumatra, Jambi, West Kalimantan and Southeast Sulawesi indicate that forests were cut at one time in these areas. However, more intensive land use has taken place as population increases, particularly at the lower elevations. Land use pressure will become increasingly evident in some parts of the outer islands as transmigration is accelerated.

4.10 The following discussion describes cropping patterns using the Agraria classification: wetlands, dryland, estate crops, mixed garden, forest, grassland and other lands.

a. Wetlands

4.11 Rice is the dominant crop in the wetlands and the most important staple food for the majority of Indonesians. Land utilization patterns, by island, is presented in appendix table 4.4. The country's rice production tripled in the last 20 years, to an estimated 25.5 million tons of milled rice in 1984. This production increase transformed Indonesia from a major rice importer in 1977 to self-sufficiency in this essential crop. Increased rice production was stimulated by introduction and promotion of high-yielding rice varieties from IRRI and in-country breeding programs and by expansion of land area cultivated through the tra nsmigration of rice farmers from Java and Bali to the outer islands. The goal of self-sufficienty would never have been attained, however, without government support and subsidies. The rice area is concentrated in Java which accounts for 52% of the rice area planted in Indonesia (appendix table 4.4). About 75% of the rice land in Java is irrigated, compared to 40% outside Java.

4.12 Farmers plant rice wherever water abounds and conditions are favorable, under both irrigated and rainfed conditions. Of Indonesia's 7.9 million hectares of wetland rice, four million, or 57%, are irrigated. Most of the remaining area is rainfed and 6% is tidal swamp. Irrigation or conserved rain water permits two harvests per year in ab out 2.6 million hectares or 37% of the wetland rice. In addition, secon..ary crops are planted to utilize residual moisture. Where year-round irrigation is available, five crops of rice can be harvested in two years.

4.13 On sloping land, one to two crops of rice are grown each year depending on water availability a. the time of land preparation. A major portion of the upland rice-growing area, however, supports only one crop per year. It should be noted that wetland exceeds dryland in all provinces of Java except Yogyakarta, and on Bali and Madura. Although the data do not indicate the use of dryland for rice, fa ers plant this crop wherever possible.

4.14 Rice cultivation on the outer islands is generally less intensive than Java. The area planted in rice varies among provinces. In South Kalimantan and South Sulawesi it is under 10%. A greater proportion of land is devoted to rice production in East, West and South Sumatra, Lampung and Aceh, largely the result of transmigration from Java and Bali.

4.15 The Agraria data do not show two rice harvests per year on many islands (e.g. South Kalimantan). Short-season high-yielding varieties used in irrigation schemes and reclaimed coastal swamplands, however, make it possible for farmers to obtain two rice harvests per year.

4.16 High land use efficiency of continuous rice and rice-secondary crop production results from sequential land use during the year and intercropping of secondary crops, particularly in the densely populated areas. In addition, bunds are used for growing food crops such as fresh beans and cucumbers on trellises, peanuts, mung beans, soybeans, peppers, cassava, maize. *Sesbania grandiflora* may be planted for its flowers eaten as a vegetable and leaves fed to animals. Alternatively, native and naturalized grasses may be allowed to grow on bunds, to provide a source of cut-and-carry animal feed.

4.17 In the terraced uplands, various food crops may be grown on the tops of terraces but more commonly native vegetation covers the terrace tops and embankments, an important source of cut-and-carry animal feed. In some areas the tops of terraces are planted with improved grasses such as elephant grass (*Pennisetum purpureum*) and setaria (*Setaria anceps* and *S. splendida*) or a shrub legume (*Leucaena leucocephala*). These are also used for cut-and-carry animal feed, along with the native vegetation growing on embankments. This cover provides an effective soil conservation practice as well as livestock feed.

4.18 Rapid turn-around between rice-rice and rice-secondary crops increases land use efficiency, particularly with a rice-rice cropping sequences. In some instances, the time from harvest to transplanting may not exceed one week. In some regions the turn-around time is accelerated by use of tractor power for land preparation.

### b. Drylands

4.19 In the areas denoted as drylands, cropping systems are closely related to seasonal rainfall and available water. They extend from sea level to over 1,000 m. In some areas the drylands have become, or are approaching, fragile lands because of poor management practices. While countrywide the percentage of drylands is low, it has increased where population pressure has become more critical (e.g. Bali and Java). Yogyakarta, particularly, has a high percentage of dryland.

4.20 While rice is cultivated in some areas designated as drylands, maize and cassava are more common. These same crops also are grown in wetland rice-based systems where they are denoted as "secondary" crops.

#### 1) Maize

4.21 After rice, more land is planted in maize than any other crop. It is widely planted in the uplands and drylands. Production in 1983 exceeded 5 million tons of dried grain for the first time, rising from 2.6 million tons in 1976. Country-wide yields averaged 1.69 tons per hectare. High yielding varieties from AARD bred for disease resistance have produced up to 3.8 tons per hectare. A hybrid developed by Cargill, and called C 1, yielded up to 5.8 tons per hectare under small plot research conditions.

4.22 Maize is largely used for human consumption, first as fresh-boiled or roasted ears, and then as dry grain. In recent years, however, some of the grain has begun to move into the feed industry, particularly for poultry rations. The white grain type accounts for most of the crop, but the yellow type has gained acceptance in some regions. Undoubtedly, this trend will continue as hybrids become more accepted and available.

4.23 Several plant fractions of maize -- stalk and leaves (stover), ear husk and cob -- provide an important source of forage for ruminants. Smallholders in some areas cut the fresh stalks just above the ears prior to maturity and feed them to cattle. The residues of interplanted grains and food legumes are also used as feed.

2) Cassava

4.24 Some 1.3 million hectares was planted in this root crop in 1984, the third largest area. The area probably exceeds this figure since cassava mixed with maize is often reported as maize. Cassava is primarily cultivated for its root however leaves are also eaten. Cassava is widely grown in home gardens, on rice bunds, intermixed with maize and other crops, along field boundaries, and in monoculture. The animal feed from this crop includes fresh leaves, fresh and dried roots and the residue from the production of cassava starch.

3) Food legumes

4.25 Among the food legumes, peanuts occupy a prominent position. Shelled nuts are used for human consumption while vines are fed to animals. The crop is widely grown in sequence with rice and intermixed with maize. There is no peanut oil extraction in Indonesia and thus no peanut meal or cake.

4.26 Soybean hectarage continues to increase and will be given additional attention during the REPELITA IV as the GOI strives to increase production of this food crop. At present some 400,000 tons are imported annually. Soybeans are used for tempe and tofu on some islands, and the waste sometimes is used for feed. After grain harvest, the dried plants are collected and fed to cattle and goats, even though most leaves have shattered. Soybeans are not crushed for oil in Indonesia.

4.27 Mungbeans are widely grown for bean sprouts and the dried beans are cooked for mixing with other foods in some places. This crop grows and matures in 40 to 60 days. In some regions, it precedes and follows rice. In addition, it is grown on rice bunds and terraces, and is interplanted with maize. The leaves readily shatter as the grain matures. Nonetheless, the stalks are often used for animal feed after harvest of the pods.

4.28 Other food and grain legumes include:

- cowpeas (Vigna sp.): This legume is generally interplanted with maize. The leaves and vines are cut for animal feed or grazed after grain harvest.

- dry beans and lima beans (Phaseolus spp.): These are managed the same as cowpeas.

- pigeon pea (Cajanus cajan): In drier regions, pigeon pea is mixed with maize or grown along field borders. Plants are cut for animal feed or browsed after pods are removed.

- velvet bean (Mucuna prueriens) is mixed with maize or cassava. The grain is used for tempe and livestock graze the vines.

- long bean (*Vigna sp.*) is grown on trellises after rice, on rice bunds and in home gardens. Vines are fed to livestock after the fresh beans are harvested.

- lablab or dolichos bean (*Lablab purpureus*) is usually trellised close to the house for use as fresh beans. Vines are fed to animals,

- winged bean (*Prosocarpus sp.*) is planted around the household. In some areas the fresh pods are eaten as a vegetable. In others, seeds are used for making tempe. Vines are fed to animals.

#### 4) Sweet potato and pumpkin

4.29 Sweet potato is widely adapted and grown throughout Indonesia, probably more than the reported 260,000 hectares since many elevated beds are located in out-of-way places. This crop follows rice and is mixed with maize, grown in the home garden, along roadways and in non-cultivated areas. Although the leaves and roots are primarily used for human food, both provide a source of animal feed.

4.30 Pumpkins are mixed with maize, grown in home gardens and on waste land. They provide a source of human food and livestock feed. Animals will consume the entire pumpkin including seeds.

#### 5) Other vegetables

4.31 Various vegetables are grown as speciality crops, usually in monoculture, in a rice-based cropping system or as a main crop at higher elevations. They may also form a part of maize-based cropping systems, being intercropped or included in home gardens. The residues are frequently used as animal feed (e.g. leaves of cabbage, carrots, vines of peas).

### c. Estate crop land

4.32 This area ranges from sea level to over 1000 m and supports such plantation crops as coconut, rubber, coffee, clove and other spices, oil palm, sugarcane, tobacco, tea, cacao, etc. Appendix table 4.3 shows the relative importance of the various estate crops. Citrus and bananas, also considered plantation crops in many countries, are found in smallholdings in Indonesia.

4.33 Coconuts: Coconut plantations occur along coastlines on the poorer sandy and silty soils and extend inland to elevations of about 400 m above sea level. Native grasses and herbaceous, low-growing woody species are found covering the ground under coconuts for the most part. While the ground cover provides grazing for all types of livestock, neither the coconuts nor ground cover is well-managed in many regions so that nut and forage yields are low. In many plantations, woody shrubs frequently cover the ground, interfering with coconut harvest and reducing grazing available to livestock.

4.34 _Rubber_: Rubber plantations are generally cropped during the early years of establishement, even though they occur on rolling and sloping topography. As the trees develop and produce shade a legume, such as _Calopogonium mucuonoides_ ("calopo"), is planted for ground cover. Other legumes, such as _Centrosema pubescens_ ("centro") and _Pueraria javanica_ ("puero") also can be observed. In addition to soil conservation, ground covers add nutrients to the soil through bacterial nitrogen fixation associated with root nodules. Grazing is not common presumably because some animals knock off the latex collecting containers. Plantation management does not like herders to intrude because of security problems (risk of latex theft).

4.35 _Oil palm_: Oil palm may be intercropped during establishment. As the palm trees develop, a legume is sometimes intersown for ground cover. More frequently native vegetation, particularly grass, occurs spontaneously.

4.36 _Coffee_: Coffee grows over a wide range of elevations, from sea level to over 1000 meters. A few bushes are often grown around the households for home consumption. In larger holdings the coffee is interplanted with taller growing trees, such as _Erithrina spp._ and _Leucaena leucocephala_, which provide shade, some soil conservation, and nitrogen fixation by root-invading bacteria. Leucaena grows more rapidly, produces edible forage for livestock and fixes more nitrogen than the _Erithrina_. Another legume, _Flemingia congesta_, is sometimes planted in alternate rows with coffee, especially on sloping land, for soil conservation and for mulch. It is also used as green manure and mulch for secondary crops and as feed for livestock.

4.37 _Clove_: Production of cloves ranges from the growing of a few trees in the home garden area to small holdings of 20 to 50 trees or more to large plantation production. Food crops are interplanted among cloves planted in home garden areas. Native vegetation often grows among the trees of small holdings and is grazed or cut as forage. Occasionally, an improved grass such as _Setaria_ is planted and used for cut-and-carry forage.

4.38 _Sugarcane_: Sugarcane is grown on large, quasi-governmental holdings, small holdings (groups of smallholders who are required to meet a quota in a given region) and as single clumps in home gardens. On large estates, the cane is ratooned. However, on small farms it is grown for only one year since rice is more profitable. At harvest time, the top leaves are cut for on-farm animal feed or they are sold to livestock producers in the village. On large holdings, residue is discarded or burned. Stalks from single clumps in home gardens are consumed in the household or sold. The leaves and tops are fed to livestock around the homesite.

d. _Mixed gardens_

4.39 The land area around the household is a storehouse of inter-mixed crops, most of which are food crops but also may include ornamentals, shrub or tree crops. The mixed garden area may be less than 100 m² but sometimes exceeds 0.5 ha. It may extend beyond the immediate confines of the household compound to including fruit or other tree crops, vegetables, specialty crops such as black pepper, bananas, cashews, and sometimes a fish pond or eel bed.The household generally consumes home garden production but it may also provide a source of income from off-farm sales. Indigenous and improved poultry, chickens, sheep and goats may have free range or be confined within the mixed garden area.

e. Forest lands

4.40 On the outer islands, forests cover vast areas of land, reaching 90 percent or more in some provinces. On Java, Bali and Madura, and to some extent South Sulawesi, forest lands comprise a smaller proportion of the land area, and the percentage continues to decline as population pressure increases. The land use category for forests includes dense tree cover (where logging is prevalent), cut-over and secondary forests, and single species forests such as teak and mahogany.

4.41 On the outer islands of Sumatra, Sulawesi, Kalimantan, and Irian Jaya, forest lands in selected areas have been, and are being, cut for establishment of transmigration sites. In planning the use of forest lands for transmigrant crop cultivation, it is essential that attention be given to crop adaptation and soil conservation practices. For the most part, transmigrant rice farmers are experienced with management practices appropriate for the more fertile volcanic soils of Java and Bali from where they originated. The red and yellow podzols require different management practices than those of the lowland volcanic soils. In general, the soils are not as deep; structure and water holding capacity are different; internal drainage is poorer so that water-logging may occur; and puddling is more of a problem. Whenever forests are cut and the soil disturbed, organic matter decreases, altering the soil texture, structure, and tilth. Fertility declines so that crop yields rapidly decrease.

4.42 Forest land area and productivity will continue to decrease in Indonesia for several reasons:

- Farmers use forests near villages to supplement the animal feed supply, and to obtain firewood and building materials. As population pressures increase, the natural regeneration of the forest lands is "short circuited" and productivity declines.

- In some areas, farmers encroach upon steep sloping forest lands, cut the remaining woody cover, remove the herbaceous material and plant secondary crops for their subsistence needs or for off-farm sales. Farmers establish their households and occupy the land as "squatters". Since they do not own the land, little or no thought is given to soil conservation. Generally, these are inherently low fertility soils which are marginal for crop production. They are highly erodible and frequently become fragile lands. Although illegal, the GOI is reluctant to reclaim forest land on which squatters reside because of the dire needs of subsistence farmers.

- Swidden, or shifting agriculture, is practiced in some areas. In general, the length of fallow periods has steadily declined, resulting in a grass-dominant sub-climax, often imperata. In some areas farmers use this grass as the fallow land cover simply because it prevails. Over a period of years, soil fertility declines in comparison to forest fallow but stabilizes at a lower level unless the fallow period is again shortened.



\\\\\\

- Commercial harvesting for the wood products industry continues to increase in intensity. Wood products, especially plywood, are an important source of employment and foreign exchange. Unfortunately, reforestation efforts have not kept pace with the rate of deforestation.

4.43 The management of forest lands in Indonesia is as important issue which impacts on many facets of agriculture and which must be addressed on a national level. Water quality and availability, soil fertility and erosion, maintenance of viable populations of wild flora and fauna which are important sources of food and fiber for indigenous peoples and the availability of firewood and materials for rural construction are all negatively impacted by destruction of forest lands through improper timber harvesting practices and poorly implemented reforestation programs.

f. Grasslands

4.44 This category is relatively small in comparison to forest lands, but exceeds rice lands in some provinces of the outer islands. Grasslands include some brush lands. For the most part, these grasslands do not comprise the commonly envisioned extensive and contiguous land areas but are frequently interspersed with belts of trees. Imperata is an invasive grass and rapidly moves into cut-over forests and untended crop and waste land. Once established, it is difficult to control or eradicate.

4.45 In grasslands, the predominant grass is imperata. Cattle ranches have been developed in some of the grasslands, especially in South Sulawesi. Some ranchers have suppressed, and largely controlled, imperata by burning the grass, preparing a seedbed, applying fertilizers, planting improved species of grasses and legumes, and practicing judicious pasture and grazing management. On other ranches and farms, an attempt is made to utilize the imperata by timely burning to induce regeneration of the more desirable young herbage. After a month to six weeks, however the grass again becomes rather unpalatable and low in nutritive value.

g. Other lands

4.46 This category includes such land classes as waste land and denuded areas, lakes and ponds, fresh water swamps, coastal swamps and tidelands. The two latter categories reportedly cover about 35 million hectares, some of which have been, and are being, reclaimed for growing rice. The tidelands and coastal swamps occur in Kalimantan, Sulawesi, and Sumatra.

4.47 Traditionally, the more easily managed sites have been used by local farmers for cultivating rice, using a long season, photosensitive type and harvesting one crop per year. Now GOI is supporting development schemes for drainage, water control, and irrigation. With the improved high yielding rice varieties two crops are harvested per year in some areas. These lands require a well-planned and implemented management scheme of alternate draining and flooding. Most soils are of peat origin, and rapidly deteriorate if allowed to dry. Furthermore, various salts accumulate with alternate flooding and draining so that fresh water is .pa needed to flush the salt from peat soil. Nonetheless, these areas have tremendous potential for expanding rice and secondary crop production as management systems and technology are refined.

B. Feeds and Feeding

1. Pastures and forage

4.48 In Indonesia, grasses and herbaceous weeds provide a major portion of the feed resources for ruminant livestock. Forage availability is determined largely by two factors: farmers' production and land utilization decisions and environmental factors (rainfall, soil type, elevation, etc). Land utilization, perhaps more than any other factor, affects the feed resource base. Land allocated for higher value crop production is not available for forage production except as a by-product of crop production. Consequently, only land not suitable for crop production is used for forage and pasture, particularly in densely populated areas. While more land is available in less densely populated areas, labor shortages constrain the harvest of by-products or the herding of animals to take advantage of available forage. In addition, shifting agricultural systems, found in less densely populated areas, leaves laid open to invasive grasses, such as imperata.

4.49 In some areas of the outer islands, ecological factors alone may determine forage and pasture availability and quality for example in low rainfall areas or areas that flood periodically.

4.50 In all areas, improved pasture and forage technology is employed primarily by specialized dairy and beef producers. Low returns to labor on smallholdings probably makes production of improved pasture or forage infeasible, except where the government provides strong economic incentives encouraging production or rules requiring farmers to plant pasture or forage.

4.51 Grasses are cosmopolitan and appear naturally when soil is exposed, either by cutting other vegetation or disturbing the soil surfaces. They occur in waste places, along roadways, foot paths and canals, in waterways and drainage ditches, on road cuts, embankments, terraces, land spills and cut-over forest lands. They invade home gardens, plantation crops, and fields of food and cash crops. They are the first species to appear after clearing forests or preparing land which has been under long-time cultivation. Legumes also appear naturally but are less universal than grasses, nor do they occupy as high a percentage of the vegetational cover as grasses.

a. Native and naturalized grasses, legumes and fodder trees

4.52 In areas where a rice-based cropping system prevails, native and naturalized grasses and other vegetation are grazed and provide the major cut-and-carry feed supply for livestock, along with the residues of secondary and vegetable crops, leaves of cassava and fodder shrubs and trees. For the most part grasses provide the major portion of the diet but in regions with high livestock population densities, crop by-products form a major portion of diets for cattle, sheep and goats (see section 2, "crop residues and by-products", below).

4.53 Native and naturalized grasses and weeds occur on bunds in non-cultivated areas of rice crops, under coconuts and trees of sparse forests, and inter-mixed with other vegetation in waste places as well as communal grazing areas. Some grasses occur in paddies after rice harvest along with the rice ratoon, and provide grazing during the dry season. Some grasses encountered include Cynodon dactylon, Paspalum conjugatum, Panicum maximum, Axonopus compressus (or A. affinis), Echinochloa colonum, Eleusine indica, Andropogon aciculatus, Themeda arguens, Chloris barbata, Polytrias amoura, Imperata cylindrica and in the wetter areas Brachiaria mutica, Leersia hexandra, and Eriochloa subglabra.

4.54 Several low-growing legumes, both native and naturalized, are occasionally encountered along roadways, non-cultivated areas and under coconut trees. These include species of Calopogonium, Centrosema, Pueraria, Phaseolus, Stylosanthes, Rhynchosia, Desmodium, Indigofera, Alysicarpus, Teramus and others. They appear spontaneously and sporadically and, in general, do not significantly contribute to the forage available for animal feed.

4.55 For the most part, herbage yields and feed quality of grasses, weeds and other native vegetation are rather low, ranging from three to five tons dry matter per hectare per year dry weight. The nutritive value and digestibility of such feed material on the more fertile soils of the lowlands, especially in paddies after rice harvest, exceeds that on the less fertile soils of the rainfed uplands and drylands. In the more fertile lowlands, total protein averages seven percent or more with 55 to 60% digestibility compared to five percent total protein or less with 50% digestibility at maturity in upland and dryland areas.

4.56 In addition to herbaceous vegetation used as forage and grazing, a large number of shrub and tree legumes exist throughout Indonesia and constitute an important component of the animal feed resource. These include species of Sesbania, Gliricidia, Leucaena, Calliandra, Acacia, Cassia, Albizia, Mimosa, Erythrina, Prosopis, Samanea, Parkisonia, Flemingia, Dalbergia, Deesmanthus and others. Frequently, they are found at the higher elevations, having been cleared from cultivated areas and cut for firewood. Some, however, occur around homesites and along field boundaries and roadways. They are especially useful during dry periods since their leaves persist into the dry season and exfoliate before the rains begin. The leaf protein content is high, often near 20% on a dry matter basis, and thus provides a high quality feed supplement.

4.57 During the dry season and periods of feed shortage, the farmer, often accompanied by his children, collects forage from grasses, weeds, and trees. Frequently, they walk from three to five kilometers to collect a human load of about 30 kg per adult male and 15 to 20 kgs per child. During times of prolonged drought, feed collection may require three to six hours per day. These forays lead to frequent vegetative defoliation and exposure of the soil surface to wind and water erosion, causing loss of soil fertility, soil erosion, destruction of vegetation and eventual denudation, eventually yielding a fragile land.

4.58 At transmigration sites on the outer islands, the feed resources closely correspond to those of the transmigrants' origin (i.e. native and naturalized vegetation). At new sites, however, available feed will be greater than at older, established sites, primarily because of reduced land pressure. Transmigrant farmers are given two to 2.5 hectares of land.



\\\'

Only a portion of the land is cleared for them. Uncleared land, which has not been overgrazed or had soil nutrients depleted from over-cultivation, yields a good source of forage. Furthermore, suitable yet unfamiliar species are frequently encountered.

4.59 Extensive areas of grassland occur in Sumatra, Kalimantan, Sulawesi and Nusa Tenggara. Much of this savanna or savanna-woodland has resulted from the degradation of climax forest, mostly caused by shifting cultivation over many years. These areas are now maintained as grasslands by regular dry season fires. The predominant grass cover is imperata. Shifting agricultural systems leave large areas of land open to invasive grass species. It is estimated that imperata either dominates or is an important component on 16 million hectares of land in Indonesia, and increasing at the rate of 0.15 million hectares annually, primarily as a result of present day shifting cultivation (Soerjani, 1970).

4.60 In the juvenile stage of growth, (e.g. regrowth after burning up to about four weeks of age), the herbage is palatable. It has medium digestibility of about 55 to 60 percent, and contains sufficient nutrients for animal maintenance. As plants mature, however, only cattle on a starvation diet graze imperata. In an attempt to provide a continuous supply of the more nutritive herbage, some farmers sequentially burn different areas. This is difficult during both the rainy and dry seasons. During the rainy season, the mass of green material may preclude burning. During the dry season, uncontrolled fire is a problem. Furthermore, repeated burning deters growth and persistance of the more desirable intermixed species and favors imperata.

4.61 In drier areas of some outer islands (e.g. NTT and NTB), large areas of grazing lands exist, caused in part by shifting cultivation. Animals usually have free range but find little to eat towards the end of the dry season. The species composition of these areas is different than that of communal grazing and waste lands of the more humid regions. Imperata is less prevalent in relation to more drought tolerant and annual species which flourish during the rainy season. They become stemmy, lignified, dry and of low nutritive value during the dry season. For the most part grasses predominate and include such species as Sporobolus, Dicanthium, Bothrichloa, Andropogon, Eriochloa, Capillepedium, Heteropogon, Themeda and Polypogon. Under some conditions native legumes such as Desmodium, Pueraria and Rhynchosa occur, along with fodder trees such as Acacia, Parkia, Pterocarpus, Prosopsis spp. (Anon, 1983)

4.62 Above 1500 meters, the cool-season grass species, kikuyu (Penniseteum clandestinum) has become naturalized. It provides excellent ground cover, even on acidic soils, and highly palatable herbage. The grass is extremely invasive and rapidly moves onto disturbed soil, but provides desirable grazing. In Irian Jaya dairy cows perform well on unfertilized kikuyu, yielding 8.0 liters of milk per day without supplement.

4.63 In Kalimantan, a traditional system of beef production from buffalo has evolved to take advantage of naturalized vegetation. Each year during the rainy season (November to April), the Barito River and its tributaries flood some 50,000 ha, 1.5 to 2.0 m deep. Grasses and water hyacinths grow in and above the water surface. During the wet season, buffalo are kept on platforms at night and graze during the day while swimming. Leersia hexandra, a nutritious and palatable grass, is a predominant species. During the dry season, the buffalo are herded in the areas of receding water.

### b. Improved grasses and legumes

4.64 Improved grass species: Species suitable for cut-and-carry hold more promise for increased and improved forage production than those used primarily for grazing, especially where land pressure severely limits or inhibits land available for grazing. Several grasses and legumes are presently used and have a proven potential to boost, by severalfold, yields of herbage available for livestock feed. Elephant grass (Penniseteum purpureum), setaria (Setaria anceps and S. splendida), brachiaria (Brachiaria decumbens), buffel (Cenchrus ciliaris), Rhodes (Chloris gayana), greenleaf panicum (Panicum maximum cv trichoglume), stargass (Cynodon nlemfuensis), and sabe (Urochloa mosambicensis) are among the improved species.

4.65 Elephant grass and setaria are bunch-type in growth habit and bracniaria is semi-prostrate and spreading. All are transplanted, using stem pieces for elephant grass and crown splits with attached roots for other grasses. Brachiaria produces true seeds which can be reproduced in Indonesia but are not always available. Imported seeds are very expensive. Some types of elephant grass develop true seeds. However, seed-type elephant grass produces less herbage than the improved types that are propagated vegetatively.

4.66 The bunch-type grasses are transplanted on terraces, along field boundaries, pathways and roadways. In some regions, particularly where dairying and beef fattening are practiced, elephant grass is grown in rows of solid stand. Brachiaria is best suited for embankments. It and setaria are well adapted and sometimes used as ground cover in the extended home garden of cloves and could be used as cut-and-carry among cashew, banana and papaya plantations.

4.67 The DGLS and provincial offices of the Livestock Services have established sites for seed multiplication or replication of vegetative material of improved grasses and legumes. These sites are part of livestock improvement and multiplication stations. A listing of these stations with the species of forage and livestock maintained is presented in table IV.1. The team also observed small grass-legume nurseries on some provincial stations and demonstration farms. These materials are distributed to farmers who have livestock.

4.68 Elephant grass produces more cut-and-carry forage, by far, than any other grass and is more widely used. Yields of this and other grasses reported by the Dinas Peternakan, Ungaran, field extension staff in the province of Central Java are shown in table IV.2. These data indicate productivity under traditional management, but not potential yields under more favorable conditions of ample soil moisture and application of fertilizer or stable manure. Generally, the propagated grasses are cut when forage is needed, irregardless of growth stage.



142

Table IV.1: Summary of forage and livestock stations under the direction of the Directorate General for Livestock Services, Jakarta

| Province | Station | Area (ha) | Mission | Forage species | Livestock |
|---|---|---|---|---|---|
| Aceh | Indrapuri | 730 | a) Breeding and multiplication of large and small ruminants<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Cynodon nlemfuensis<br>Euchlena mexicana | Brahma crosses<br>29 males<br>87 females |
| North Sumatra | Siborong-borong | 910 | a) Breeding and multiplication of ruminants and swine<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Panicum maximum | Cattle and buffalo - 500<br>Swine - 1,630<br>Rabbits - 550 |
| West Sumatra | Padang Mangatas | 252 | a) Breeding and multiplication of exotic breeds of ruminants<br>b) Forage multiplication and distribution | Brachiaria decumbens | Beef cattle - 460 |
| South Sumatra | Sembawa | 275 | a) Breeding and multiplication of local crossbreed ruminants<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Paspalum plicatulum<br>Panicum maximum<br>Setaria splendida<br>Leucaena leucocephala<br>Stylosanthes guinensis | Cattle - 150 |
| West Java | Cisarua | 28 | a) Breeding and multiplication of poultry and small ruminants<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Panicum maximum<br>Paspalum plicatulum<br>Setaria anceps<br>Setaria splendida | Poultry - 1,000<br>Rabbits - 590 |
| Central Java | Baturraden | 250 | a) Breeding and multiplication of dairy cattle and swine<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Penniseteum purpurem<br>Setaria splendida<br>Leucaena leucocephala | Dairy cattle - 150<br>Swine - 75 |
| South Kalimantan | Pleihari | 226 | a) Breeding and multiplication of local crossbred large and small ruminants<br>b) Forage multiplication and distribution | Arundinella nepalensis<br>Brachiaria decumbens<br>Euchlena mexicana<br>Panicum maximum<br>Setaria splendida<br>Calopogonium muconoides<br>Pueraria javanica | Coats - 100<br>Etawah crossbreds |

(continued)

Table IV.1: (Continued)

| Province | Station | Area (ha) | Mission | Forage species | Livestock |
|---|---|---|---|---|---|
| West Nusa Tenggara | Seranding | 422 | a) Breeding and multiplication of purebred Bali cattle<br>b) Forage multiplication and distribution | Brachiaria decumbens<br>Penniseteum purpurea<br>Seteria splendida<br>Centrosema pubescens<br>Leucaena leucocephala<br>Macroptilium atropurpureum<br>Stylosanthes guianensis | Cattle - 50 |
| East Nusa Tenggara | Lili | 465 | a) Breeding and multiplication of purebred Ongole cattle<br>b) Forage multiplication and distribution | Panicum maximum<br>Penniseteum purpureum<br>Leucaena leucocephala | Cattle - 400 |

Source: DGLS (1985)

4.69 At Boyolali, a commercial forage production operation sells 10 kg bundles of elephant grass to backyard dairies in the city at Rp 150 each. The grass is grown in pure stand, fertilized with over 100 kg/ha of urea and dressed with stable manure after each cutting of approximately six-week intervals. At this stage of growth, the grass reaches a height of 1.5 to 2.0 meters. Forage yields were estimated at about 300 tons/ha/year of fresh material. Nutritive quality and digestibility are high, probably 20 percent moisture, 10 to 12 percent total protein (dry matter basis) and greater than 65% digestibility.

Table IV.2. Annual fresh weight (t/ha) of grasses and legumes, Central Java, 1983

| Species | Yield | Adaptation (soil) |
|---|---|---|
| Brachiaria mutica | 60 | Wet lowland |
| Chloris gayana | 75 | Relative dry |
| Paspalam plicatulum | 80 | Dryland |
| Panicum maximum | 126 | Dryland |
| Penniseteum purpureum | 193 | Relative dry |
| Setaria anceps | 70 | Dryland |
| Centrosema pubescens | 40 | Relative dry |
| Macroptilium atropurpurcum | 41 | Dryland |
| Pueraria javanica | 50 | Relative dry |
| Sesbania grandiflora | 20 | Relative dry |
| Stylosanthes guianensis | 40 | Relative dry |

Source: Buku Peternakan Java Tenggah (1984)
Note: Grasses and legumes cut when fully mature, production

4.70 Legumes: The tree legumes are more promising than trailing species, especially leucaena (Leucaena leucocephala, "lamtoro" ) Three others are also commonly used, sesbania (Sesbania grandiflora, or "turi"), Gliricidia sepium and Calliandra callothyrsus. Nonetheless, several low-growing and trailing legumes show potential, including Centrosema spp., Stylosanthes spp., Neonatonia wightii, Clitoria fernatea, Desmodium spp., and Macroptilium atropurpureum.

4.71 Leucaena, a leguminous tree, is becoming important in some areas where land pressure is intense. The legume was imported about 300 years ago (Metzner, 1983) and is well adapted in localities where limestone exists or where soil pH exceeds 6.0 and soil phosphorus is readily available. Some farmers have also established leucaena by sowing seed in enriched soil enclosed in small plastic bags. Seedlings are transplanted onto terraces, along field boundaries and around the household mixed garden. Leucaena is unique among tropical legumes because it requires a specifically associated symbiotic root bacterium for growth and development. This organism needs a readily available supply of calcium found in non-acid soils. It is called alkali-loving, acid-producing. (In contrast, other tropical legumes grow in more acidic soils, even pH below 5.0 if there is ample exchangeable calcium. They require bacteria which are so-called acid-loving, alkali-producing.)

4.72 Leucaena is capable of producing up to 30 tons/ha/year of consumable dry forage and edible stems. However, under farmer conditions three to five tons production is more likely. It has has 22 to 25% total protein on a dry matter basis. However, leucaena contains mimosine, a protein complex that is damaging to livestock, especially monogastric animals. Indigenous ruminants possess a bacteria which degrades mimosine into a harmless product. While cattle imported from Australia and New Zealand do not carry this organism in their rumen upon arrival in Indonesia, they acquire it through saliva exchange with local cattle (Siregar, 1984, 1983; Siregar, et al, 1984; Siregar and Semali, 1982; Jones, 1982).

4.73 Leucaena not only has the potential to yield large quantities of high quality forage but also the plants effectively conserve soil, producing up to 500 kg/ha/yr of nitrogen (including that from associated root nodules and leaf tissue). Moreover, the main stem (tree trunk) can be used for firewood or charcoal. When cut back to near ground level (30 to 50 cm), the plants readily regenerate new shoots and branches. Most types produce large quantities of seed when plants are allowed to mature. The seeds possess a hardened coat which is readily scarified by immersing in 80°C water for five minutes.

4.74 Leucaena yields more edible forage than sesbania, gliricidia, calliandra and other shrubs. In addition, cattle find the herbage more palatable and acceptable than other legumes. The leaves provide an excellent source of protein-rich meal when dried, a product often found in villages. The leaf meal must be used in moderation for chicks, however, supplying no more than 5.0 percent of the total ration.

4.75 On some of the larger ranches in South Sulawesi, for example Bina Mulya Ternak (BMT Ranch) near Enrekang, Bila River Ranch and the Wawolemo Transit Farm, sown pastures of improved grasses and legumes have been established. These include brachiaria, brown-seeded paspalum, setaria and para. In addition, pastures have been oversown with calapo, siratro, centro and stylo. In some pasture, native grasses still persist but in combination with legumes. For pasture establishment land is cleared by felling trees or removing bushes, and disked to prepare the seed bed. Limestone (2.0 t/ha) and 100 kg/ha triple superphosphate are applied. Grasses are then transplanted and legumes overseeded. To assure maintenance of the improved pasture species, an annual dressing of phosphate is required. Experimental studies at the BMT ranch showed that supplemental applications of sulphur and molybdenum are also needed for optimal legume growth on some soils. In some pastures imperata reappeared because of inadequate fertilization and overgrazing. In general, 1.5 animal units (300 kg equivalent) can be carried per hectare of native grass and improved legumes and 2.0 animal units of improved grasses.

c. Distribution of improved grasses and legumes

4.76 At the ADB project sites in Sulawesi and Aceh, farmers who receive cattle are also given seeds and vegetative material of improved grasses and legumes. In S.E. Sulawesi farmers who are candidates to receive cattle are selected by means of a questionnaire handled through S.E. Sulawesi Transmigration Area Development Project (SESTADP). They attend a three to four week training course on livestock management and forage development, held at the Wawolemo Transit Farm. Upon finishing the course each farmer is given sufficient elephant grass stem cuttings and leucaena seeds to plant 0.25 ha, plus 25 kg urea and 25 kg triple superphosphate for establishment. Despite this effort, relatively little elephant grass was observed although plantings of setaria and leucaena were seen at several transmigration sites.

4.77 The IFAD project imports seeds of improved grasses and legumes from Australia, and obtains vegetative pieces of elephant grass and setaria from local sources to establish nurseries at its holding sites. Farmers who recieve animals through the IFAD project are given improved grasses and legumes and instructions on establishment and management. Staff make follow-up visits to check results.

4.78 Various projects and the extension service on the outer islands have given greater attention to leucaena than similar organizations on Java. Thus, this legume is more frequently observed in and around transmigrant and local villages. Extensive plantings are found in parts of NTT and NTB.

d. Forage and pasture research

4.79 Since 1950 research emphasis has been placed on plant introduction and evaluation, cutting management strategies for fertilized grass species and yield responses of grasses to nitrogen, phosphorus and potassium fertilizer applications and legumes to the latter two (Siregar, 1983; Ivory and Siregar, 1984; Panjaitan and Blair, 1984).

4.80 Forage research in upland areas has concentrated mainly on species adaptation. This approach is a response to the increasing pressure to clear steeper slopes for crop land. Forage species are introduced to reduce soil erosion and to establish stable crop-animal production systems.

4.81 Investigations of improved grasses and legumes are underway at the Research Institute for Animal Production (Balai Penelitian Ternak), Ciawi, West Java and at two substations: Gowa Forage Research Station (near Ujung Padang, South Sulawesi) and Sungai Putih (North Sumatra). Two other substations are functioning: Klepu (Central Java) and Grati (East Java) and provision has been made to establish a new substation near Kupang (West Timor). A research program on small ruminants grazing under rubber trees is planned with the USAID-funded Small Ruminant Collaborative Research Support Program (SR-CRSP, Farrell, 1984). In addition, collaborative grazing research is underway at the Bina Mulya Ternak ranches in South Sulawesi and on Sumba.

4.82 The BPT forage studies begun in 1982 represent a joint effort by the GOI and the Government of Australia. They are following a detailed and orderly plan for thoroughly evaluating grasses and legumes best suited to given agro-ecological conditions. Grasses and legumes, collected worldwide, are being introduced and evaluated at Ciawi and Gowa. Currently, collections are being made from various parts of Indonesia as well as in Australia. In addition to the in-country collection by the BPT, FAO supported a collecting expedition in 1985 seeking native legumes and agro-types of naturalized species. This material was shared with BPT and CSIRO. Based on preliminary trials, the more promising selections are placed in regional trials to obtain additional information regarding adaptation, herbage yield, pattern of growth, seed production, prevalence of disease and insects, regeneration of growth after cutting, leaf density, and persistence. Species which appear to have the greatest potential are subjected to further testing, such as plant spacing, frequency and height of cutting, response to kinds and amounts of applied nutrients, intermixture of grasses and legumes, drought tolerance, chemical composition, and in vitro digestibility. Following laboratory and small-plot screening, various field studies under pasture or cutting conditions are initiated using the animal as evaluator to determine intake and digestibility, plant persistence under cutting or grazing and animal performance. Before completing the evaluation sequence, seed production procedures will be determined, or methods of vegetative propagation examined and refined. Recommendations, along with procedures for management practices, will be assembled for use by the DGLS and extension service for transfer to farmers.

4.83 To date the most promising grasses are _Pennisetum purpureum_, _Panicum maximum_ cv. Riversdale (shade tolerant), _Cenchrus ciliaris_, _Brachiaria decumbens_, _Setaria anceps_, _Urochlora mosambincensis_ and _Digitaria milanjiana_, the legumes being _Centrosema pubescens_, _C. plumieri_, _Macroptilium atropurpureum_, _Desmodium heterophyllum_, _Pueraria javanica_, and _Arachis glabra_ (a trailing, perennial peanut).

4.84 Forage and pasture research under dry conditions (800 to 1250 mm annual rainfall and a long dry season lasting as much as nine months) is being carried out in the upland of Central Timor by the Indonesia - Australia NTT Livestock Development Project. The project, begun in 1982, was designed to develop water storage and reticulation systems at group management units (15 to 20 households), investigate a range of improved grasses and legumes, survey the livestock sector of NTT, study cattle stocking rates and mating management trials, conduct crop trials with cereal and food legume grains in association with leucaena for organic manure, and provide in-service training and on-the-job experience. A second five-year phase has been negotiated by the ADAB with World Bank supporting some aspects of the project.

4.85 In pasture research trials, the NTT Livestock Development Project found the following legume species promising: _Centrosema pascuorum_, _Clitoria ternatea_, _Leucaena leucocephala_, _Macroptilium atropurpureum_



ᐟ43

(siratro), *Sesbania grandiflora*, *Stylosanthes humata* (verano), and *S. scaba* (seca). Promising grasses were: *Bothriochloa pertusa*, *Brachiaria decumbens*, *Cenchrus ciliaris* (buffel), *Chloris gayana* (Rhodes), *Panicum maximum* (green panic), and *Urochloa mosambicensis* (sabe). All are established successfully from seed and seeded freely in NTT. Additional grasses useful for grazing and erosion control on dam banks and spillways include: *Brachiaria humidicola*, *B. mutica*, *Cynodon nlemfuensis*, *Digitaria decumbens*, cv. Transvala and *D. milanjiana*. All of these grasses must be transplanted with vegetative material.

4.86 A significant potential exists for increasing the supply of high quality forage on islands where intense pressure on land resources exists as well as on the less populated outer islands. Sufficient data and information already obtained point to the need for rapid movement of improved grasses and legumes onto farms for testing. This information can be mobilized by researchers and promulgated by the extension service as well as certain private agencies, e.g. Institute of Soil Development (Lembaga Penelitian Pembangunan Sosial) in Sikka, Flores. This joint effort will require a supporting policy by the Ministry of Agriculture, additional trained staff both research and extension (particularly extension subject matter specialists), a well-organized and orchestrated training program, and on-farm follow-up visits.

4.87 The pasture and forage research programs in Indonesia are well organized and executed. Over time they should make a significant impact on improvement of the livestock sector. Researchers tend to be conservative, however, and are reluctant to move technology onto farm demonstration rapidly. Research programs should include on-farm as well as station-based trials in order to speed adoption by farmers of appropriate forage production technology.

e. Forage production potential

4.88 As noted earlier, cut-and-carry forage production has greatest potential where land pressure exists. This also includes transmigration sites since land assignment of two to 2.5 ha per migrant is insufficient to allow establishment of pastures for grazing.

4.89 Elephant grass and leucaena are widely scattered throughout Indonesia, less so above 1,000 meters elevation. They are well-suited as cut-and-carry forages. Elephant grass yields more than all other grasses, up to 250 t/ha fresh weight when properly managed. Good quality herbage can be harvested when plants are cut at about 1.5 meters height, then fertilized on a regular basis with urea, triple superphosphate, and .pa potassium chloride, if P and K are lacking in the soil. Stable manure supplemented with phosphate and other compost material will favor increased plant growth.

4.90 It is suggested that additional genetic material of elephant grass be introduced and evaluated. In particular, there are several selections of hybrids derived from crosses of elephant grass (*Pennisetum purpureum*) and bullrush millet (*P. americanum*). The F1 hybrids are highly sterile and must be propagated vegetatively (a practice now followed in Indonesia). They yield up to 20 percent more herbage than elephant grass, with increased rate of animal intake and higher digestibility (five percent increase or more). Furthermore, some selections produce few or no flowering stems and seeds and thus retain nutritive value for a longer period of time than either parent. These hybrids can be obtained from the University of Ibadan in Nigeria, from CIAT and the Indian Agricultural Research Institute.

4.91 A number of leucaena selections from Australia and the Philippines have been tested on a limited basis. They need to be extended into regional trials. Under conditions of low acidity (pH 6.0 or above) with ample exchangeable calcium and other soil nutrients and on neutral or alkaline soils, leucaena plants spread naturally from seed. This was observed on calcareous soils in the southeastern region of Java, the islands of Timor and Flores. In acidic and low fertility soils applications of limestone (2.0 t/ha or more, depending on soil acidity) and P-K fertilizer are necessary for successful establishment of leucaena seedlings. In fact, it is advisable to dig a hole about 50 cm wide and deep, add compost, limestone and a starter fertilizer to the soil before transplanting seedlings. Leucaena can also be established from seeds but seedlings must be protected.

4.92 One means of increasing the quantity and quality of forage is the exploitation of improved grasses under coconut trees, as demonstrated in Bali (Rika et al., 1981). Brachiaria is an appropriate grass and several others have equal potential and nutritive value, e.g. para (Brachiaria mutica), buffel (Cenchrus ciliaris), giant cynodon (Cynodon nlemfuensis), brown seeded paspalum (Paspalum plicatulum) and setaria (Setaria anceps and S. splendida). For success, however, this operation will require land tilling and preparation to destroy or reduce the influence of existing and less desirable species, a regularized fertilization scheme, and appropriate cutting or grazing management practices. Under some conditions, legumes such as calopo, centro and siratro could be inter-mixed with the grasses. Such an approach will require considerable inputs, capital outlay and a well-organized program to enlist and coordinate farmer collaboration. An added benefit will be an increase in coconut production because of applied fertlizers.

4.93 Under a rice-based cropping system, the forage supply during the fallow period between rice crops could be augmented by overseeding the rice stubble with a rapid growing selection of centro, calopo, rice bean (Phaseolus calcaratus), phasey bean, or phaseolous (Macroptilium phaseoloides), or a short-season semi-bunch type of velvet bean (Mucuna pruriens, sometimes referred to as Stizolobium spp.) Researchers in the Department of Agronomy at the University of Gadjah Mada have noted some 20 or more agro-types of velvet bean in the uplands near Yogyakarta. Seeds of the other legumes can be obtained locally or from the CSIRO in Australia. A local supply of seeds will be needed, however, which then requires organization of specialized seed growers.

4.94 The feasibility of establishing improved pasture where land is available on some of the outer islands was discussed previously. This is a costly operation and requires inputs of labor and machinery for land clearing, soil preparation, seeding and stand maintenance. In addition, a desirable mixture of about 40% legume in a pasture mixture is difficult to maintain in the tropics. Nonetheless, the effort increases animal output. Undoubtedly, these elaborate procedures are best suited to a ranch operation of 300 to 500 or more cattle more than to small holders.

4.95 In the drier regions, e.g. NTT and NTB, improved type legumes such as Stylosanthes hamata and S. scabra can be established by burning and overseeding the native grass cover, often imperata.

4.96 Efforts have been made to improve imperata grasslands through the introduction of legumes. Results from long-term grazing experiments (since 1979) with oversown legumes in South Sulawesi (centro, calopo and stylo) and on Sumba (siratro and Verano stylo) have shown that the legumes persisted and desirable native grasses increased (Blair et al., 1981 and team observation). However, imperata persists in some locations of the pasture. Stocking rates were 2.0 animal units (AU) per hectare (200 kg heifers) in South Sulawesi and 1.5 AU/ha on Sumba. Establishment of legumes into an imperata sward, however, is uncertain and a low-cost method has still to be found. Hayman (1972) failed to obtain satisfactory legume establishment of imperata-dominated native pasture in North Sumatera, either by using tines to disturb the soil or cultivating strips.

4.97 While researchers have shown interest in the feed potential of imperata, little research has been conducted, and no extensive systematic studies exist describing their botanical composition, ecology or the seasonal variation in forage yield and quality. However, many papers have been written on imperata biology, ecology and chemical control in plantation crops (Anon., 1980). Imperata's role in Southeast Asian animal production was reviewed by Falvey (1981).

4.98 Soewardi and Sastradipradja (1980) reviewed the chemical and nutritive value of imperata in Indonesia. They concluded that the forage is useful for ruminants when properly managed and utilized. When juvenile herbage (less than four weeks regrowth) was fed to cattle in pens, they gained 0.14 kg per head per day. Supplementation with 0.24 kg cassava meal and 0.55 kg maize per day significantly increased liveweight gains. Pelleting more mature forage with additives to form a complete ration gave liveweight gains of 1.15 kg per day.

4.99 Attention to the supply of soil nutrients is highly important where a cut-and-carry or a grazing system of improved pastures is used by cattle producers. As noted previously, the availability of soil nutrients determines plant nutrient content. When plants grow on low fertility soils it is likely that they will contain insufficient nutrients for animal maintenance and production. There are known critical levels in respect to animal needs and contents of different grasses and legumes. For example, the critical P level of elephant grass is about 0.23 percent on a dry weight basis of forage.

### f. Forage Preservation

#### 1) Silage

4.100 Conservation of forage as silage is relatively uncommon in Indonesia. Successful silage-making depends on numerous factors including:

- An appropriate material in sufficient quantity for ensiling (maize, sorghum, elephant grass, etc.);

- Material sharply and finely chopped (pieces 2.0 to 3.0 cm in length);
- Addition of molasses or lacto-bacillus to enhance fermentation;
- Tight packing to exclude air; and
- Sides of silo air tight and top of silage securely covered to reduce spoilage.

4.101 While there was some experimentation ensiling grasses, such as guinea in trench silos, spoilage rates sometimes exceeded 50 percent. Technical problems were encountered with fine chopping and excluding air. In addition, water seepage into below ground pits increased losses. Furthermore, high quality forage available during the rainy season contains too much moisture for ensiling. Wilting to remove moisture before ensiling was not feasible. During the dry season plants become stemmy and highly fibrous as they mature, making them unsuitable for silage.

4.102 Maize is widely used for silage making in many countries where it can be grown on a large scale, and harvested mechanically. The small fields of maize in Indonesia preclude mechanical harvesting. Furthermore, the crop is largely grown for human consumption rather than animal feed. The use of maize for silage, however, is successful in a USAID-funded dairy project (CLUSA) at Klaten near Yogyakarta. Upright cement silos with 50 ton or more capacity were constructed. Under contractual arrangement, small growers produce hybrid maize and cut the plants by hand when ears are in the soft dough stage. This material is transported by truck to the silos, chopped mechanically and blown into the silos along with molasses.

4.103 Above ground bunker-type wood silos appear to be more desirable than trench or upright types. Silos of this type, constructed on a concrete slab, were observed in South East Sulawesi. Each silo was divided into sections, holding about 18 tons each, and lined with plastic. Silage was covered with plastic and earth. Commercial plastic bag-type storage may also be feasible on a group sharing basis. Air is extracted, then the bag sealed. Different types of storage should be tried on an experimental basis and compared before making recommendations to farmers.

2) <u>Hay making</u>

4.104 Forage is rarely stored as hay in Indonesia because the highest quality forage becomes available during the rainy season when sun-drying is not possible. As the dry season approaches, the grasses rapidly mature, develop floral stems and seeds, increase in fiber content and lose much of their total protein content. Total protein content may drop below five percent dry weight basis which is insufficient for animal maintenance. In regions where land pressure is great, however, grass is cut and stored in small quantities as cattle feed for the dry season. While cut and stored grasses are generally the major feed source, they are often supplemented by herbage cut from fodder trees.

3) <u>Standing hay</u>

4.105 In some regions, grasses are put in reserve during the growing season and serve as standing hay until cut or grazed. A higher quality of standing hay could be obtained in areas with an extended dry season of six



152

to nine months by growing annual legumes such as _Stylosanthes hamata_ and _S. scabra_. This was shown to be feasible by studies in Central Timor (Piggin, _et al._, 1985). These legumes are reseeding species which produce 5.0 tons/ha or more of dry forage and about 300 kg/ha of seeds during the rainy season. During the growing season, animals prefer the more juvenile grasses and largely ignore the legumes until the grasses mature, making the legumes available for dry season grazing. Even though seeds are also eaten, sufficient fall to the ground for reseeding. Furthermore, seeds passed through the animal and became more widely distributed. Production of standing hay of improved quality requires certain labor, seed for improved species and fertilizer inputs as well as pasture and animal management to guard against overgrazing.

g. _Agroforestry_

4.106 The potential for reclaiming eroded and abused grasslands, communal grazing, marginal and fragile lands which have resulted from improper cultivation practices requires special approaches to problem solving. A first approach is to reduce abuse of the land by reducing stocking rates and monitoring land use for marginal and fragile lands. Following this, the second step is to develop, test and introduce appropriate forage production systems.

4.107 Where terrain is undulating with rolling hills and gentle slopes, an innovative system might be considered whereby traditional crop production methods are combined with improved forage management practices. This is best exemplified by the "Amarasi Model", an agroforestry system established in southeastern Timor more than 50 years ago (Jones, 1983; Metzner, 1983). An edict by the administrative head and his council of the subdistrict (kecamatan) required every farmer in Amarasi to plant rows of leucaena, which had grown in the region for many years, spacing rows 3.0 m apart along the contour before abandoning a plot of land and clearing another. Within a few years, massive thickets of leucaena, the result of natural reseeding, covered large parts of the area. Today, this leguminous forage is cut daily and fed to fattening animals (40 to 60 kg/head, depending on body weight) and to brood cows and their offspring. About one-fourth of an average 2.0 hectare farm site is cleared of leucaena on a rotating basis for growing secondary crops. Several factors contributed to the success of this system:

- Soil conditions favoring the natural reseeding of a local agrotype of leucaena (i.e. calcareous in origin, partially covered with a thin soil layer but having numerous outcroppings of limestone);

- A compulsory law firmly enforced by the local administrative head and his council;

- The creation of contiguous field complexes whereby groups of farmers (20 or more) worked their land as a unit;

- The gradual introduction of bananas, papayas, coconut palms and other tree crops to build a layered canopy of ground cover; and

- Recognition by the farmer that the animal-crop farming system increased farm income and improved the well-being of the household.

4.108 On steeper slopes and in regions of increased land pressure, a different approach of incorporating leucaena into the traditional farming system is needed. The "Sikka System" which evolved on Flores in the mountains near Maumere provides one solution (Jones, 1983; Piggin and Parera, 1984). An attempt was made in the 1930s to utilize leucaena thickets in rotation with food crops (mainly maize). With only hand labor, conventional terracing proved too time consuming a method to establish the leucaena. Consequently, the scheme did not succeed.

4.109 In the 1960s, a Roman Catholic priest recognized the value of leucaena for erosion control on the steep slopes. He established a small garden on the church grounds with the local type leucaena planted along contour lines. Each year an indirect terrace formed as soil was moved by alleyway cultivation from the lower portion of the leucaena hedge towards the upper side of the downhill hedge. One enterprising farmer observed the garden and duplicated the contour row planting on his farm. The technique did not gain prominence, however, until the 1974 introduction of the national food crop intensification program (BIMAS), which specified that only farmers who planted leucaena on their land could receive credit. Since then, more than 50,000 ha of steep slopes, which were becoming fragile lands, have been reclaimed. An additional 1000 ha are being reclaimed annually.

4.110 In the early years, the leucaena hedges were separated by 6.0 m alleyways which were cropped, sometimes in fallow rotation. Over time, it was recognized that erosion still occurred, particularly upland of the terraces. Today, the leucaena hedges are separated by a 3.0 m alleyway.

4.111 In the 1970s, the "giant" type leucaena was introduced and substituted for the local type in new plantings. However, the plants grew too tall, produced too much shade, and competed with the alleyway crops. The local type is more easily managed when seeds are thickly sown (about one kg/25 m of row) and plants are compacted in the row. The plants grow to about 5.0 m height during the dry season with leaves remaining green. Before the rainy season they are cut back to a height of 75 to 100 cm above ground level and laid in the alleyways where leaves shatter. With the first rains the stems are removed and maize planted (intercropped with rice, cassava, peanuts, mungbean). In addition, cash crops of cotton and tobacco are grown in monoculture. By the time seedlings emerge, the leucaena has regenerated new growth which is cut for mulching the food or cash crops. Alleyways can be continuously cropped, an advantage over shifting cultivation. Maize yields exceed 1.0 ton/ha each year. In contrast, this yield can only be obtained the first year following a 10 to 15 year fallow under shifting cultivation. In addition, some farmers have planted shrub and tree crops such as cacao, cloves, bananas and coconuts in the alleys, forming a canopied ground cover. Interestingly, a river that had previously dried up during the dry season regenerated its year-round flow as a result of the altered mountainside environment.

4.112 There are several projects to promote leucaena in NTT and NTB other than those in Amarasi and Sikka. These include the GOI-ADAB pasture research project (carried out by Australian Consulting Incorporated Limited



154

at Besi Pae), the Provincial Development Project (PDP- supported by GOI and USAID), the Institute of Social Research and Development (LPPS - associated with a Roman Catholic Diocese in Flores) and World Neighbors. These promote leucaena farming systems in areas where swidden agriculture has led to severe land degradation. They focus on research, training, demonstrations and seed distribution,

2. Crop residues and by-products

4.113 The diverse and intensive cropping systems of Indonesia produce a large volume of straws, stovers and other vegetative materials which are useful as livestock feeds. The principal by-products available in quantity are rice straw, the stovers of corn and sorghum, the vines of peanut, soybean and sweet potatoes, leaves of cassava, and sugarcane tops. However, given the resources and technology available to the farmer, particularly in mixed animal-crop farming systems in Indonesia, especially on the intensively-cropped islands of Java, Madura and Bali, these by-products are currently being utilized to the fullest degree possible. Further expansion of the contribution of these materials to livestock nutrition will most likely require new methods of forage treatment and preservation, design of low-cost, on-farm storage structures such as silos, and farmer training in the new forage management technology.

a. Sources of crop residues and by-products

4.114 Rice crop by-products and paddy grazing: Rice straw, including that available immediately after grain harvest while still fresh (green) and that cut and dried after grain harvest, is frequently fed to livestock. Rice straw oftentimes comprises the major source of feedstuffs during certain periods of the year. A high percentage of the straw is burned, however, especially where the livestock population density is low. Rice straw also provides a valuable source of material for bedding animals confined in stables attached to or near the farmer's house. The straw becomes mixed with manure and is useful as mulch and a source of plant nutrients for crops.

4.115 The grazing of rice paddies after grain harvest is a common practice throughout Indonesia. The regeneration of foliage after cutting rice affords nutritious herbage for grazing along with grasses and weeds, but quality can be improved by oversowing with a legume.

4.116 Rice bran is another by-product of grain milling which provides a protein and carbohydrate supplement for livestock. Rice bran is used extensively in livestock feeding in Indonesia and is an important ingredient in commercial feeds (see Section 4, "Commercial Feed Industry"). Considerable cracked rice and hulls are included in the bran from village mills. The hulls tend to lower overall feeding value of the bran.

4.117 Secondary crop by-products and residues: The stover of maize (leaves and stalks after grain harvest) and husks from ears provide a substantial amount of forage for maintenance of ruminants on many farms. Whole plants may be fed to livestock when the grain crop fails as a result of drought. In addition, maize fields are grazed after grain harvest and stalk removal. Green maize is harvested and sold for roasting. In times of surplus or low prices, whole corn plants including the ear may be fed to ruminants, especially bulls stall-fed for fattening.

4.118 Peanut commands importance in Indonesia as a dual-purpose crop, the nuts providing a protein-rich food for humans and the vines (haulms) an excellent feed for livestock. The plants are usually lifted from the soil somewhat early as regards maximal pod formation in order to assure an optimal nut harvest and provide herbage for livestock feed. If left too long in the field leaves quickly shatter, resulting in a stemmy product of inferior forage quality. Farmers are well aware of the correct plant growth for lifting so as to optimize pod and forage yield (a matter of filled pods versus so-called "pops" with inferior kernels). Two distinct procedures characterize the harvest of peanuts for pods and forage. In the first, the plants are lifted from the soil, pods removed in the field and vines bundled, transported to a village market and sold as livestock feed (mainly for cattle and carriage horses). In the second, plants are lifted and transported to an assembly point where pods are removed and vines bundled for sale. In addition, vines are used on-farm as livestock feed after pod removal. In some instances, the vines are dried and conserved for dry season feeding but leaf shattering results in a low quality product.

4.119 A number of other secondary crops also contribute to the supply of livestock feed. Soybean plants are used as on-farm feed even though most leaves have dropped after grain harvest resulting in a low-quality feed. Plants of several other leguminous food crops are fed to livestock after grain harvest, e.g. green bean, cowpea, lima bean, mung bean, lablab and velvet bean.

4.120 The leaves of cassava offer a source of fresh herbage for ruminant livestock on many farms, even though this forage contains hydrocyanic acid. This product becomes degraded when leaves are wilted. The leaves of sweet potatoes are sometimes picked for livestock feed and the whole vine is fed after root harvest. The leaves and stems of several vegetables add to the supply of animal feed, e.g. cabbage, cauliflower and carrots.

4.121 Sugarcane tops: When grown on small holdings, sugarcane tops are fed to cattle, but less so when grown on estate farms. The leaves and meristematic tissue contain less total protein (from six to seven percent) than elephant grass when the latter is cut in a juvenile stage of growth (up to 10 percent dry matter, 70 days or less post-cutting growth). The protein content may be even less since sugarcane is allowed to develop flowering stems before plants are harvested and taken to the sugar mill. Nonetheless, the fresh green leaves comprise a good source of forage.

4.122 Banana stems: Banana stems are relished by animals but have little nutritive value, being about 80 percent water. In fact, they are often used as a water supplement for tethered or confined cattle where a shortage of water exists. At present a single stalk sells for Rp 10 on Java with one animal being fed about one-half stalk daily.

4.123 Cull fruits: Cull fruits, especially papaya, bananas and jackfruit are fed to pigs on Bali and Sumatra where they are located near areas of intensive fruit cultivation. Cull fruits are high in moisture but are an excellent source of supplementary energy (Appendix 4.A, table 4.A.1).

b. Yield of crop by-products

4.124 Yield of by-products within a given crop is highly influenced by variety, rainfall, temperature, soil type, fertility levels, method of harvest and other factors which influence growth and yield patterns of crops. Declaring a definitive coefficient for yield of by-product per hectare or even per unit of food crop harvested is not feasible with any large degree of confidence.

4.125 The data in appendix table 4.5 from a joint study of the Direktorat Bina Produksi Peternakan of the Direktorat Jendral Peternakan and Fakultas Peternakan, Gadja Mada University, Yogyakarta (DBPP/FPGM, 1983) illustrates this point. Crop by-product yields per hectare and as a percent of food crop yield were measured for ten crops (including IR "improved", upland and "local" rice varieties) in four different ecosystems: wet lowlands and highlands and dry lowlands and highlands. Yields of rice straw varied between varieties (IR and local) and between ecosystems. Yields were highest for local rice varieties in the lowlands and dry highlands. Yield of straw from dry highland IR rice was higher than that from wet highlands and both lowland ecosystems. Similar degrees of variation were seen for the other crop by-products. Highland corn stover yields were higher than lowlands but stover DM yield as a percent of grain DM was highest in the wet lowlands. Peanut stover DM yields were highest in the wet highlands while soybean stover and sweet potato vine DM yields were highest in the dry lowlands. Yields of DM from sugar cane tops were similar between the wet and dry lowlands, the only two ecosystems in which it was measured.

4.126 Using coefficients derived from appendix table 4.5 and estimates of planting area for the same crops in Java, Madura and Bali, annual yields of crop by-products can be roughly estimated (appendix table 4.6). Rice straws account for more than 75% of estimated annual production of crop by-products, followed by corn stover (6.7%), soybean stover (4.0%) and cassava tops (3.8%). Total DM production from crop by-products on the three islands are estimated at 24.68 million tons per year.

4.127 The estimates of appendix tables 4.5 and 4.6 for Java, Madura and Bali can be compared with those in table IV.3 for all of Indonesia (Lebdosoekojo and Reksohadiprojo, 1982). If the yield values in appendix table 4.6 and table IV.3 are accurate, the percent of Indonesian corn stover, cassava tops and sweet potato vines produced in those three islands are 8.3%, 65.8% and 42.6%, respectively. Despite the large production of corn in East Java and Madura, the majority of Indonesia's corn production is found in the highland areas of North and West Sumatra.

4.128 The value of 24.68 million tons for total by-products from the major food crops for the three central islands can also be compared to the estimate of Muller (1973) at 21.75 million tons per year for all Indonesia and 10.85 million tons for Java and Madura. Expansion and intensification of the production of rice since 1973 may account for some of the large difference in estimations between Muller and the more recent studies.

Table IV.3: Estimated total available dry matter (DM) and percent content of total protein (TP) and total digestible nutrients (TDN) from crop by-products in Indonesia

| Crop by-product | DM | TP | TDN |
|---|---|---|---|
| | ('000 tons/yr) | ----------(%)---------- | |
| Rice straw | 34,215 | 5.5 | 26.6 |
| Corn stover | 19,745 | 6.5 | 46.6 |
| Sorghum stover | - | 6.5 | 41.4 |
| Cassava tops | 1,410 | 22.0 | 57.8 |
| Sweet potato vines | 555 | 14.6 | 72.4 |
| Peanut vines | 1,025 | 13.9 | 67.2 |
| Soybean vines | - | 7.7 | 50.7 |
| Sugar cane tops | 1,717 | 2.0 | 49.4 |
| Total | 58,667 | | |

Source: Lebdosoekojo and Reksohadiprodjo, 1982

c. Nutritive value of crop by-products

4.129 The nutritive value of crop by-products determines to a large degree the role they will play in support of animal production. Crop by-products are primarily the vegetative residue which remains after the harvest of the food crop. Within a plant, nutritive value varies from the highly digestible, high-protein content young, growing leaves to the low-protein, poorly digestible main stem. The nutritive value of crop by-products is therefore highly correlated with the amount of leaf as a percentage of the total biomass available. Corn stover in which the leaves have already been stripped off for livestock feed during the field-maturing of the ear is of low nutritive value relative to stover which is left over from the harvest of immature corn sold for roasting ears which usually contain a high proportion of green leaf.

4.130 Soybean stover can be of little nutritive value when the leaves have all shattered in the drying of the pods. The leaves of cassava tops are highly nutritious but mixing main stems into the feedstuff presented to the animal, even if chopped, drastically lowers the overall nutritive value of the diet.

4.131 Therefore, prediction of nutritive value from table values for chemical composition of crop by-products is difficult as the morphological composition of the vegetative material actually being fed and consumed is highly variable. Between the harvest of the material in the field and actual consumption by the animal, leaching of soluble nutrients and loss of leaf and volatile components can drastically reduce nutritive value and alter animal performance.

4.132 Most of the research work on crop by-products in Indonesia has used the "approximate analysis" or "crude fiber" laboratory procedure to separate the material into fractions with differing nutritive value. Work over the past 20 years by Van Soest and co-workers at the United States Department of Agriculture and Cornell University has shown that the crude fiber system is not adequate for predicting nutritive value for ruminant livestock, especially for highly fibrous materials such as crop by-products. A more useful procedure, the "detergent" fiber procedure, separates forage dry matter into (1) "cell wall" where cellulose and hemicellulose are variably available to ruminants through fermentative digestion depending upon the degree of lignification, and (2) "cell contents" which are totally available in the rumen. Fibrous forages such as stovers and straws differ in their digestibility largely depending upon the digestibility of the cell-wall fraction.

4.133 In table IV.4 is a crude fiber evaluation of crop by-products from Java, Madura and Bali (DBPP/FPGM, 1983). In this particular set of samples, cassava tops are shown to be highest in total protein (20.4%) and ether extract (6.0%), and lowest in crude fiber (22.8%) compared to other crop by-products. Soybean vines are particularly high in crude fiber (36.3%) and low in nitrogen-free-extract (NFE), a possible indication of a high degree of leaf-shatter of the plant post-harvest. The high values for crude fiber and low values for crude protein for rice straw, sorghum stover and sugar cane tops indicate that these materials would probably not support an adult cow with a maintenance-level diet.

Table IV.4: Chemical composition of agricultural residues from Java, Madura and Bali [a]

| Residue | Crude fiber | Ether extract | NFE | Total protein | Ash |
|---|---|---|---|---|---|
| Rice straw | 28.8 | 1.5 | 45.2 | 4.5 | 20.0 |
| Corn stover [b] | 27.8 | 1.5 | 53.1 | 7.4 | 10.8 |
| Sorghum stover | 32.3 | 1.6 | 52.8 | 4.4 | 8.9 |
| Peanut vines | 29.9 | 1.8 | 38.2 | 11.1 | 18.7 |
| Soybean vines | 36.3 | 2.8 | 42.8 | 10.6 | 7.6 |
| Sweet potato vines | 24.9 | 2.5 | 46.8 | 11.3 | 14.5 |
| Cassava tops | 22.8 | 6.0 | 40.9 | 20.4 | 9.9 |
| Sugar cane tops | 32.4 | 1.5 | 51.1 | 5.6 | 9.5 |

Source: DBPP/FPGM (1983)

[a] Weighted average of samples from four ecosystems: wet lowlands, wet highlands, dry lowlands and dry highlands.

[b] Part of plant actually used, excluding bottom of stem

4.134 Crude fiber and detergent fiber analyses of ten forages from Java by Hartadi, et. al. (1981) at Gadjah Mada are presented in table IV.5. Values for crude fiber fractions of crop by-products are similar to those from table IV.4 Leucaena and gliricidia leaves are higher in percent total protein and lower in crude fiber percent than the tested crop by-products. Pangola grass cut at 80 days is lower in percent total protein than peanut vines and cassava tops and comparable to sorghum stalks and sugar cane tops in percent crude fiber. Corn stover, sorghum stalks and sugar cane tops are all very high in percent cell wall (79.5, 81.8 and 86.5%, respectively) indicating voluntary dry matter consumption would probably be the first limiting factor to animal performance on diets high in these materials. Cassava tops, while high in percent total protein, are also high in lignin (14.2%) which might limit digestibility of the cell wall and thereby reduce availability of energy from this by-product. Cassava tops appear to be more suitable as a protein supplement to forages low in total protein such as corn and sorghum stalks. Of the forages analyzed in table IV.4 only peanut vines and cassava tops appear to be adequate as a feedstuff for high-forage diets ( >80% forage).

4.135 The study by Hartadi, et. al. (1981) summarized in table IV.5 includes analyses for calcium (Ca) and phosphorus (P). Most crop by-products are high in Ca and low in P. Only corn stalks, of the crop by-products analyzed approaches an adequate level of phosphorus (P) and a balanced Ca:P ratio which is especiall, important to milk production by dairy cattle and goats.

4.136 Measures of digestibility are presented in appendix table 4.7. Estimates of total digestible nutrients (TDN) are derived from regression equations using chemical constituents while in vitro digestible dry matter (IVDMD) and organic matter (IVOMD) are determined from digestion of samples with rumen fluids in the laboratory. Feedstuffs with TDN values below 55% are usually inadequate to support the maintenance of adult cattle. Below this level, cattle (and sheep and goats) usually will cease eating due to rumen fill long before sufficient nutrients are consumed to support production. In vitro dry matter digestibilities (IVDDM) below 45% indicate that a forage would probably be of little value in ruminant diets unless the animal is able to select more digestible plant parts from among the biomass fed. For the samples in appendix table 4.7, only peanut and sweet potato vines and cassava tops would allow for consumption of levels of nutrients above maintenance. Values for IVDMD and IVOMD correlate closely with those for TDN.

4.137 The low digestibilities of dry matter, protein and energy of the corn stalks determined in the Hartadi report are notable. It is possible these stalks were sampled from fields harvested for grain rather than roasting ears and most of the more digestible leaf material was gone.

4.138 The work of Prabowo, et. al. (1984), summarized in appendix table 4.8 compared mineral levels of crop by-products being fed to small ruminants in Garut to "critical" minimum levels required for maintenance of mature sheep and goats as reported by McDowell and Conrad (1977). All crop by-products tested for Ca and P, magnesium (Mg), potassium (K), iron (Fe) and manganese (Mn) were at or above critical levels with only corn leaves collected in January slightly deficient in P. As in the previously cited report by Hartadi, et. al. (1981), corn residues (stover and leaves) had



160

Table IV.5 Chemical composition, in vitro and in vivo digestion values for certain crop residues and forages

| Measurement | Corn stalks | Sorghum stalks | Sorghum straws | Peanut vines | Cassava tops | Sugar cane tops | Leucaena | Gliricidia | Pangola grass 80 days | Pangola grass 150 days |
|---|---|---|---|---|---|---|---|---|---|---|
| DM % | 39.8 | 39.8 | 84.8 | 29.3 | 23.5 | 37.4 | 28.6 | 29.6 | 32.5 | 34.9 |
| Crude fiber analysis: | | | | | | | | | | |
| Ash % | 23.8 | 10.6 | 8.6 | 18.4 | 8.8 | 9.8 | 11.2 | 11.2 | 9.3 | 10.6 |
| Ether extract % | 1.2 | 1.4 | 1.1 | 1.[illegible] | 5.6 | 1.8 | 3.8 | 3.8 | 1.5 | 1.3 |
| Total protein % | 5.5 | 6.5 | 7.7 | 13.9 | 21.5 | 5.7 | 26.7 | 26.7 | 8.5 | 7.5 |
| Crude fiber % | 28.1 | 35.6 | 42.2 | 24.7 | 24.4 | 33.4 | 14.1 | 14.1 | 32.5 | 37.2 |
| NFE % | 41.5 | 45.1 | 42.6 | 43.2 | 39.7 | 49.3 | 44.3 | 44.3 | 48.3 | 43.5 |
| Detergent fiber fractions: | | | | | | | | | | |
| Cell wall % | 79.5 | 81.0 | - | 69.4 | 62.4 | 86.5 | - | - | - | - |
| ADF % | 73.5 | 76.0 | - | 62.0 | 58.5 | 81.5 | - | - | - | - |
| Hemicellulose % | 6.0 | 5.8 | - | 7.4 | 3.4 | 5.0 | - | - | - | - |
| Lignin % | 12.8 | 16.0 | - | 6.8 | 14.2 | 9.2 | - | - | - | - |
| Silica % | 20.4 | 4.4 | - | 1.9 | 1.6 | 4.6 | - | - | - | - |
| In vitro digestibilities: | | | | | | | | | | |
| IVDDM % | 32.7 | 39.4 | 44.9 | 67.3 | 54.3 | 39.4 | - | - | 51.0 | 38.5 |
| IVDOM% | 30.7 | 39.2 | 40.3 | 59.0 | 48.7 | 36.3 | - | - | 40.5 | 34.5 |
| In vivo digestibilities: | | | | | | | | | | |
| TDN % | 26.6 | 33.0 | 41.3 | 67.2 | - | 43.8 | 40.5 | 58.7 | - | - |
| Dig. prot % | 0.6 | 1.0 | 3.9 | 12.1 | - | 1.5 | 10.6 | 12.6 | - | - |
| Digestible energy (Kcal/kg) | 901.8 | 1766.0 | 2120.4 | 2991.8 | - | 1916.9 | 1827.5 | 2921.3 | - | - |
| Ca % | 0.55 | 0.70 | 1.55 | 0.97 | - | 0.72 | - | - | 0.27 | 0.97 |
| P % | 0.23 | 0.15 | 0.12 | 0.19 | - | 0.16 | - | - | 0.35 | 0.26 |

Source: Hartadi, et al., 1981

the most desirable Ca:P ratios. Copper (Cu) levels were very high in potato vines indicating a potential toxicity danger if high levels of this crop by-product are fed. Deficiencies in Cu and zinc (Zn) were seen in the December and January sampiings of corn leaves. The most notable mineral deficiency was for sodium (Na) in all samples except the January peanut vines. The results for Na illustrate the importance of salt supplementation when diets high in crop residues are fed to ruminants.

d. Yields of protein and energy from crop by-products

4.139 Using estimates of yield (appendix table 4.6) and nutritive value (table IV.4 and appendix table 4.7), estimates for annual production of crude protein, TDN and digestible dry and organic matter (DDM and DOM) can be derived (appendix table 4.9). In reality, these types of estimates can only be used on a very gross basis for predicting potential animal production from crop by-products in a given region (e.g. dividing total available nutrients by annual nutrient requirements per animal unit). This is especially true when the tremendous yields of energy (TDN, DDM and DOM) from rice straw are considered. Rice straw is markedly low in digestibility and high in cell wall per unit of dry matter, both of which tend to negatively restrict voluntary dry matter intake and thereby impede performance of ruminants on high rice straw diets. Quality of forage must be given equal weight with quantity when using such data to predict capabilities for animal production.

e. Use of crop by-products

1). Frequency of utilization

4.140 The availability of crop by-products is one of the principal reasons ruminant livestock are found on Indonesian small farms. Livestock are used to convert crop residues to consumable and marketable commodities; meat, milk, manure and draft power. They represent an economically favorable cost-benefit ratio compared to the use of residues as organic fertilizer or harvest and sale off-farm.

4.141 In general, due to the seasonality of availability and limited total yield of by-products relative to animal requirements, crop residues are used to supplement native grass either grazed or cut-and-carried. On Java, Madura and Bali, most ruminants are tethered or stable-confined. Cut-and-carry grass from roadsides, fallow paddy or from plantations of improved grasses such as Penniseteum purpureum ("rumput gadja") form the basis for the ruminant diet with crop residues and rice bran providing necessary supplementation. Only at limited times of the year are cattle, sheep and goats allowed to graze tethered on fallow paddy.

4.142 Appendix table 4.10 from the survey of the Direktorat Jendral Peternakan and the Fakultas Peternakan of Gadja Mada (DBPP/FPGM, 1983) provides examples of how crop residues are used in ruminant diets in the four ecosystems studied (wet and dry, lowlands and highlands) on Java, Madura and Bali. Use of rice straw, sweet potato vines, corn stover and peanut vines is common to all ecosystems. Only at Klaten, Central Java, a dry lowland area, are both cassava and sugar cane tops used for livestock feeding. Considering the high nutritive value of cassava tops (>20% total protein, table IV.5) this result is surprising. However, the area of cassava per farm is generally small due to the high productivity of this crop. Therefore the availability of cassava tops in any appreciable quantity is limited. Greater use of rice straw in the wet lowlands compared to the other three ecosystems is probably due to the use of this residue in the feeding of water buffalo.

4.143 Van Eys, et al. (1983) studied the use of crop by-products, native grasses and leaves from shrubs and trees in small ruminant diets at three villages in West Java. The villages, Garut, Cibury and Cirebon, are differentiated by their cropping systems and small ruminant management practices. Intensive multiple cropping is practiced at Garut and only sheep are raised in full confinement. Goats are fully raised in confinement at Cibury, a lowland region where rice monoculture is dominant, and Cirebon, where multiple cropping is practiced in the vicinity of a rubber plantation. Sheep are allowed to graze roadsides, paddy bunds and recently harvested fields at Cibury and under rubber trees at Cirebon. Seasonal availability and accessibility of native grasses appears to have a greater influence on use of crop by-products than the cropping pattern. Native grasses in West Java tend to contribute 60% or more of total diet dry matter at all times. Crop by-product use decreases rapidly in the dry season because they are immediately used as available following crop harvest (table IV.6). Only at Cirebon were crop by-products (stovers of watermelon and potato) dried and stored for use when forage is in short supply. The authors conclude that small ruminant farmers are "opportunistic feeders" . When animal density is high, such as in Garut,

Table IV.6: Composition of hand-fed small ruminant diets and frequency of feeding (F) [a/b/]

| Feedstuff | Season | Garut % | Garut F | Ciburuy % | Ciburuy F | Cirebon % | Cirebon F |
|---|---|---|---|---|---|---|---|
| Grasses [c/] | Wet | 65.2 | 95.2 | 91.4 | 100.0 | 61.8 | 72.4 |
| | Dry | 74.3 | 96.1 | 94.1 | 100.0 | 80.0 | 76.7 |
| Herbs | Wet | 3.1 | 12.0 | 3.7 | 18.2 | 11.3 | 11.2 |
| | Dry | 2.7 | 11.0 | 2.9 | 19.4 | 1.9 | 2.4 |
| Crop by-products | Wet | 20.8 | 66.8 | 2.7 | 21.1 | 12.8 | 10.5 |
| | Dry | 10.6 | 39.4 | 1.9 | 14.5 | 2.8 | 15.2 |
| Shrubs and leaves | Wet | 9.8 | 35.1 | 0.6 | 4.5 | 12.2 | 21.3 |
| | Dry | 11.5 | 38.7 | 1.8 | 4.2 | 15.0 | 18.2 |

Source: Van Eys, et. al. (1983)

a/ Composition of diets expressed as a percentage of total feed (as fed basis)

b/ Frequency of feeding (F) = Percent of monitored flocks receiving each feed category

c/ Including sedges



161

farmers use a greater variety of feedstuffs, including crop by-products, then when density is lower and more grasses are available. Further, difference in feeding systems characteristic of one village compared to another are more a function of crop production and the availability of by-products rather than a specific effort by farmers to combine feedstuffs to acheive a balanced diet.

4.144 The conclusions of Van Eys and colleagues are supported by the reports of Sabrani, et al. (1981) and Mathius and Van Eys (1983) based on surveys of feeding practices among small ruminant farmers in Sukawargi and Wanaraja villages in West Java. Results from these studies are presented in appendix table 4.11. As in the previously cited study (Van Eys, et al., 1983), native grass formed the major part of the diet fed to sheep and goats in these villages. The more diverse cropping patterns of Sukawargi village resulted in a greater variety of forages used than in Wanaraja where cassava leaves, corn tops and jackfruit leaves were the most common supplements to native grass.

2). Use of crop by-products as supplements

4.145 The work of Van Eys, et al. (1983) suggests that smallholder feeding of sheep and goats (and by extension cattle and buffalo) take an "opportunistic" approach and do not attempt to strategically combine crop by-products and other forages to acheive a balanced diet. Ample evidence exists, however, that more effective utilization of on-farm feed resources can be made if such resources are better combined. Work reported by Hartadi, et al. (1984) at Gadjah Mada is illustrative of this point. They compared diets of corn stalks and sorghum stalks and sugar cane tops supplemented with peanut vine, cassava leaf and leucaena leaf for feeding supplemented with a concentrate mixture of coconut meal and rice bran in a 3:1 ratio. All of the feed ingredients were fed separately to monitor their consumption.

4.146 Results of the Hartadi study are shown in table IV.7. In this study sorghum stalks were of relatively low nutritive value (TDN % of 31.1 vs. 44.4, 42.0 and 47.2 for corn stalks, sugar cane tops and napier grass, respectively). The higher (though not significantly so) ADG of goats in group II was apparently due to their higher daily consumption of peanut vines. Peanut vines, with 58.1% TDN and 14.9% CP in this study, are an excellent protein supplement to lower quality forages such as corn and sorghum stalks and sugar cane tops. Given that goats were allowed consumption of the feeds free choice, the authors postulate a direct substitution effect of peanut vines for leucaena leaf. Cassava leaf, though lower in TDN and CP in this study (40.0% and 23.4%, respectively) relative to leucaena leaf (68.9% and 26.4%) had a higher rate of consumption (table IV.7) which the authors relate to its lower half-life in nylon bag studies (38 hrs vs 50 for leucaena leaf) which probably indicates a faster digestion rate in the rumen. Average daily gains (ADG) were not significantly different in this study. DMI per kg BW 0.75 and a slightly higher amount of DP was required per g ADG for the goats on the by-product diets (groups I, II and III) but TDN intake per gram of ADG was lower. Considering only ADG, the napier grass-concentrate diet (IV) was clearly deficient relative to the crop by-product diets. No possible explanation was given by the authors.

Table IV.7: Intake of dry matter (DMI), digestible protein (DPI) and TDN (TDNI) and average daily gain (ADG) of 6-month old male Kacang goats fed mixtures of crop by-products

| Group: | I | II | III | IV |
|---|---|---|---|---|
| DMI (gms/hd/day): | | | | |
| Corn stalks | 135 | - | - | - |
| Sorghum stalks | - | 136 | - | - |
| Sugar cane tops | - | - | 118 | - |
| Peanut vines | 162 | 189 | 148 | - |
| Cassava leaf | 136 | 143 | 147 | - |
| Leucaena leaf | 112 | 93 | 143 | - |
| Napier grass | - | - | - | 186 |
| Concentrate | - | - | - | 145 |
| Animal performance: | | | | |
| ADG (g/hd/day) | 56.3 | 55.0 | 50.0 | 40.4 |
| DPI/g ADG | 1.2 | 1.0 | 1.1 | 0.9 |
| TDNI/g ADG | 6.2 | 5.1 | 5.8 | 6.5 |
| DMI (g/kg BW 0.75) | 78.5 | 74.8 | 67.3 | 42.8 |

Source: Hartadi, et.al. (1981)

4.147 Cassava leaf meal (CLM) was used as a protein supplement to napier grass for growing wether lambs by Sudaryanto, et al. (1984). Sheep were allowed napier ad libitum and supplemented with 0, 50, 100 or ad libitum levels (g/day) of CLM. Data indicated that intake of all nutritive constituents (DM, CP, neutral detergent fiber (NDF) and organic matter (OM)) significantly increased with increasing amounts of CLM. Digestibility of DM and NDF did not significantly differ among treatments though digestibilities of OM and CP were higher with higher levels of CLM. Average daily gain was higher with ad libitum CLM (65.71 g/day vs. 42.86, 48.57 and 48.57 for the 0, 50 and 100 g CLM groups) and feed conversion ratio lower (10.26 g feed/g ADG compared to 10.90, 10.66 and 11.61, respectively) with increasing intake of CLM.

### 3. Crop and livestock components of farming systems

4.148 The studies of farming systems in Indonesia has evolved over the past 15 years. The process began in 1969 with multiple cropping studies in the Central Research Institute for Agriculture (CRIA, later designated Central Research Institute for Food Crops, CRIFC) within AARD. In subsequent years, the extension service (Directorate General of Food Crops)



165

collaborated at central and provincial offices. Support has also been provided by IRRI, USAID and IDRC.

4.149 In 1976, the Directorate General of Transmigration provided funds for cropping systems research in several new transmigration sites. These activities were further expanded with the support of other agencies, and research sites were established in Provincial Development Project (PDP) areas in Central Java and NTT, in the Citanduy Upper River Watershed Project in West Java and in rural development projects in Yogyakarta and Central Java. There have been, or presently exist, 40 CRIFC cropping/farming systems research sites in Indonesia.

4.150 The cropping systems program developed several alternative cropping patterns for different agro-climatical and edaphological conditions. The primary effort has been directed toward rice-based cropping systems in:

- lowland rice areas (irrigated, partially irrigated and rainfed)
- upland rainfed areas (highland, humid, drought prone, upper watershed) and
- coastal wetlands (tidal swamps, fresh water swamps).

The principal objectives of the program have been to develop technologies that permit more intensive cropping patterns for existing areas and expansion of improved cropping systems onto marginal or under-utilized lands. It has been successful in developing stable and sustainable cropping patterns that are acceptable to farmers for the major land areas in Indonesia. This has been accomplished by strategies such as introduction of early-maturing and improved varieties, direct seeding of rice, reduction in turn-around time between successive crops, simplification of cropping patterns, inclusion of additional secondary crops and intercrops, and improved crop management practices.

4.151 The cropping systems research program has been inter-disciplinary and integrated with other government agencies through on-site trials, workshops and training activities. Farmer adoption of modified rice cropping systems has increased gradually year-by-year. Implementation of the technology in the 1982-83 crop season through BIMAS, INSUS and OPSUS programs represented a major breakthrough for the wide-scale adoption and transfer of new technology.

4.152 Over the years, some attention has been given to secondary crops as well, particularly in localities where the cropping patterns are maize-based. Cropping systems, however, are based on an edaphological breakdown of land areas in Indonesia. Thus, there is no need for use of such terms as rice-based or maize crop based but simply development of systems relevant to a given area.

4.153 The cropping systems program has developed methodologies and a core of trained personnel. Approximately 150 research and extension workers have been sent to IRRI and other places for training, workshops, and study tours in cropping systems over the past 10 years. This staff can design and carry out on-farm studies and demonstrations. Linkages with other commodity research groups and government agencies have also been developed. The capability to approach farming systems research holistically has



166

developed gradually. The present program strategy encourages the introduction of perennial crops into the farm systems.

4.154 Even though improved cropping systems provided increased feedstuffs as a by-product of increased crop production, future research should explicitly consider crop/livestock relationships. The cropping systems program plans to include studies to develop more stable and nutritious animal feed supplies. Some integrated research is already underway in transmigration areas in Lampung and South Sumatra.

4.155 A livestock farming systems research program also resides in the program of the Research Institute for Animal Production (Balai Penelitian Ternak - BPT, Bogor) of the AARD. The overall aims of the program were defined in the BPT Master Plan 1981 and discussed by Sabrani et al. (1982). To date, work has been limited to Java with collection of secondary data and survey information describing ruminant feeding systems, village buffalo fertility, fodder utilization in the dry season, and composition of village feedstuffs. Four sites were selected on the basis of land classification and livestock systems. Agro-economic and forage profiles were determined, and major constraints to improving livestock production and farmer income were identified.

4.156 Ideas generated from these profiles were first tried in demonstration stock pens, both at BPT and in villages. Studies were kept simple in nature and design because low stock numbers make it is difficult to maintain proper livest[illegible] controls in farm trials. Some data have been attained and examples of ideas/technology transferred to the Directorate General of Livestock Services include the recommendation to use approved bulls rather than AI for servicing buffalo bulls, advice on aflatoxin poisoning of ducks through infected maize, supplements for Madura cattle and forage trials in Madura villages.

4.157 The BPT livestock systems program is relatively new. Unfortunately it is constrained by a shortage of funds and personnel, and lack of tested techniques and methodologies applicable to livestock studies. This is a pioneering effort to study the livestock component in farming systems, and places BPT ahead of most livestock research organizations of the world. At this stage, linkages between the BPT livestock farming systems research program and cropping systems programs have not been developed. It is hoped that the CRIFC cropping systems program, which envisions including an animal component, and the BPT program will find mutual areas for collaboration and complementation but not duplication of efforts.

### 4. Agro-industrial by-products

#### a. Introduction

4.158 As a result of food and export crop processing, the highly developed agro-industrial sector in Indonesia produces several by-products that are of current or potential value as feedstuffs to the livestock sector. Many by-products, especially rice bran and copra meal, are being utilized extensively both at the local village level around the centers of availability and at the level of the commercial feed industry where they are important feedstocks for poultry and livestock feeds. Other materials, such as the waste by-products ("ampas") from soy curd and cassava starch processing, have special problems (e.g. moisture content) and limited availability which preclude their extensive use in the commercial feed industry. Nevertheless, they are important feedstuffs in the immediate area in which they are produced and often form the basis for profitable livestock enterprises such as swine fattening. A third group, including the fibrous by-products of sugar, cacao and coffee processing, have specific chemical characteristics which limit their use as livestock feeds except in special circumstances where their availability and low cost make them attractive as maintenance rations for adult ruminants. This third group has a great deal of potential as a feed resource but will require a significant amount of research and application of processing and storage technology before they will contribute significantly to animal production.

b. Rates of recovery

4.159 Appendix table 4.12 from the work of Nitis (1981) presents a list of agro-industrial by-products available in Indonesia and their rates of recovery. Recovery rates vary largely depending on the process being used to produce the primary product. In the production of oils from oil palm, copra and other crops, processes which use pressure for extraction are less efficient in removing oil than are solvent-based processes and therefore the residue left over is a greater percentage of the original parent material. The quality of the parent material will also affect the yield of the by-product. Small cassava tubers used for starch extraction yield a higher percentage of peelings than do larger tubers. Finally, the efficiency of processing machinery and equipment affect yield of by product. Village-level rice mills are much less efficient in seperating hull, bran and grain than larger, more modern mills found in the cities and result in a larger percentage of "halus", or rough bran, than "bekatul", a bran lower in fiber.

c. Availability of agro-industrial by-products

4.160 Estimates of annual availability of various by-products in eight Indonesian provinces are presented in appendix table 4.13. The greatest volume of rice bran is produced in Java, a reflection of the intensive rice cropping of that island. By-products of the palm oil industry, palm fiber, palm kernel cake and refinery waste, are principally produced in the province of North Sumatra where P.T. Pekerbunan, the government-owned oil palm operation is located. Despite the large volumes of these by-products, little is used by the nearby Medan feedmill companies. Palm fruit fiber, after oil removal, is burned as fuel in palm oil factories and palm kernel cake flows from the factory direct to export markets in Europe and ASEAN countries. The reason for the lack of use of palm oil by-products by the commercial feed industry is discussed below. A tremendous quantity of sugarcane bagasse is produced in East Java. The majority of this is used to fuel boilers at the cane factories. Given the high crude fiber content of bagasse (48%, appendix table 4.14) this material has little feeding value without further treatment. Most sugarcane producing countries utilize bagasse as boiler fuel or in the production of fiberboard.

4.161 Based on predictions of TDN content derived from chemical analyses similar to those shown in appendix table 4.14 and estimated areas of planting, the DBPP/FPIPB report estimates that 20.8 million MT of TDN are available annually in Indonesia from agro-industrial by-products (table IV.8). Given the current livestock population of the 8 provinces and the production of agro-industrial by-products, the IPB report estimates that this energy production is sufficient to satisfy from 32.9% (DI Yogyakarta) to 115.8% (DKI Jakarta) of provincial livestock TDN requirements (table IV.9).

d. Potential for use in animal feedstuffs

4.162 Lebdosoekojo and Reksohadiprodjo (1982) expressed maximum inclusion levels of agro-industrial by-products in livestock rations (appendix table 4.15). Ruminants generally are able to handle larger amounts of fibrous by-products such as cassava pomace and coffee and cacao residues. The estimates do not consider such factors as amino acid balance, of special importance in commercial poultry rations, or the special "combining abilities" of some by-products which might alter the amounts which can be utilized in a ration.

e. Rice by-products: a special role in livestock feeding

4.163 Rice by-products deserve special attention in any survey of Indonesian feedstuffs because of their importance to the livestock industry at all levels. Dairy cows produce milk on concentrates which may be as high as 40% rice bran mixed in the KUD feed mill with commercial concentrates. Village-level fattening of Holstein-Friesian bull calves in Java is based on rice bran supplementation of crop residues and cut-and-carry native grass. Pigs in Bali and Sumatra consume rice bran and cassava as the main dietary energy sources. Many Indonesian ducks produce eggs on paddy grazing supplemented by rice bran, water plants, snails and sago palm pith. The Indonesian compound feed industry based in Java and Sumatra depends upon locally available rice bran for 15 to 20% of its feedstock in commercial poultry rations. In Indonesia, rice bran is truly a key factor to the production of the livestock sector.

4.164 Rice milling results in four principal by-products; rice hulls, rice bran, rice polishings and broken rice or rice "screenings". Rice hulls are of little or no value in animal feeding being very high in indigestible fiber and ash, particularly silica. They actually represent a disposal problem in some village situations but have been converted to useful non-livestock applications such as fuel, compost to improve soil physical characteristics, and bedding for rice seeding.

4.165 Rice bran is the coat of the rice seed. Depending on the degree of hull included in the bran portion as a result of milling, its feeding value ranges from 50 to 80% of that of yellow corn. A serious problem with the use of rice bran in the feeding of non-ruminants and poultry is its phytic acid content which tends to reduce the absorption of zinc from the diet and can lead to a zinc deficiency condition known as parakeratosis.

4.166 Rice polishings are the final bran portion surrounding the rice grain and are higher in nutritive value (total protein content and digestibility, appendix table 4.14) than the bran. Most of the village-level mills in operation in Indonesia are not designed to seperate out the polishings from the grain.

Table IV.8. Estimated 1983 production of TDN from agro-industrial and crop by-products in eight provinces of Indonesia [a]

| Crop | Area harvested | TDN production |
|---|---|---|
| | (ha) | (tons) |
| Paddy rice | 8,173,197 | 13,654,208 |
| Upland rice | 1,202,747 | 1,436,714 |
| Corn | 3,013,034 | 3,024,564 |
| Cassava | 1,395,010 | 773,511 |
| Sweet potato | 265,337 | 275,141 |
| Peanuts | 518,757 | 622,899 |
| Soybean | 811,424 | 660,951 |
| Sugar cane | 171,900 | 352,934 |
| Total | | 20,800,925 |

Source: DBPP/FPIPB, 1985
[a] Provinces included are South Sumatra, Lampung, DKI Java, West Java, Central Java, DI Yogyakarta, East Java and Bali

Table IV.9: Estimated potential production of TDN from agro-industrial by-products and capacity to provide energy needs of current livestock populations in 8 Indonesian provinces [a]

| Province | Potential TDN | % of livestock reqs satisfied |
|---|---|---|
| | (tons) | |
| South Sumatra | 539,431 | 94.3 |
| Lampung | 199,723 | 106.1 |
| DKI Jakarta | 59,295 | 115.8 |
| West Java | 1,085,056 | 76.8 |
| Central Java | 765,104 | 98.9 |
| DI Yogyakarta | 106,459 | 32.9 |
| East Java | 2,083,105 | 59.2 |
| Bali | 100,326 | 13.8 |

[a] Source: DBPP/FPIPB, 1985.

4.167 Broken grains and dust are seperated out in the final screening ("rice screenings") of the milling process. Basically this material has the same nutritional value as rice grain and is very digestible for all classes of livestock.

### f. Imports of agro-industrial by-products

4.168 Imports of maize, sorghum, soybean meal, fish meal and other commodities with known or potential feeding value are presented in appendix table 4.16. All importations of fishmeal, soybean oil meal and corn for livestock feeding are handled by the government through its Bureau of Logistics (BULOG). Soybean meal imports have risen steadily from 71,769 tons in 1982 to 206,077 tons in 1984. At the same time, imports of peanut, sunflower and other oil seed cakes has also been increasing. Interviews with ingredient purchasing agents of several large feedmills indicate that imports of oilseed cakes are made periodically when there is a problem with availability of soybean meal through BULOG.

### g. Major constraints to the use of agro-industrial by-products

4.169 Many of the major agro-industrial by-products produced in Indonesia are utilized in livestock feeding systems. The commercial feed manufacturing industry consumes a large proportion of domestically-produced soybean, peanut and copra meal. Rice bran is utilized by feed mills and by smallholders feeding dairy cattle or fattening calves and pigs. Wastes from the production of soy curd, tempe and cassava starch are fed to pigs in commercial and smallholder herds located nearby to processing plants. Many times, these enterprises are feasible because they are able to take advantage of low-cost by-products which have little alternative use.

4.170 Whether or not an agro-industrial by-product is used in feeding systems is determined by several factors discussed below. Most important among them are the chemical composition, physical characteristics and moisture content of the material, its availability throughout the year, its cost relative to alternative feedstuffs and its value in the export market relative to the return which can be expected from domestic use.

4.172 Chemical composition: Chemical composition for the major agro-industrial by-products are available from research and commercial laboratories in Indonesia. Compositions reported for a given by-product vary due to the condition of the sample, confusion as to nomenclature, and the specific laboratory process being used to seperate nutritional entities such as fiber, carbohydrate and protein. The traditional "crude fiber" methodology for determining nutritional value of livestock feedstuffs has been shown to have serious deficiencies and has been replaced in most modern animal nutrition laboratories with "detergent" methods which seperate feedstuff fractions in closer correlation with their true nutritional availability. A large body of work on Indonesian by-products has been reported over the past two decades, but unfortunately the majority of the data has been derived from crude fiber processes.

4.173 For many by-products, chemical composition is an important constraint to their use in animal feeding, especially in poultry rations. The commercial feed industry is primarily involved in the manufacture of poultry feeds. Indonesian poultry production systems are designed around the use of feeds formulated with a corn-soybean oil meal base typical of most countries with a sophisticated egg and broiler-producing sector. Many of the agro-industrial by-products available but not extensively utilized such as palm kernel meal and products of coffee and cacao processing have chemical compositions which make it costly or impossible to include them in commercial poultry rations. For some by-products, the principal problem is amino acid content. Inclusion of these feeds would require the use of costly synthetic or natural amino acids to balance resulting amino acid excesses or deficiencies. Others, such as cacao or coffee wastes and kapok seed meal, are high in cell wall (fiber) which chickens (and pigs) cannot digest and which reduces the feeding value for ruminants. Toxicities represent another problem for the use of by-products such as cassava peelings. Available processes for reducing toxicities often result in a cost for the final product greater than its value in feed rations. In most cases, alleviating the constraints caused by chemical composition is not economical.

4.174 Relative price: In table IV.10, Lebdosoekojo and Reksohadiprodjo (1982) determined the "relative price" of agro-industrial by-products on the basis of their content of total protein and total digestible nutrients relative to corn priced at Rp 90/kg and soybean oil meal at Rp 300/kg. Feedstuffs with a lower relative price than their actual price are of equal, or greater, value than corn and soybean oil meal in livestock rations (all other factors such as crude fiber levels, toxins and digestion

Table IV.10: Price comparison of commercially available agro-industrial residues in Java, 1979

| Product | Actual Price [a] | Relative Price [b] |
|---|---|---|
| | (Rp/kg) | |
| Rice bran | 40.23 | 92.45 |
| Maize bran | 45.00 | 115.89 |
| Molasses | 70.00 | 31.58 |
| Cassava pomace | 42.70 | 50.78 |
| Cassava peelings | 15.00 | 42.82 |
| Copra meal | 104.45 | 147.39 |
| Peanut meal | 284.19 | 248.14 |
| Palm kernel meal | 111.00 | 148.35 |
| Kapok meal | 27.00 | 204.19 |
| Soybean curd sludge | 97.00 | 196.77 |
| Fish meal | 389.00 | 373.97 |

Source: Lebdosoekojo and Reksohadiprodjo (1982)
[a] Average price in Java, 1979, dry matter basis
[b] The relative price was computed on a nutrient content basis with the nutrients (CP and TDN) given the same value as their cost in corn at Rp 90.00/kg and soybean oil meal at Rp 300/kg
Note: 645 Rp (1979) = U.S. $1.00



172

inhibitors being equal). Considering 1979 prices of the feedstuffs listed, only molasses, peanut meal and fish meal had a relative price higher than their actual price. Given the availability of corn and soybean oil meal at the prices cited, use of the other listed feedstuffs in commercial concentrate formulas as substitutes for these imported ingredients would not have been economically advantageous.

4.175 Moisture content: For some agro-industrial by-products the primary constraint to use is water, or moisture, content. High moisture and the high environmental temperatures characteristic of Indonesia create ideal conditions for the growth of molds. Chemical treatment of high moisture feedstuffs to inhibit mold growth is possible but usually not economical or practical for smallholders. Transporting and storing feedstuffs high in moisture require special equipment and structures. Most high moisture by-products such as soy curd and tempe waste, brewer's grains and cassava pomace are used opportunistically by swine and cattle producers in the immediate vicinity of the processing plant. In very few cases is it economical to transport high moisture by-products any significant distances.

4.176 Volume: Like moisture, volume, or bulk, can create problems of transport and storage. In highly mechanized feed mills, movement of bulky materials such as peanut skins requires special equipment. In addition, bulky materials with low nutrient densities can only be used by ruminants and only in quantities which will not cause limitations to intake due to rumen fill. This problem can be reduced somewhat by grinding to reduce bulk and to increase rate of passage through the ruminant gut.

4.177 Seasonality of availability: For by-products of crops with seasonal production and harvest curves such as molasses, alternative feedstuffs must be available in the off-season or the by-product must be stored for use across the year. This is practical and economical for by-products such as rice and corn bran and copra meal which, when properly processed, do not deteriorate in storage and have a high feeding value. For other by-products the cost of further-processing to allow long-term storage is not economical.

4.178 Value in export: For some agro-industrial by-products such as palm kernel cake and molasses, their value as export commodities exceed their value as domestic feedstuffs. Most of Indonesia's palm kernel cake is exported to Europe where it is an important ingredient in concentrates for ruminant livestock. Its use in poultry rations is precluded by a high fiber content and disadvantageous amino acid balance. The ruminant livestock sector in Indonesia does not have the level of productivity which would create a demand that could compete with the European livestock sector for this valuable feedstuff. With regards to molasses, use of molasses in Indonesian commercial poultry rations is very low (2% or less) and Indonesia has no extensive manufacture of ethyl alchohol and distilled spirits. As a result, most of the molasses produced as a by-product of sugar refining is exported to other Pacific rim countries. Appendix table 4.17 derived from data collected by the Central Bureau of Statistics lists the most important by-products exported by Indonesia in the period 1981-1984. In 1984, molasses, rice bran, palm kernel cake and copra meal accounted for US$ 62.8 million, or 54.1%, of the US$ 116.1 million worth of by-products exported. Indonesia's exports of feedstuffs also includes the use of feeds formulated with a corn-soybean oil meal base typical of most countries with a sophisticated egg and broiler-producing sector. Many of the agro-industrial by-products available but not extensively utilized such as palm kernel meal and products of coffee and cacao processing have chemical compositions which make it costly or impossible to include them in commercial poultry rations. For some by-products, the principal problem is amino acid content. Inclusion of these feeds would require the use of costly synthetic or natural amino acids to balance resulting amino acid excesses or deficiencies. Others, such as cacao or coffee wastes and kapok seed meal, are high in cell wall (fiber) which chickens (and pigs) cannot digest and which reduces the feeding value for ruminants. Toxicities represent another problem for the use of by-products such as cassava peelings. Available processes for reducing toxicities often result in a cost for the final product greater than its value in feed rations. In most cases, alleviating the constraints caused by chemical composition is not economical.

4.174 Relative price: In table IV.10, Lebdosoekojo and Reksohadiprodjo (1982) determined the "relative price" of agro-industrial by-products on the basis of their content of total protein and total digestible nutrients relative to corn priced at Rp 90/kg and soybean oil meal at Rp 300/kg. Feedstuffs with a lower relative price than their actual price are of equal, or greater, value than corn and soybean oil meal in livestock rations (all other factors such as crude fiber levels, toxins and digestion

Table IV.10: Price comparison of commercially available agro-industrial residues in Java, 1979

| Product | Actual Price [a] | Relative Price [b] |
|---|---|---|
| | (Rp/kg) | |
| Rice bran | 40.23 | 92.45 |
| Maize bran | 45.00 | 115.89 |
| Molasses | 70.00 | 31.58 |
| Cassava pomace | 42.70 | 50.78 |
| Cassava peelings | 15.00 | 42.82 |
| Copra meal | 104.45 | 147.39 |
| Peanut meal | 284.19 | 248.14 |
| Palm kernel meal | 111.00 | 148.35 |
| Kapok meal | 27.00 | 204.19 |
| Soybean curd sludge | 97.00 | 196.77 |
| Fish meal | 389.00 | 373.97 |

Source: Lebdosoekojo and Reksohadiprodjo (1982)
[a] Average price in Java, 1979, dry matter basis
[b] The relative price was computed on a nutrient content basis with the nutrients (CP and TDN) given the same value as their cost in corn at Rp 90.00/kg and soybean oil meal at Rp 300/kg
Note: 645 Rp (1979) = U.S. $1.00

inhibitors being equal). Considering 1979 prices of the feedstuffs listed, only molasses, peanut meal and fish meal had a relative price higher than their actual price. Given the availability of corn and soybean oil meal at the prices cited, use of the other listed feedstuffs in commercial concentrate formulas as substitutes for these imported ingredients would not have been economically advantageous.

4.175 Moisture content: For some agro-industrial by-products the primary constraint to use is water, or moisture, content. High moisture and the high environmental temperatures characteristic of Indonesia create ideal conditions for the growth of molds. Chemical treatment of high moisture feedstuffs to inhibit mold growth is possible but usually not economical or practical for smallholders. Transporting and storing feedstuffs high in moisture require special equipment and structures. Most high moisture by-products such as soy curd and tempe waste, brewer's grains and cassava pomace are used opportunistically by swine and cattle producers in the immediate vicinity of the processing plant. In very few cases is it economical to transport high moisture by-products any significant distances.

4.176 Volume: Like moisture, volume, or bulk, can create problems of transport and storage. In highly mechanized feed mills, movement of bulky materials such as peanut skins requires special equipment. In addition, bulky materials with low nutrient densities can only be used by ruminants and only in quantities which will not cause limitations to intake due to rumen fill. This problem can be reduced somewhat by grinding to reduce bulk and to increase rate of passage through the ruminant gut.

4.177 Seasonality of availability: For by-products of crops with seasonal production and harvest curves such as molasses, alternative feedstuffs must be available in the off-season or the by-product must be stored for use across the year. This is practical and economical for by-products such as rice and corn bran and copra meal which, when properly processed, do not deteriorate in storage and have a high feeding value. For other by-products the cost of further-processing to allow long-term storage is not economical.

4.178 Value in export: For some agro-industrial by-products such as palm kernel cake and molasses, their value as export commodities exceed their value as domestic feedstuffs. Most of Indonesia's palm kernel cake is exported to Europe where it is an important ingredient in concentrates for ruminant livestock. Its use in poultry rations is precluded by a high fiber content and disadvantageous amino acid balance. The ruminant livestock sector in Indonesia does not have the level of productivity which would create a demand that could compete with the European livestock sector for this valuable feedstuff. With regards to molasses, use of molasses in Indonesian commercial poultry rations is very low (2% or less) and Indonesia has no extensive manufacture of ethyl alchohol and distilled spirits. As a result, most of the molasses produced as a by-product of sugar refining is exported to other Pacific rim countries. Appendix table 4.17 derived from data collected by the Central Bureau of Statistics lists the most important by-products exported by Indonesia in the period 1981-1984. In 1984, molasses, rice bran, palm kernel cake and copra meal accounted for US$ 62.8 million, or 54.1%, of the US$ 116.1 million worth of by-products exported. Indonesia's exports of feedstuffs also includes



175

"further processed" by-products such as pelleted rice bran, dried cassava pellets and chips and tapioca waste pellets (appendix table 4.18). Given the need of Indonesia to diversify its export product line and the low demand for concentrates from the domestic ruminant livestock sector, exportation of these feedstuffs will continue to be the best alternative to domestic utilization.

4.179 Lack of appropriate technology: Some Indonesian agro-industrial by-products which are not appropriate for use in commercial concentrates formulated for intensive poultry production could be of value to smallholders when used to supplement critical nutrient deficiencies in swine or ruminant rations. For instance, a small amount of molasses fed to dairy cattle on rations high in early-cut elephant grass and rice bran could provide the necessary energy needed to boost production and to provide a positive return to the cost of the molasses. Further, for many by-products, their nutritional value can be increased by low-cost further processing on-farm. What is lacking in many cases is appropriate technology or a feeding plan which will allow the by-product to be used economically. For some livestock production systems which do not use concentrated sources of energy and protein, including available agro-industrial by-products in the feeding program could result in significant increases in productivity. On an aggregate basis, development of feeding systems for the use of such by-products as palm kernel cake and molasses could allow Indonesian livestock producers to compete with foreign producers for these valuable feed resources.

## 5. Commercial feed industry

4.180 The commercial livestock feed industry of Indonesia has grown in parallel with the development of egg and poultry meat production from hybrid chickens ("ayam ras"). Of total bulk feed sales, 90% or more of industry output goes to the poultry industry with less than 10% for swine, dairy, duck, fish and shrimp. The industry is centered around five cities: Jakarta, Bandung, Semarang and Surabaya on Java, and Medan on the island of Sumatra. The industry expanded rapidly in the 1970's at 20-40% per year, but growth decelerated to 12% in 1982 and to a current rate of 8 to 10% per annum (World Bank, 1984). The industry was pioneered by foreign investors (Charoen Pokphand of Thailand and Cargill Industries of the United States) but entry to outside investment is now restricted and existing foreign firms must reduce their equity share to 49% or less within 10 years of their establishment. Licenses for new (domestic) firms are currently not being issued for West Java and Medan. Currently 25 commercial feed mills operate under liscense from the government and maintain membership in the Indonesian Feed Mill Association (World Bank, 1984).

4.181 The relationship of the feed mills to the poultry industry is very close. Many of the largest feed mill operators own breeder flocks and hatcheries and distribute day-old-chicks as well as poultry feed, equipment and supplies. In the absence of government restrictions on size of commercial broiler and layer flocks (5,000 layers and 500 broilers per week as per KEPRES 50), the feed and poultry sectors would most likely evolve into a modern vertically integrated industry characteristic of the U.S., Europe and many other ASEAN nations. Interviews with feedmill operators indicate that they are not pleased with the new restrictions, but feel that future demand for feeds will continue to expand as many new smallholders enter the market, many of them participating in "nuclear estate schemes" (PIR). This will probably mean that the portion of feed marketed through poultry shops will increase as the number of large producers diminishes. Most small-scale producers buy through poultry shops rather than take truck-load lot deliveries direct from the feed mill.

4.182 The product line of the commercial feed industry is primarily of two types. "Concentrates" are mixtures containing 40 to 50% total protein which are meant to be mixed with an energy source available on-farm. The on-farm energy source is usually rice bran, as in the case of KUDs providing feeds for member dairy farmers, or corn, as is common on large scale poultry layer operations. "Complete" feeds contain from 12 to 22% total protein and are sold ready to use as starter rations for pigs, calves, chicks and ducklings or production rations for poultry grow-out, egg and milk production. Very little commercial feed is sold for beef or pig fattening. Due to depressed prices for pork, sale of commercial swine feeds have been declining for the mills in Surabaya and Medan which service the industries of Java and Sumatra, respectively. An expanding segment of the feed industry is sale of formulations for fish and shrimp.

### a. <u>Characteristics of feedmills</u>

4.183 Commercial feedmills are defined as those which formulate feeds from purchased ingredients for sale to the general public, farmers and KUDs. Other types of feedmills would include mixing operations on private farms, such as large swine farms around Medan, and facilities operated by KUDs which mix feeds for member dairymen. Feedmill capacities range from C to 10 tons per day up to 400 or more. In general, feedmills can be divided into three broad classes based primarily on plant capacity.

4.184 <u>Large commercial feedmills</u>: These feedmills have daily capacities of 200 to 400 tons. Some of them are owned by multi-national corporations while others are under domestic ownership. They may have more than one mill, usually one in either Jakarta or Surabaya and a second in Medan or Lampung. They distribute their feeds nationally but concentrate sales to the poultry and duck producing regions of Sumatra, Java and Kalimantan with limited distribution to Bali and Sulawesi. Poultry feeds (broiler and layer) account for 90% or more of sales. Most of these feedmills are part of corporations which also operate poultry breeder flocks and hatcheries and sell breeder lines developed in the U.S., Japan, Europe and Australia. Both feed products and day-old-chicks are distributed to small producers through poultry shops in and around major cities, or sold direct to large poultry producers.

4.185 The larger mills acquire the major part of their domestic ingredients (e.g. corn, copra meal, rice bran) through agents who buy from producers and factories to the specifications of the client feedmill. Ingredients are delivered to the feedmill gate in the agent's truck. For ingredients produced in factories located near to the mill such as rice bran and other milling by-products, the feedmill may send its own trucks for pick-up. Fish meal produced by one of the seven fish oil plants on the west coast of Bali is mostly utilized by the large feedmills in Surabaya. Deliveries of fish meal at the factory gate are tested for total protein and a price penalty is assessed for each percentage point below specifications.

4.186 These mills have sophisticated laboratories manned by trained technicians which analyze ingredients coming in and products going out of the plant. The primary concerns as regards quality characteristics of ingredients are moisture content and aflatoxin levels in corn and peanut meal. Those mills which mix ingredients according to closely controlled formulas will also test ingredients for total protein and possibly gross energy before they are unloaded from the delivery truck. The laboratories also monitor product quality by analyzing for the major nutrients (e.g. TP, crude fiber) and macro-minerals of concern to poultry production. They also test feed samples from farms which have experienced production problems and samples of competitors products. In the absence of government monitoring, these laboratories are the only means of maintaining standards of quality in the country.

4.187 The majority of feedstuffs move into the feedmill and are stored in 50 kg bags. The larger mills may receive some bulk shipments of rice bran and corn which are stored in upright silos. Almost all mixing operations are done in upright mixers of 3 to 6 tons capacity. The larger mills usually have equipment to pelletize feeds or to package them as "crumbles". Almost all sales are in 50 kg plastic bags which bear the company trademark and product identification. The larger mills also attach a label to their bags which identify ingredients and gross nutrient content.

4.188 The larger mills formulate their feeds according to computerized least cost programs which consider basic nutrient requirements for a particular feedstuff and ingredient price and nutrient content. While ingredient prices may fluctuate as much as 30 to 40% according to season of the year and international market conditions, product formulations are changed rarely and only within narrow limits in order to avoid problems in customer flocks.

4.189 The large feedmills employ veterinarians, animal nutritionists and laboratory technicians as part of management staff. Many of these people receive training outside of Indonesia and attend periodic shortcourses in the country. These companies also do not hesitate to call on technical consultants from within Indonesia and outside when engineering or nutritional problems arise.

4.190 Medium commercial feedmills: These feedmills have capacities in the range of 20 to 200 tons per day. These are distinct from the larger feedmills in that, with some exceptions, they are domestically owned, operate only one plant and do not have an associated poultry breeder/hatchery operation. They generally sell most of their product within a single region of Java or Sumatra with a significant proportion of their sales going directly to poultry farmers and KUDs. Credit is generally of greater importance as a sales mechanism for these companies compared to the larger plants.

4.191 These feedmills generally have no computer facilities and no extensive laboratories though they may do simple tests for moisture and aflatoxins in the ingredients received at the factory gate. Feed formulation is based upon assumed nutrient content of the ingredients received into the plant. This means that when a shipment of poor quality corn or soybean meal is received, the nutrient content of the final formulation can fluctuate widely. In addition to ingredient quality, these feed mills tend to make more substitutions in their formulations with changes in ingredient prices. The combination of both, changes in final product nutrient content and changes in formulation, could have profound effects on a poultry flock's productivity.

4.192 Small commercial feedmills: These are feedmills with capacities below 20 tons per day. They survive in the face of competition from the large, more efficient multi-national companies because they service a market the larger plants ignore and because of the intervention of BULOG in the market for ingredients, they are able to buy soybean and fish meals, the most costly feed ingredients, at the same price as the larger plants. These feedmills generally do custom mixing of complete or concentrate formulas for poultry and swine producers and KUDs. Like the medium-sized feedmills they lack laboratory facilities and are therefore at the "mercy" of whatever quality of ingredients are available through the agents they buy from and BULOG. Feed mixing and grinding operations in these plants is not rigidly controlled as in the larger plants. Scales are usually very old and not highly accurate. Formulations are usually based on "number of bags" rather than precise weights and measures.

4.193 The small plants usually do not own their own trucking and hire all transportation, the cost of which is added to their product cost. They also tend to extend more liberal credit to their customers, especially the KUDs, than do the larger companies.

b. Feed ingredients

4.195 Projected use of feed ingredients is given in appendix table 4.19. Ingredient use is expected to increase an average 9.7% annually during Repelita IV. Use of domestic feed resources, especially copra cake and rice bran will increase markedly as government efforts to reduce the use of foreign exchange to import fish and soybean oil meals become more restrictive. It would be expected that greater domestic use of high quality agro-industrial by-products will have a negative impact on import of these feedstuffs.

4.196 Role of BULOG: In an effort to control the use of foreign exchange, all imports of soybean and fish meals are done by the Bureau of Logistics (BULOG), an agency of the Government of Indonesia. Feed mills are allowed to purchase domestic fish meal directly from Indonesian fish oil and canning factories but supply from this source is limited and is generally "cornered" by the larger mills. The larger feedmills import on their own some oilseed meals such as sunflower and safflower meal but use is limited by the high cost of these ingredients. All other feed ingredients move freely in the marketplace and are purchased directly by the feedmills, usually through contracts with agents who bulk the supply through purchases in the villages and transport it to the feedmill gate. The presence of BULOG in the ingredient marketplace appears to have had several results. As mentioned before, the price of these two highly expensive ingredients is stabilized by BULOG. This aids the smaller, less efficient mills in competing with the larger operations. On the negative side, the mills have to depend on BULOG to control the quality and quantity of meals coming into the country. From observations by study team members, this is not always achcived and feedmills are periodically burdened with poor quality ingredients. Also, BULOG distributes soybean and fish meals on a "quota" basis. The larger feedmill companies can regulate the availability of these ingredients by moving supplies between plants. The medium-sized mills, if their quota is insufficient to needs over a short period, have to purchase small quantities of meal available on the market at higher prices or change their formulations and turn to lower-quality ingredients. No feedmill managers interviewed indicated that they ever had to shut down operations due to insufficient supply of soybean or fish meal. Further analysis of BULOG's role is carried out in Chapter VIII.

4.197 Sources and prices of feed ingredients: Feed mill managers and purchasing agents were interviewed during the course of the study. Prices quoted below are those obtained in August, 1985. Appendix table 4.20 presents a list of prices and price ranges as obtained in different localities and at different plant sizes.

4.198 Corn: Corn is used at the rate of 30 to 50% in poultry rations. The source of the majority of the corn used in the commercial feed industry is domestic production in East Java, Madura and Sumatra. Corn prices at Surabaya range from Rp 150 to Rp 170 per kg. Purchase by the large feedmills through long-term contracts with buying agents tends to reduce the seasonal fluctation in price. The medium and smaller mills sometimes experience large increases in price and decreases in quality. BULOG occasionally imports a significant amount of corn but most of this appears to be destined to human foodstuff manufacture.

4.199 Soybean meal: All soybean meal is imported by BULOG from the United States, Brazil, Taiwan and China. The reported price at Surabaya in August, 1985 was Rp 265/kg. Availability of supply is generally not a problem to the larger mills but quality can vary largely based on country of origin. Soybean meal is used at the rate of 20 to 40% in poultry rations.

4.200 Fish meal: Import of fish meal is controlled by BULOG but some meal is available from domestic fish oil and canning plants on the west coast of Bali near Negara. Quality of domestic fish meal is a problem for the feed mills with total protein content varying from 40 to 55%. In the larger mills, shipments received at the plant gate are tested before unloading and penalties assessed for deficiencies in crude protein. One plant at Surabaya reduced the Rp 400 per kg price paid to suppliers by Rp 10 per kg for each 1% drop below 45% total protein.

4.201 On the production side, total protein content of fish meal varies with the kind of fish being processed and the amount of heads and bones going into the mixture. BULOG imports fish meal and provides it to feed mills at a price lower than what processors on Bali claim is their cost of production plus transport. Pure fish meal from fish oil production tests at 65% total protein but has an F.O.B. Surabaya cost for the processor of Rp 645 per kg. In order to reduce F.O.B. cost to at or below BULOG prices, fish oil processors lower the quality of their meal by mixing in lower priced fish heads and bones from their canning lines. This also lowers the true protein content from 65% down to the minimum 45% the feedmills will accept without assessing a price penalty.

4.202 Wheat pollards: Wheat pollards ("middlings") are the germ of the wheat seed and are a by-product of the flour milling industry in Jakarta and Surabaya. Only the larger feedmills in these two cities use wheat pollards. Factorygate price in August, 1985 at Surabaya was Rp 95/kg.

4.203 Broken rice: Broken rice is available from the larger rice mills which screen their polished rice. Factorygate price at Surabaya in August, 1985 was Rp 120/kg.

4.203 Copra meal: Copra meal is rarely used in large feedmills on Java because of problems with price, quality and availability. It is used in limited quantities (10% or less) by the mills on Sumatra where large quantities are available from the many small coconut oil mills. Factorygate price at a large mill in Medan in August, 1985 was Rp 100/kg.

4.204 Sorghum: Indonesian feedmills import some grain sorghum for use in poultry feeds and a small amount is grown in East Java. Domestic sorghum production in the amounts necessary to supply the large feedmills of Surabaya is limited between December and March. Feedmills in the other cities of Java and Sumatra used little or no sorghum in their formulations. Factorygate price at Surabaya in August, 1985 was Rp 135/kg.

4.205 Bone meal: Bone meal is produced domestically from bones collected at municipal slaughterhouses and from larger meat markets in the principal cities of Java and Sumatra. Factorygate price at Surabaya in August, 1985 was Rp 165/kg.

4.206 Leucaena leaf meal: Limited amounts of leucaena leaf meal ("lamtoro") is used in poultry feeds: 2% in complete and 5% in concentrate feeds. These concentrates are designe to be mixed with farmer-supplied corn or rice bran. Leucaena leaf meal is used by the feed mills because it adds color to the egg yolk. Acquiring a consistently high-quality supply of leucaena leaf meal is a problem for the large mills. Leaf meal producers often mix in other leaf species of lower nutritive value. Also, leucaena leaves are often dried by farmers on bare ground and in collecting the leaves after drying a great deal of soil, sand and other foreign materials are included. Price at Surabaya in August, 1985 was Rp 70/kg.

4.207 Shrimp waste: The heads and carapaces of shrimp are an excellent feed source for poultry, especially ducks, however, availability in sufficient quantity is a problem. As the shrimp industry expands in the future and exports of frozen shrimp increase, shrimp waste will probably become a more important feed ingredient. Much of the small quantity now available which is not used by the commercial feed industry is used by duck egg producers in East Java.

4.208 Limestone: Limestone is domestically produced and priced at Rp 25/kg at the factory gate in Surabaya.

4.209 Oyster shell: Oyster shell is domestically produced. Factorygate price in August, 1985 at Surabaya was Rp 25/kg.

4.211 Additional ingredients used in commercial feed mixtures not listed in appendix table 4.20 include reject palm oil and fish oil. A small amount of reject palm oil (1% or less) is used in poultry rations to provide good binding qualities to the feed mixture, reduce dust and raise



(5)

energy levels. Price at Surabaya in August, 1985 was Rp 700/kg. At the same location reject fish oil was priced at Rp 400/kg.

4.212 As mentioned above, some high-protein feedstuffs are imported directly by feedmills in order to assure a steady supply of quality ingredients. These include sunflower meal and corn gluten meal from the U.S. Because of their cost they are generally used at a level of 10% or less in poultry rations.

4.213 Additional trace minerals, amino acids and vitamin pre-mixes are added to rations as customary in other countries with modern poultry feed industries. Amprol is generally added to poultry rations as a coccidiostat with bacitracin used in layer rations and monensin in broiler rations as bacteriostats.

4.214 Prices for soybean meal and fish meal imported by BULOG tend to be fixed according to international market prices plus transportation and handling. Some feedmills can reduce their costs for these ingredients by utilizing locally-produced oil meals. The small feedmill at Bandung was able to satisfy all its fish meal needs with domestic fish meal costing Rp 400 per kg compared to Rp 600 to 625 per kg from BULOG. Prices for corn tend to be lower on Sumatra and in East Java where the production is located. Copra meal prices fluctuate widely due to periodic demand for export. Prices for rice bran are fairly consistent within a season but in regions with little irrigation, prices between the growing season or between crops will rise due to reduced supply.

c) Commercial feed prices

4.215 Prices for commercial feeds collected from feedmills and poultry shops in August, 1985 are presented in appendix table 4.21. All prices are F.O.B. factorygate and for feed purchased in less than bag lots. Prices are discounted by poultry shops for bag-lot or multiple bag purchases. Where prices were collected from poultry shops, F.O.B. factorygate price is determined considering the discount the poultry shop receives and transportation costs.

4.216 Prices vary widely by location and by feedmill. Generally the larger mills and those located closer to a supply of domestic corn have lower prices. Prices for higher-protein starter and grower complete feeds and for other concentrate supplements are higher due to the use of higher-cost ingredients.

6. Feed composition and feed requirements for Indonesian livestock

4.217 Appendix 4.A presents tables of nutritional composition and feed requirements for Indonesian livestock. Feed composition tables can be used for comparison of feedstuffs in the absence of laboratory data and for the design of feeding programs. Where available, actual analyses for feedstuffs collected on farm should be used. Nutritional requirments presented in Appendix 4.A (tables 4A.5 through 4A.10) are derived from tables prepared by the National Research Council (NRC) of the U.S. National Academy of Sciences and list appropriate adjustments for feeding under the hot, humid conditions of Indonesia. As for nutritional analyses of feeds and forages, where available, recommendations based on nutritional requirements actually determined for Indonesian livestock should be used.

C. Strengths and Weaknesses

1. The agricultural resource base

4.218 Rice is the most important component of crop/livestock production systems in the irrigated lowlands and rainfed uplands. It is replaced by maize in the more drought prone uplands. These two crops, plus cassava, occupy about 90 percent of the cultivated cropland in Indonesia.

4.219 Crop yields are closely related to soil types and their fertility. Thus, soil surveys and classifications are important for determining land capabiltiy and allocating land for crop use, especially in newly-developed transmigration sites. Soil survey and type classification is a responsibility of the Soils Institute of the Agency for Agricultural Research and Development. Soil maps are available for all of Java and most of the major islands with soil survey work continuing to classify types on all islands where crop/livestock enterprises are found.

4.220 In general, lowlands are primarily devoted to rice growing while drylands at the higher elevations are used for secondary crops. Rice is also grown in the rainfed uplands under ample moisture conditions. Estate crops and forest occupy less land than rice on Java and Bali. Both, however, exceed rice land on the other islands, forests by sevenfold on Sulawesi, Kalimantan, Sumatra and Irian Jaya.

4.221 Mixed gardens around the household compound are used to grow vegetables, food legumes, root and leafy crops as well as fruit and nut trees for household consumption and for off-farm sales. Livestock are also kept in the mixed garden area.

4.222 Grasslands are relatively small in area in comparison to rice land and dryland devoted to crops in the densely populated areas of Java, Bali, parts of Sulawesi and Sumatra. Grasslands are largely comprised of imperata, a grass which invades after land is cleared. Its presence indicates a decline in soil fertility. Its forage quality is insufficient to maintain animal weight, except in the juvenile stages of growth. Such grasslands can, however, be improved with land preparation, fertilization and seeding of superior grasses and legumes.

4.223 Land use is closely related to population density. In the densely populated areas, food crops must be grown on all soil types regardless of fertility. Forest lands in some areas of the outer islands offer a release from the pressures of high population density for transmigrants from Java, Bali and Lombok. In addition, the crop component of the whole farm is related closely to available moisture from rainfall and/or irrigation, degree of slope and to some extent elevation on most islands.

4.224 Annual rice grain yields have tripled in the past 20 years, primarily due to more intensive cultivation. Farmers plant two or more crops per year, use irrigation water and fertilizer more efficiently, and plant higher yielding varieties. In addition, cultivated land has been



87

expanded as a result of transmigration schemes. Other crop yields have also increased but less dramatically. Now that self-sufficiency in rice has been attained, the GOI land-use policy should be directed toward shifting rice growing away from the thinner, less fertile soils of the rainfed uplands. These soils are more appropriate for secondary crops and reforestation.

4.225 In the macro-planning process for transmigration, land classification and capability maps have permitted the selection of sites well-suited for rice-based cropping systems. Within a given transmigration site, soil surveys and soil ype classification facilitate location of villages, roadways and field divisions enabling more effective cropping patterns. Knowing the fertility status of the soil, and its structure, lead to more efficient fertilizer recommendations and more efficient use of available water.

4.226 A close relationship exists between rice-secondary crop culture and livestock. The latter provide draft power and valuable manure for crop nutrients. In turn, the crops supply a feed source through residues and by-products as well as grazing after crops are harvested. In many areas, however, rice straw is burned. Its abundance at harvest hinders rapid turn-around for a second crop. Furthermore, the feeding quality of many crop residues is low due to poor management, labor constraints, and lack of storage facilities.

4.227 Despite the interaction of crops and animals in the whole farm operation, livestock and crop research within AARD is not well-integrated. A research program exists for both but in separate divisions. The cropping systems research program began in 1969, and has been successful in developing stable and sustainable cropping patterns for the diverse land systems of Indonesia.

4.228 The livestock systems research began in 1981 with work focused on classification of feeding systems, use of supplements, and artificial insemination. Research on the livestock component is a pioneering effort among worldwide research institutions, and should strengthen collaborative crop/livestock studies which will benefit the Indonesian small holder engaged in a mixed crop/animal whole farm system.

2. <u>Forages and pastures</u>

4.229 Indonesian farmers have capitalized on the availability of native and naturalized grasses, legumes and fodder trees. These are grown in non-cultivated areas on bunds and terraces, under coconut, on communal grazing and public lands and invade crop fields after harvest. Unfortunately, they are cut and grazed as needed with little concern for stage of growth and feeding quality. In the lowlands, this practice has led to deterioration of the vegetation so that forage yields are low. In the uplands, this practice leads to soil degradation causing erosion and denudation of steep slopes. Communal and public land management do not seem conducive to pasture improvements.

4.230 In some of the outer islands, land clearing and subsequent land abuse, especially under hifting cultivation, have resulted in soil deterioration and invas : of imperata grass. This species is also found



184

in some non-cultivated areas of all islands. Imperata forage can neither sustain animal maintenance or provide for growth, whether cut or grazed, except in the juvenile stage. Use of frequent burning to stimulate fresh growth maintains a subclimax grassland condition. Grasslands in imperata cover more than 16 million hectares in Indonesia. While these areas hold potential for improved pasture and forage production, little information is available to assist in identifying effective management of imperata. Additional research is needed before launching an improvement program.

4.231 Several improved grasses and legumes are widely distributed throughout Indonesia, primarily elephant and setaria grasses and leucaena, a leguminous tree. They are primarily used for cut-and-carry feed. In some specialized crop/livestock systems (e.g. dairying and beef fattening), smallholders manage grasses in order to obtain greater quantity and quality, fertilizing and cutting on a timely basis. In general, however, their potential is not being exploited because of poor management. Farmers rely on these three improved species, along with sesbania and gliricidia, even though research trials and observation of introductions have shown that others are well-adapted and highly productive when properly managed. This reflects the lack of an integrated program for technology transfer.

4.232 The experimental approach used to evaluate forage species and management procedures might have been enhanced and accelerated by visiting and reviewing research at other institutions and surveying the present forage production systems existing under farmer conditions. For example, improved grasses and legumes have been examined over several years at the Institute Pertanian Bogor (IPB), University of Gadjah Mada, various other universities and different DGLS and provincial experimental stations. Most of the same promising grasses and legumes exist (or have been evaluated) in some of the plant nurseries. Furthermore, similar grasses and legumes were evaluated and used at the BMT Ranch (Maiwa) in the early 1970s.

4.233 Little research has been conducted on the integration of legumes with food crops. Siregar and Semali (1982) compared four legumes and found that dry matter yields of 10 t/ha could be obtained when intercropped with maize, without affecting grain yields. Since grazing of crop residues is an important component of animals feeding in areas of high land pressure, there is a need for additional research on: 1) species which can be sown into crops near maturity for quick growth on the residual soil moisture: and 2) forage legumes which can be grown on bunds and terraces during the wet season.

4.234 Nonetheless, available research coupled with the understanding of practical applications accumulated on demonstration farms leads the team to conclude that on-farm verification and demonstration of improved pasture and forage technology should begin as soon as possible.

### 3. Crop residues and by-products

4.235 For the most part, Indonesian farmers have utilized crop residues and by-products to the degree of efficiency possible given the feeding management technology they have available. However, through design and testing of new technology in such areas as forage preservation and balancing rations high in crop by-products and extension programs to train farmers, greater utility could be acheived from the forage materials available from cropping activities. Development of such technology will be best carried out in a farming systems research and extension (FSR/E) framework, similar to that currently employed by the Small Ruminant Collaborative Research Support Program (SR-CRSP). The goal of such a program should be to evaluate limitations to the efficiency of utilization of crop residues and by-products and to develop alternative management systems to reduce those limitations. Among the limitations to consider are the following:

a. Seasonality of availability of crop-residues and by-products

4.236 Especially for those residues with high nutritive value (e.g. cassava tops and sweet potato vines), the major limitation to their greater use in the feeding of livestock is the seasonality of their availability which is tied to the cropping cycle. Unless they are stored in some way, crop residues must be used as they become available. This leads to a "feast or famine" situation which, at best, results in periodic savings to the farmer in the amount of labor expended in cutting grass but, at worst, causes a loss of much of the productive potential that crop residues could provide if their availability was less fluctuating and their use as a supplement to grass could be better rationalized. Forage preservation as hay or silage is the obvious technology suggested. However, smallholders in Indonesia can ill afford to devote space to structures for preserving forages and most do not have access to the equipment needed for fine chopping of residues to reduce particle size for storage and increased animal intake. Innovative design of structures and appropriate processing equipment needs to be designed and introduced to the mixed crop-livestock situation typical of Indonesian small farms.

b. Low nutritive value

4.237 The inherent low digestibility of fibrous fractions and loss of high quality leaves makes many crop by-products, as fed to livestock, low in feeding value. Considering that they may end up substituting for higher quality cut grass, either because the farmer prefers to devote his labors elsewhere or rumen fill reduces grass consumption, crop by-products may actually have a negative impact on animal productivity. "Strategic" supplementation with crop or agro-industrial by-products concentrated in protein or energy can greatly enhance the feeding value of fibrous by-products. Budhi, et al., (1981) found corn stalks to be of equal value for growing goats as elephant grass when supplemented with rice bran or leucaena leaf. Recent research into processing techniques utilizing sodium hydroxide (NaOH) or urea treatment has shown that nutritive value of rice straw can be substantially improved. In the report by Budhi, et al. (1981), sodium hydroxide treatment of rice straw (at 2% of dry matter) fed to growing bulls improved dry matter intake, average daily gains and feed conversion ratio compared to untreated straw. It was postulated that this treatment increased digestibility and rate of passage. Despite favorable research results for treatment of rice straw, transfer and application of this technology at the small farmer level presents formidable obstacles of safety and cost.



\3b

c. Toxicities

4.238 Cassava leaves can contain high levels of cyanic acid but this can be reduced through drying. Rice straws may bear residues of pesticides applied to the rice crop which can be toxic to livestock and/or passed on to human consumers of meat and milk. The results of Prabowo, et al. (1984) in appendix table 4.8 indicate that minerals such as copper and zinc may be present at toxic levels in some crop by-products.

3. Agro-industrial by-products

4.239 Indonesia's agro-industry produces a large quantity of livestock feeds as by-products to the processing of food grains, oilseeds and other commodities. From observations and interviews during field visits it appears that little of these by-products which have known feeding value are being wasted. What is not utilized by the domestic livestock sector is being moved in export channels to overseas markets in Europe and other Asian nations. The comparative advantage of exporting such products as molasses and palm kernel meal should be examined in a multidisciplinary study which considers the costs and benefits of increased domestic use. On a national level, increased domestic utilization of these by-products can only be acheived by channelling them through the commercial feed industry because of their storage and transportation capabilities. Given that the Indonesian commercial feed industry is closely tied to the egg and poultry meat industry, any agro-industrial by-product which does not have value in poultry rations will not be in great demand in the short-term. Development of processing and feed formulation technology to make the nutrients in these "non-conventional" feedstuffs available to chickens and ducks will result in greater utilization in the domestic livestock industry. Where that research and development will take place is the question to be answered.

4. Commercial feed industry

4.240 Indonesia has a commercial feed industry with feedmills which range from the sophisticated, computer-controlled mixing, pelleting and bagging operations characteristic of the U.S., Europe and Australia to rudimentary one-room factories where mixing and bagging is done by hand. On the whole, the development of the commercial feed industry has proceeded in parallel to that of the egg and poultry meat production sector and has been a positive factor in the development of the entire livestock sector.

4.241 There appears to be a healthy degree of competition between feed manufacturers which is acting to hold commercial feed prices to the lowest level possible. The presence of the government in the feed ingredient market appears to have its greatest positive effect in allowing many small feed companies to survive. On the negative side ingredient quality may be suffering.

4.242 As a result of visits to 12 feedmills, obervations were made on several problems. The medium and small feedmills generally have very inadequate storage facilities. Since all ingredients are stored in plastic or burlap sacks, damage by rats and water was commonly seen. There seemed to be little or no control on storage or on access to expensive and possibly toxic micro-ingredients such as antibiotics and vitamin and mineral pre-mixes. All mills visited, including some of the largest in the country, had severe dust problems in the areas where workers were mixing feeds. The upright mixers used had no dust-collection mechanisms or venting to the outside. Workers had to wear rags and handkerchiefs over their mouths. This presents not only a health hazard to employees from the inhalation of dust and toxic ingredients such as antibiotics, but also creates a potential for explosion and fire.

4.243 The quality of ingredients being used in many of the medium and smaller feedmills, based on gross visual inspection, was very poor, especially for corn and some soybean meal. Whole shipments of corn were observed to be roach-infested with much of the protein-bearing germ eaten away. Sacks of very dark soybean meal which was obviously heat-damaged and moldy copra meal were commonly seen.

4.244 The lack of laboratory facilities in the medium and small mills, and proper scales in some, leads to a general lack of quality control in the final product. The larger feedmills which compete with one another for market share generally maintain strict quality control procedures involving periodic laboratory testing of products. The smaller feedmills are under no such compulsion. Some of these mills periodically test their outgoing products by sending samples to private laboratories or universities. However the results of these laboratory tests usually do not come back to the feedmill for several weeks. Fortunately most of these feedmills do not mix urea in their dairy concentrates or complete feeds. While there is minimal danger of serious health hazards due to inadvertent mixing of toxic ingredients, smallholder poultry, dairy and swine units purchasing feeds from these plants may suffer periodic declines in productivity due to poor feed formulation or the use of low-quality ingredients. Government regulation through periodic sampling and testing in a DGLS laboratory, or strict, voluntary regulation by an industry association, is warranted if private producers and KUDs are to get the optimum return from their investment in purchased feedstuffs.

4.245 The health of the commercial feed industry is closely tied to that of the poultry sector as 90% or more of capacity is used to produce chicken feeds. Future expansion of capacity will probably be devoted to the feed needs of the poultry sector but aquaculture and dairy feeds may be in increasing demand if government policy continues to favor the development of shrimp for export and domestic milk production to replace imports.



189

## CHAPTER V. Animal Health

### A. Animal Health Services

#### 1. Introduction

5.1 Veterinary services in Indonesia are largely the responsibilty of the government. In recent years, a comprehensive animal health delivery system has been established which includes field services, laboratories, quarantine facilities, vaccine production centers and drug assay laboratories guided by a central policy-making organization in Jakarta. As a result of increasing availability of veterinary graduates, private animal health services are beginning to have an impact on livestock production, particularly in more specialized areas such as dairy and commercial poultry enterprises. This trend is likely to continue in view of the more attractive salaries offered by private enterprise.

#### 2. Manpower

5.2 In 1985 there were approximately 1500 veterinary graduates working in Indonesia (Perhimpunan Dokter Hewan Indonesia). This represents approximately 12,200 animal units per graduate (DGLS, 1984; Dinas Peternakan Jawa Tengah, 1983). However, if veterinarians working in administrative positions are excluded, the number of units per practicing veterinarian is probably much greater. Veterinary employment is summarized in table V.1, which also demonstrates the increase in private sector involvement over the last few years.

5.3 Technicians are also employed in diagnostic laboratories, vaccine production centers and drug assay units. This is likely to increase as advanced diagnostic services become more widespread.

5.4 The large majority of the 3570 kecamatans in Indonesia are serviced by a veterinary assistant who carries out the functions of the livestock service at the district level.

#### 3. Government Services

##### a. Policy

5.5 National animal health policies are determined by the Director General of Livestock Services on the advice of the Director of Animal Health. This process usually involves consultation with the heads of provincial livestock services.

5.6 Within the overall national policy, provincial heads, administratively responsible to the provincial government, have the authority to tailor their animal health delivery services to local requirements. Although the operating budget for the Dinas Peternakan in each province is provided from the governor's office, a high proportion of the operating budget is provided directly from DGLS development funds. Hence DGLS has a considerable influence over provincial animal health



\ 2 \

policies. Figures V.1 through V.3 illustrate the organization of government services from the minister to the farmer.

Table V.1. Veterinary manpower in Indonesia

| | 1982 | | 1985 | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Government Services (DGLS, Dinas Peternakan etc) | 530 | 48 | 600 | 40 |
| Universities | 360 | 33 | 420 | 28 |
| Private Enterprise (Private practice, drug companies etc) | 165 | 15 | 420 | 28 |
| Armed Forces | 45 | 4 | 60 | 4 |
| TOTAL | 1100 | 100 | 1500 | 100 |

Source: Perhimpunan Dokter Hewan Indonesia

5.7 The Directorate of Animal Health has five subdirectorates. The Disease Prevention, Eradication and Control Subdirectorate formulates national policies for disease control such as vaccination programs and disease eradication campaigns. It is also the section responsible for planning the activities of the field service in the event of a major disease outbreak. The Disease Surveillance Subdirectorate collates surveillance information from the field, and is responsible for estimating both the economic effects of disease on the national herd and the cost of control measures. This division also controls the activities of the seven Disease Investigation Centers (DICs) which are discussed later.

5.8 Policy concerning abattoir hygiene, meat, milk and egg inspection, and slaughter control of productive females is made by the Veterinary Public Health Subdirectorate. This section is also responsible for the supervision of animal welfare.

5.9 With the transfer of quarantine functions to the Directorate of Agricultural Quarantine (DAQ), the Disease Repulsion Subdirectorate now has the role of supplying the technical livestock expertise required by the DAQ, supervising movement control and providing testing protocols for the import and export of livestock and animal products.

5.10 Finally, the Veterinary Drug Supply and Supervision Subdirectorate is responsible for controlling the importation, production, distribution and marketing of drugs for use in animals. It also provides information for the registration of drugs by the Veterinary Lrug Registration Commission.



190

Figure V.1 Schematic diagram showing veterinary laboratory structure.

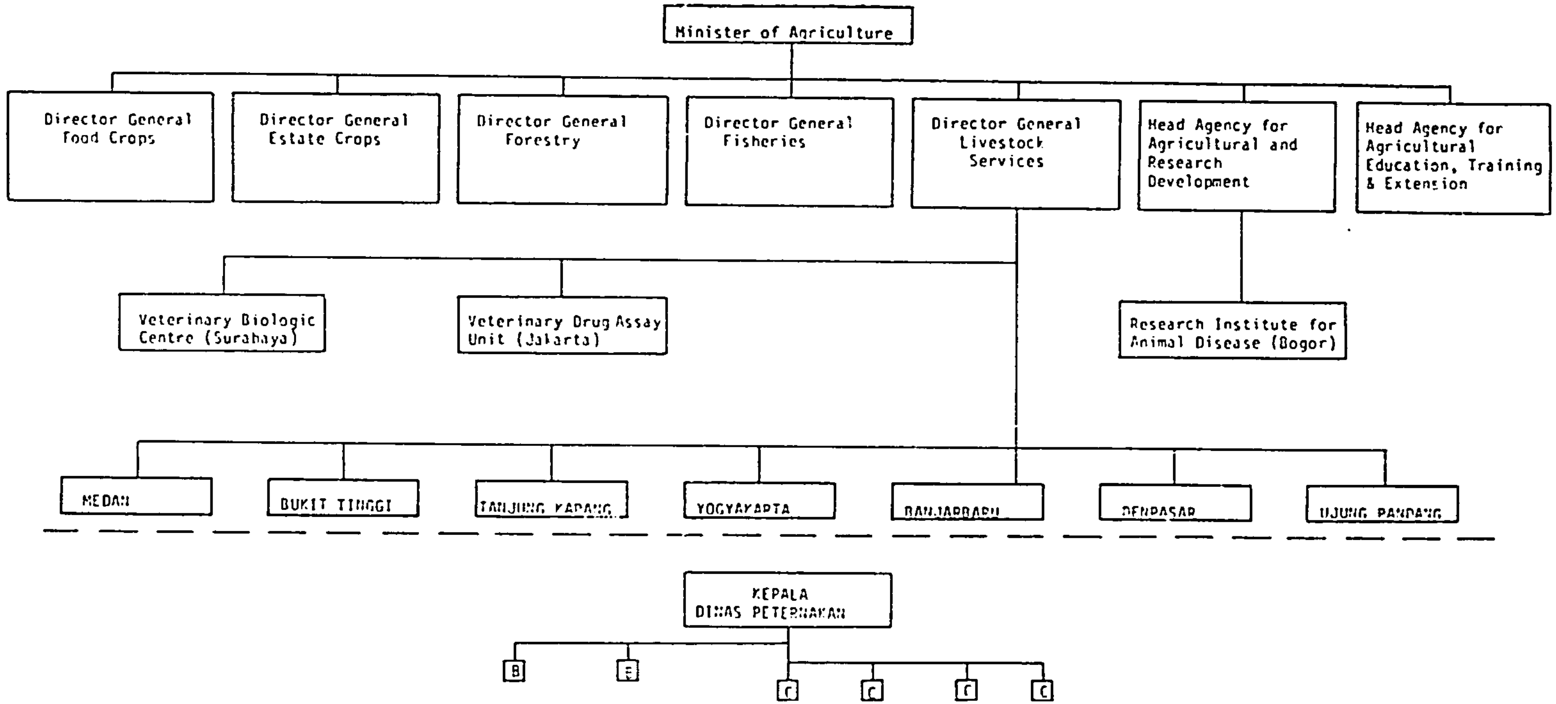


Figure V.2 ORGANISATION AND RESPONSIBILITIES OF THE DIRECTORATE OF ANIMAL HEALTH

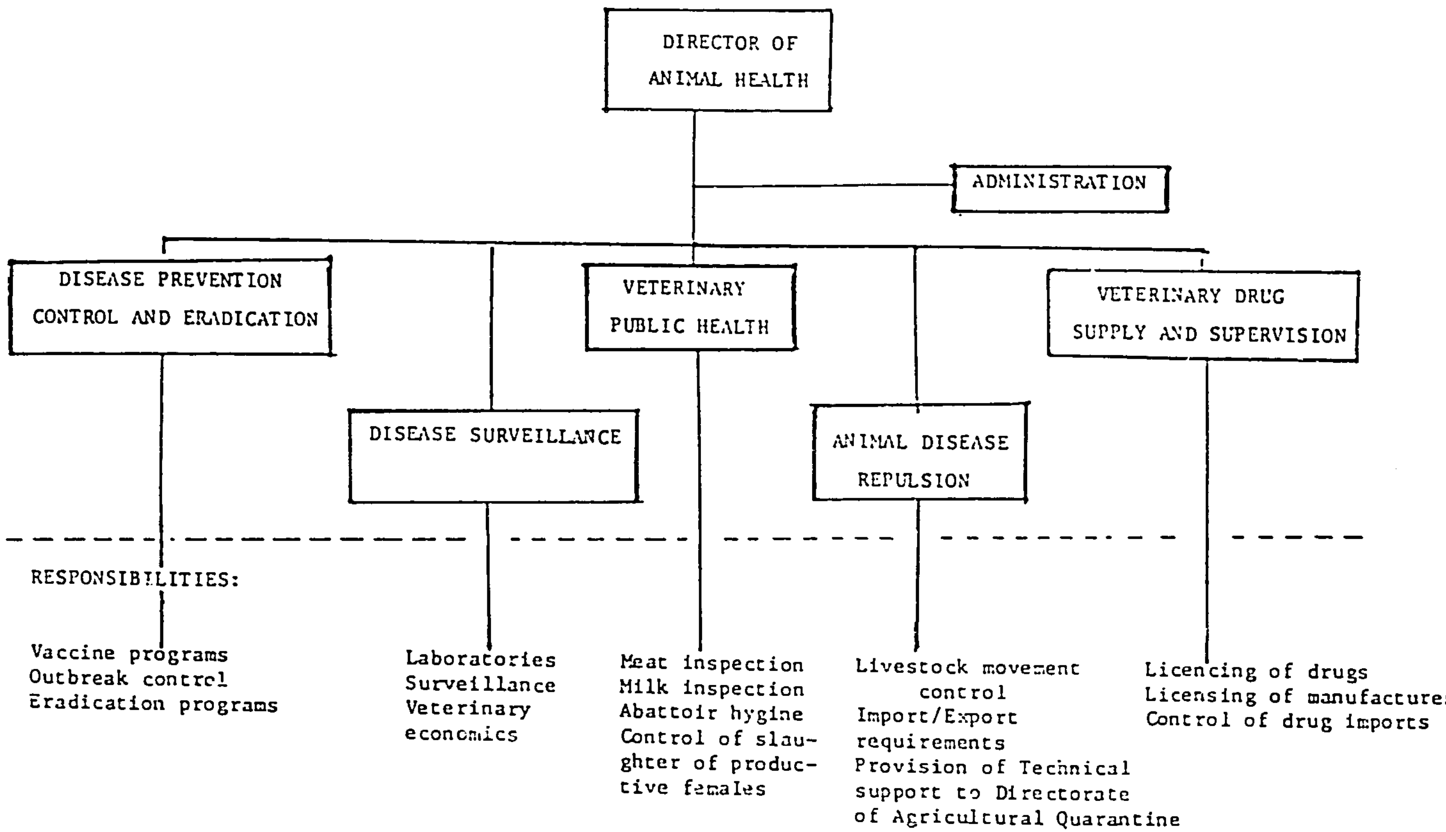
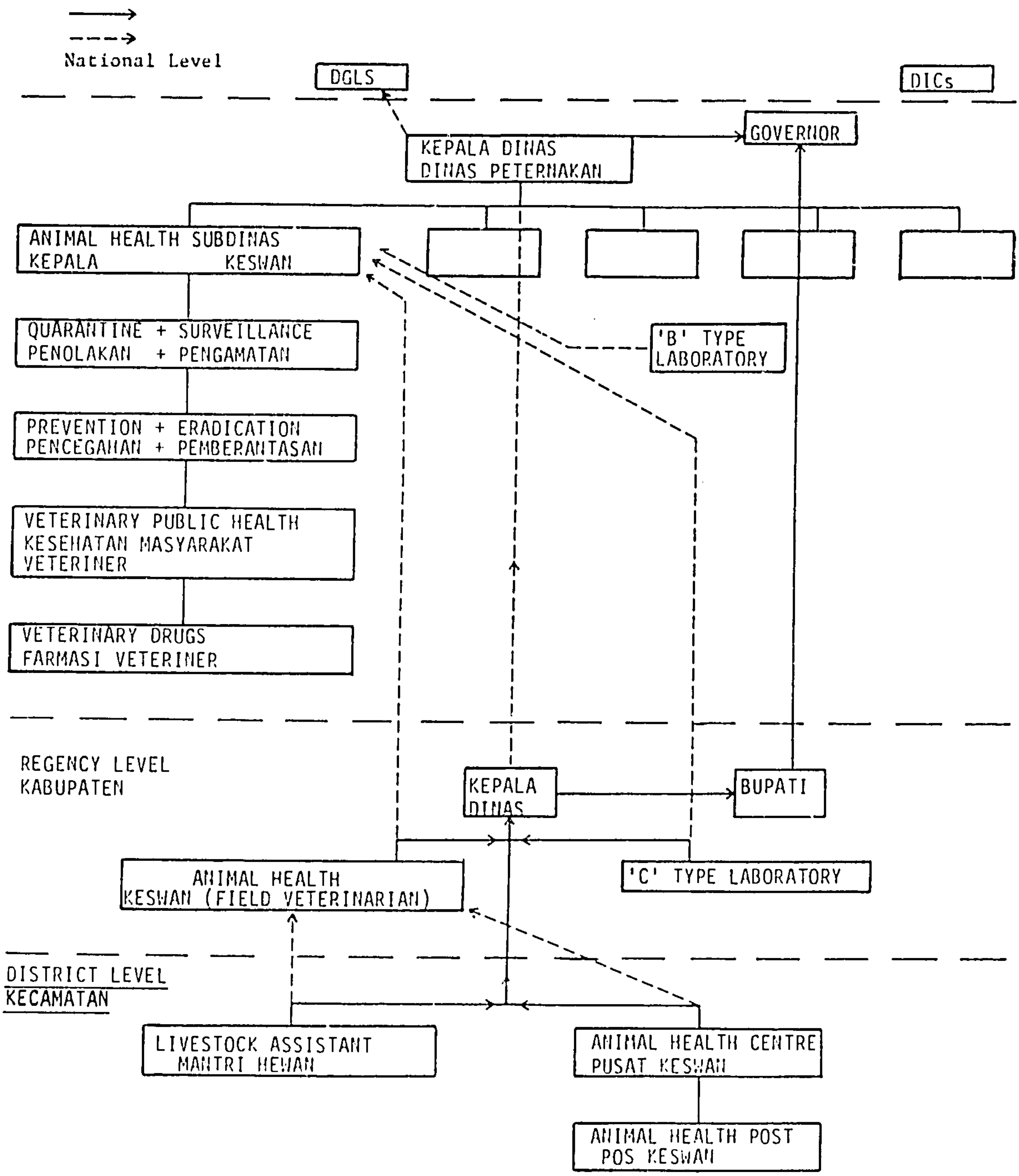


Figure V.3 Organizational chart of a typical provincial veterinary service.



5.11 As well as a policy-making body, the Directorate of Animal Health also executes animal health programs though the seven DICs, the Veterinary Biologics Center (VETMA) and the quarantine service. These are considered below.

b. Execution of animal health programs

5.12 Field veterinary service: This is provided by the animal health sections of the Dinas Peternakan in each province. The "kepala dinas" (provincial head) is responsible to the governor's office but, as mentioned above, follows the general policy guidelines laid down by the Directorate of Animal Health. Each dinas peternakan office at the provincial level has five sub-dinas's, one of which is animal health (Kesehatan Hewan or KESWAN). Each sub-dinas has three or sometimes four sections.

5.13 The quarantine and surveillance section ("Penolakan dan Pengamatan") deals with inter-provincial quarantine matters, such as manning checkpoints on roads between Javanese provinces as a precaution against FMD and maintaining quarantine stations for inter-island livestock shipments. This section also is responsible for collating field surveillance data which is used by policy makers at the provinical and national levels. The class B and C laboratories, which will be considered in more detail later, are responsible technically to the surveillance section. The prevention and eradication section organizes vaccine supplies and vaccination teams to control infectious diseases such as haemorrhagic septicaemia, anthrax and Newcastle disease. This section also coordinates provincial eradication programs such as foot and mouth disease in Java .

5.14 Veterinary public health ("Kesehatan Masyarakat Veteriner" or KESMAVET) is supervised by a separate section which is mainly involved with the inspection of meat, milk and eggs, abattoir hygiene and animal welfare. All provinces also have a veterinary drug section ("obat hewan") which acts as a watchdog on provincial supply and consumption of drugs for animal use. It also provides information used by the central government in the drug registration process.

5.15 The field livestock service at the kabupaten level is also under the control of the provincial kepala dinas. Although reponsible to the bupati administratively, the head of the Kabupaten Dinas Peternakan is technically answerable to the provinical capital. Each kabupaten has its own animal health section which works in the field. However, not all sections at this level include a staff veterinarian. Animal health care is extended into each kecamaten through veterinary assistants who, under the supervision of field veterinarians, provide animal health services to farmers.

5.16 A recent advance in animal health care has been the construction of animal health centers and posts ("pusat" and "pos keswan"). Staffed by veterinary and animal health assistants, the centers are situated in key

Table V.2. Provinces covered by Disease Investigation Centers

| Disease Investigation Center | Province |
|---|---|
| Medan (Region I) | Aceh, North Sumatra |
| Bukit Tinggi (Region II) | West Sumatra, Riau, Jambi |
| Bandar Lampung (Region III) | Lampung, South Sumatra, Bengkulu |
| Yogyakarta (Region IV) | West Java, Central Java, Yogyakarta, Jakarta, East Java |
| Banjarbaru (Region V) | West Kalimantan<br>South Kalimantan<br>East Kalimantan<br>Central Kalimantan |
| Denpasar (Region VI) | Bali<br>Nusa Tenggara Barat<br>Nusa Tenggara Timur<br>East Timor |
| Ujung Pandang (Region VII) | North Sulawesi<br>Centeral Sulawesi<br>South Sulawesi<br>Southeast Sulawesi<br>Maluku<br>Irian Jaya |

development districts requiring more advanced animal health services, such as areas with a high livestock density or specialized production systems (e.g. dairying). The posts are branches of the centers, and are usually staffed by veterinary assistants. Only a few Pusat and Pos Keswan have been constructed to date but the policy is to increase their numbers as funds become available.

5.17 Laboratories: There are three distinct groups of veterinary laboratories responsible to three different agencies. Research is undertaken largely by the Research Institute for Animal Disease (BALITVET) at Bogor. Supported by both Australian and British expatriate teams, research at the institute is aimed at overcoming some of the basic disease constraints faced by Indonesian livestock producers. A total of 38 research projects are in progress (refer to section on research). The institute is administered and funded through the Agency for Agricultural Research and Development (AARD).

5.18 In addition, seven Disease Investigation Centers (DICs or class A laboratories) have been established in Medan, Bukit Tinggi, Bandar Lampung, Yogjakarta, Banjarbaru, Denpasar and Ujang Pandang, using bilateral and multilateral aid funds. DICs are regional laboratories each providing services to several provinces (table V.2) and are primarily responsible for surveillance; however some applied research is also carried out on regional problems (Sukobagyo, 1985). Staff are engaged in diagnostic work as well as training field veterinarians and veterinary assistants. The DICs capabilities and levels of development vary, ranging from the well-established and active center in Denpasar to the still incomplete unit at Banjarbaru. The DIC are a central government function under the control of the Directorate of Animal Health, Jakarta.

5.19 A third group of laboratories are run by the Dinas Peternakan at the provincial level and are classified as class B or C depending on their size and capabilities. (There are 23 class B and 21 class C laboratories.) They deal with routine diagnostic work, receiving specimens from field veterinarians and veterinary assistants or directly from farmers. Specimens are dispatched to the nearest DIC if a diagnosis cannot be made. Laboratory staff also take part in field work, monitoring animal disease at the village level and treating livestock as necessary. Although there is variation in the capabilities of class B and C laboratories among provinces, in general, their functions are severely limited by lack of funds, equipment and training.

Table V.3. Products of the Veterinary Biologics Center (VETMA)

| | Doses 1984/85 |
|---|---|
| Vaccines: | |
| Anthrax | 2170,000 |
| Brucellosis | 30,000 |
| Foot and Mouth Disease | 1493,000 |
| Fowl Cholera | 1835,750 |
| Haemophilus gallinarum | 11,920 |
| Haemorrhagic Septicaemia | 5346,750 |
| Newcastle Disease (F. Strain) | 26738,700 |
| Newcastle Disease (Inactive) | 197,000 |
| Newcastle Disease (Komarov) | 76406,000 |
| Newcastle Disease (La Sota) | 120,000 |
| Rabies (Semple) | 615,000 |
| Antigens | |
| Brucella abortus (Rose Bengal) | 30,000 |
| Brucella abortus (S.A.T) | 3,800 |
| Fascioliasis | 10,000 |
| Mycoplasma gallisepticum | 10,000 |
| Salmonella pullorum | 22,400 |

5.20 Veterinary drugs and biologicals: The Veterinary Biologics Center (VETMA) started producing vaccines and diagnostic antigens in 1979 and now manufactures a wide range of products (table V.5). Despite some of the labor-intensive techniques used, the overall quality is high. Most of the products are used by the government in eradication programs (foot and mouth disease), mass vaccination schemes (haemorrhagic septicaemia, anthrax, Newcastle disease) and diagnostic laboratories (antigens), but production only satisfies approximately 20% of demand (Mahyuddin - personal communication). Most commercial poultry producers, for example, still use imported vaccines. VETMA is administered by the central government through DGLS.

Table V.4. Regional divisions of the Disease Quarantine Service

| REGIONS | PROVINCE |
|---|---|
| I. Medan | Aceh<br>North Sumatra<br>West Sumatra<br>Riau<br>Jambi |
| II. Jakarta | Lampung<br>South Sumatra<br>Bengkulu<br>West Java<br>Central Java<br>Yogjakarta |
| III. Surabaya | West Kalimantan<br>South Kalimantan<br>East Kalimantan<br>Central Kalimantan,<br>East Java |
| IV. Denpasar | Bali<br>Nusa Tenggara Barat<br>Nusa Tenggara Timur<br>East Timor |
| V. Ujung Padang | North Sulawesi<br>Central Sulawesi<br>South Sulawesi<br>Southeast Sulawesi<br>Maluku<br>Irian Jaya |

5.21 One additional laboratory recently has been constructed with Japanese help just outside Jakarta. The Veterinary Drug Assay Unit is intended to act as a testing center for all veterinary drugs and vaccines before release in the Indonesian market. The unit uses essay and challenge tests. While no drugs or vaccines have been tested to date, routine testing is expected to commence in 1986.

5.22 Querantine service: Animal quarantine is the responsibilty of both central and provincial governments. Indonesia is divided into five quarantine zones (table V.4) Movements of animals between provinces within a quarantine zone is under the control of the provincial Dinas Peternakan. Holding grounds and road blocks are used to prevent the spread of animal disease from province to province and are staffed by dinas staff. Control of animal movements between quarantine zones is the responsibility of central government which has a representative in each region. However, the day to day tasks are frequently done by provincial staff. Cloven-hoofed animals are prohibited from leaving Java for other regions because of the risk of spreading foot and mouth disease. Similarly, Bali cattle cannot be exported from the island of Bali to prevent the possible spread of Jembrana disease, except to Java for slaughtering. With these exceptions livestock can be moved between regions provided that they undergo a minimum of two weeks quarantine at an approved government station. During the quarantine period, animals are examined daily and any sickness or mortality carefully investigated.

5.23 Entry of animals from overseas is also under the control of central government and is only possible through quarantine stations. Typical procedures carried out during the quarantine of medium and low risk animals are listed in table V.5. Quarantine is for a minimum period of two weeks and the intensity of control depends on the risk involved. For this purpose, countries are grouped into three categories depending on their animal health status. Australasian countries are classified as group I (low risk); European countries, group II (medium risk); and African or Indian sub-continent countries, group III (high risk). Animals from group III countries are not imported at present. However, a high-security facility for quarantine of animals from high risk countries is being constructed on Pulau Kepala Jernih Riau, several miles from Singapore.

5.24 The control of inter-regional and foreign animal quarantine is being transfered from DGLS to a new Directorate of Agricultural Quarantine (DAQ), which will also be responsible for plant and fish quarantine. Staff at DAQ will continue to receive technical support from DGLS.

4. Private sector support

5.25 Approximately 28% (420) of Indonesian veterinarians are working in the private animal health sector, a substantial increase in recent years (table V.1). Some of these are in small animal practice in the larger towns but there are a few full-time practices serving the livestock industry. Where the private sector cannot fill demand for veterinary services, the deficit is commonly made up by government or university veterinarians acting as consultants to the larger commercial enterprises outside government working hours. In addition, all drug distributors and animal feed manufacturers who use medicaments in their products are now required to employ a staff veterinarian. These agribusinesses provide an animal health service to consumers and follow up complaints or problems concerned with the product.

Table V.5. Quarantine procedures for low to medium risk animals from overseas

| Day | Procedure |
|---|---|
| -2 | Report from importer on progress of shipment |
| -1 | Quarantine station disinfected |
| 0 | Documents inspected, animals offloaded |
| 1 to 3 | Any sick animal drafted off and treated |
| 4 | Vaccinated for FMD, Anthrax, SE. Blood samples taken for laboratory analysis (Brucellosis, blood parasites, etc). Faecal samples taken for laborotary analysis (Endoparasites). Animals tested for blood parasites if orginating from infected areas. |
| 5 to 13 | Daily examination |
| 14 | Disinfection, Release from quarantine. |

5.26 Becauses KUD's are involved with specialized livestock production systems they also employ veterinary staff as a service to members, particularly in dairy cooperatives which now employ over 20 veterinary graduates. While private sector posts provide less job security, salaries are substantially higher than in government, particularly with drug companies. It is likely that the private sector animal health services will expand with the growth of technically advanced livestock industries. However, the requirements of most smaller farmers will continue to be met by the government livestock service for the forseeable future.

B. Animal health status

5.27 Livestock in Indonesia suffer from most of the common diseases found in other parts of Southeast Asia although it is claimed that there are at least two conditions not found anywhere else in the world (Jembrana disease and Baliziekte). The natural maritime barriers of the archipelago have prevented the spread of several animal diseases to all parts of the country. For example, foot and mouth disease (FMD), until recently relatively common in Java and western Indonesia, has never been recorded in the eastern islands or Irian Jaya. These natural quarantine barriers will also aid any disease eradication programs which might be considered in the future.

5.28 The following review covers the overall health status of Indonesian livestock. It starts with a detailed description of some of the important diseases and their economic impact on production systems.

1. Large ruminant diseases

a. Haemorrhagic septicaemia (HS)

5.29 Haemorrhagic septicaemia (Septicaemia epizootica) is one of the most economically important diseases of large ruminants. With the exception of Irian Jaya and the Moluccas, it is found throughout Indonesia (Sukobagyo et al., 1979), particularly in low-lying swampy areas during the wet season. If unchecked the disease may result in heavy mortalities in draft buffalo and cattle. The causal organism (Pasteurella multocida) is a common inhabitant of the respiratory tract of healthy livestock. Disease is usually seen only when animals are stressed and consequently HS is found most frequently in working animals during the wet season. Treatment with antibiotics is frequently successful. However the cost of treatment and the subsequent loss of draught power during the recovery period, together with mortalities, result in an estimated economic loss of approximately US$ 11 million per year. (DGP, 1984). A vaccine, effective for about one year is available (FAO, 1985; Bain, 1963; Jan Nari and Syamsudin, 1973) and widely used in government vaccination campaigns, but outbreaks still occur due to incomplete coverage.

5.30 A pilot project to eradicate the disease on Lombok was started in 1977 when the large majority of all cattle, buffalo, sheep, goats and pigs on the island were vaccinated annually until 1980 (BPPH Denpasar, 1982). An evaluation team from DGLS, which included staff from DIC at Denpasar, decided in 1981 that the island was still infected after recovering Pasteurella organisms from 2.3% of 500 respiratory tracts of cattle at slaughter. Vaccination was restarted in one small northern area of the island where some animals had escaped previous campaigns (Djamaluddin, personal communication). Apart from this one district, no vaccine has been used since 1980 and no cases of HS have been recorded in the subsequent five years. In 1982, a second evaluation team was unable to detect the organism and Lombok was considered provisionally free of the disease (BPPH Denpasar, 1982). However no subsequent evaluation has been made and there is some evidence that although the vaccine is highly effective in preventing the disease, it may not entirely eliminate the causal organism from the respiratory tract. Moreover, the lack of clinical cases is not necessarily indicative of eradication. Consequently, there is a strong case for a re-examining for the presence of Pasteurella on Lombok, and conducting research to determine whether or not vaccination eliminates the organism before an eradication program is extended to other parts of Indonesia.



200

b. Trypanosomiasis

5.31 Typanosomiasis, or "surra", is widespread in most parts of Indonesia with the exception of Irian Jaya (Adiwinata and Dachlam, 1972), and can be detected subclinically in a high proportion of cattle and buffalo populations in many areas (Sutiono et al., 1985). The disease is usually chronic throughout its course with few symptoms other than debility. Acute cases are uncommon. The lack of a clear clinical picture and the inadequacy of the technique used in most veterinary laboratories (blood smears) to detect the causal organism have probably resulted in an underestimation of the disease's economic importance in the recent past. The widespread distribution and high prevalence rates which can be detected with more sensitive tests (Luckins, 1983), coupled with the reduction in work output from draught animals (Rukmana, 1977), results in an economic loss estimated at roughly US$ 28 million per year (DGP, 1984). Treatment is possible but it is expensive and of only short duration. It is unlikely that any major advance towards reducing the impact of this problem will be made until an effective vaccine is produced. However African experience suggests that this is unlikely in the immediate future.

c. Foot and mouth disease (FMD)

5.32 There is no reason to believe that the severe losses in production due to foot and mouth disease (Apthose epizootica) which have been documented in detail overseas do not plague livestock systems in Indonesia similarly. In 1975, the cost of FMD was estimated at US$ 10 million per year (Sukobagyo, et al, 1979). However, in recent years the geographical distribution of FMD has contracted significantly. Moreover, since the successful eradication program in Bali, Java and South Sulawesi in 1974-82 (Sukobagyo, et al, 1979) the virus (O strain) has been limited to the island of Java. The last outbreak in Java was in July 1983, with the last case diagnosed in December of that year. Since then, no cases have been detected. The rapid execution of a mass vaccination and surveillance campaign at that time may have eradicated the disease, but confirmation of this can only be made when the vaccination program ends in 1986.

d. Helminths

5.33 Liver fluke: Abattoir surveys indicate that liver fluke (fascioliasis) is both common and widespread in most parts of Indonesia (Sutiono, et al, 1985) despite that the life cycle of the parasite (through aquatic snails) restricts its distribution to coastal areas in the drier eastern islands. Prevalence rates of 90% have been recorded (Edney and Muchlis, 1962). While no studies have fully examined the effect on production, this parasite appears to cause the greatest loss of edible meat at Indonesian abattoirs, valued at US$ 75 million annually. Acute cases are rare in cattle and the parasite is usually undetected until meat inspection. Although treatment and control methods are available, they are rarely used because of cost and inadequate knowledge of the epidemiology.

5.34 Gastrointestinal parasites: Although abomasal and intestinal parasites are known to be of major significance in small ruminants, their effect on calf mortality, growth rates, production, and work in cattle and buffalo is uncertain. It is likely that internal parasites result in significant losses in the wetter zones of Indonesia. However, gastrointestinal parasites are unlikely to be of great importance in the drier eastern islands where faecal egg counts are usually insignificant in inland areas, even after the wet season (Banks, 1985).

5.35 Ascariasis: Ascariasis is caused by the parasite *Neoascaris (Toxocarara) vitulorum* and results in considerable losses both in terms of mortality and reduced growth rates in calves, particularly in buffaloes (Gunawan 1984, Syarwani and Djogera 1984). The annual cost of this disease is estimated to be $38 million (DGLS 1984). However, some farmers are aware that this can be avoided by the strategic use of piperazine citrate which is available fairly inexpensively in most central parts of Indonesia.

5.36 Stephonofilarisis ("kaskado") is also reported to be of economic significance (Muchlis and Sutiono, 1972) due to the loss of work from draught animals and reduced value of hides.

e. Malignant catarrhal fever (MCF)

5.37 MCF is found throughout the country but usually only in Bali cattle or buffalo (Ginting, 1979; Hoffman, et al, 1984). Other breeds appear to be more refractory to infection. The disease is usually fatal and results from contact with carrier sheep which show no symptoms of the disease. The method of transmission is still unknown. Apart from animal losses, perhaps the main economic impact of this disease is that Bali cattle cannot be introduced to sheep raising areas or vice versa. This has particular significance when selecting suitable breeds of draft cattle in transmigration areas. There is some evidence in Bali that goats may occasionally act as carriers also (Agung - personal communication), but this is unconfirmed.

f. Jembrana disease

5.38 Another problem in Bali cattle which has received much attention in recent years is "Jembrana disease". This is thought to be confined to the island of Bali, but a syndrome with similar characteristics ("rama dewa") is also recognized in Lampung province in South Sumatra. The first known outbreak of Jembrana disease in Bali apparently occurred in 1964 when it resulted in the death of an estimated 60,000 Bali cattle by 1967 (Budiarso and Hardjosworo, 1977). The epidemic died out until 1972 when a disease with similar, but milder symptoms apppeared (Anon, 1984). It is probable that Jembrana disease is now hyperendemic in Bali (and possibly Lampung) since it is only seen sporadically (morbidity approximately 0.8%). Also, the mortality rate is now much lower (13%) in untreated cases (Budiarso and Hardjosworo, 1977). The economic loss from the disease at present seems to have fallen dramatically. However, if the disease was introduced into a susceptible population of Bali cattle in, for example, NTB or NTT, the very high mortality rates previously experienced in Bali might recur. For this reason, there is a quarantine ban on the export of cattle from Bali which is likely to remain in place until more is known about the causal microorganism and its epidemiology.



202

g. Anthrax

5.39 Anthrax is endemic in parts of Indonesia, particularly in NTB, NTT (Gozali et al., 1985) and Southeast Sulawesi. It is controlled by widespread use of a killed Sterne vaccine. The Directorate General of Livestock Services estimates the cost of anthrax to be approximately US$ 20 million per year. Human infections sometimes result in death and are usually associated with eating meat from infected animals.

h. Ephemeral fever

5.40 The economic impact of ephemeral fever and other arbovirus infections possibly has been underestimated in the past. Ephemeral fever seems to be particularly prevalent in Sulawesi where farmers insist that the prolonged recovery time during which draft animals cannot be worked is a serious impediment to agriculture. Purnomo and Rastiko (1982) note that animals have to be rested for approximately 30 days after infection.

i. Bovine brucellosis

5.40 Brucellosis has been detected in dairy cattle in Java and Sumatra (Soeroso et al., 1985) at low prevalence and also in beef cattle from Sulawesi (Akoso and Siregar, 1984; Sutiono et al., 1985), where the disease is more widespread. The economic significance of abortions caused by this disease in Indonesia is not clear . However, its presence in dairy cattle is undesirable from a public health perspective. A major brucellosis problem seems to exist in the Surabaya area (Hirst - personal communication). Both S19 and 45/20 vaccines are used to control brucellosis in dairy cattle which complicates the test and slaughter policy now in operation. It has been reported that another major impediment to eradication in dairy cattle is the lack of compensation payments for animals slaughtered in the scheme (Sutiono et al., 1985).

j. Bovine mastitis

5.41 Recent work by DGLS and BALITVET has revealed a high incidence of bacterial mastitis in Java dairy herds. Streptococcal and staphylococcal forms predominate. Poor hygiene is an important predisposing factor. Table V.6 summarizes the impact of bovine mastitis on two commercial herds.

Table V.6: Incidence and effect of mastitis in two control dairy herds

| Farm | Percent incidence | | Mean daily production per cow (liters) | Est. daily loss/cow (%) |
|---|---|---|---|---|
| | Clinical | Subclinical | | |
| A | 11 | 60 | 9.6 | 28.7 |
| B | 5 | 79 | 8.6 | 25.6 |

Source: Rompis et al., 1985

k. Other parasitic diseases

5.42 Other ectoparasites such as Sarcoptes scabei and Haematopinus spp. in buffalo are also present, as well as the principal bovine tick of the region Boophilus microplus, but their effect on production both as parasites and vectors of disease is not documented. Anaplasmosis and Babesiosis are widespread and reported to be particularly prevalent in Sumatera and Sulawesi. Bovine tuberculosis occurs but is usually only detected at meat inspection. Additional diseases of unknown significance found in large ruminants in Indonesia are listed in table V.7.

2. Small ruminant diseases

a. Parasitic (helminth) infestations

5.43 Parasitic infestations appear to be the major disease constraint on goat and sheep production, particularly in the wetter areas of Indonesia.

5.44 Haemonchosis is found in all provinces where small ruminants are grazed and is a very common cause of death or anemia and emaciation in both goats and sheep. While the problem is less severe in the dry inland areas of NTB and NTT and parts of Eastern Java, other areas have sufficient moisture to allow the survival of the larvae on pasture for long periods ensuring continuing infestation. The disease is partially avoided when small ruminants are housed and fed on cut forage, e.g., the more intensive agricultural systems in West Java, although some forage contamination still occurs. In grazed flocks, levels of infestation can be very high (Chotiah, 1983; Ronohardjo et al., 1985). This disease is believed to have been one of the major causes of death in goats in the transmigration areas of South Kalimantan.

5.45 In areas where Haemonchus is known to be a major problem, such as West Java, Sumatra and Kalimantan, conventional control measures including rotational or mixed grazing are unlikely to be effective due to the prolonged survival time of larvae and limited available grazing acreage. Control relies on cutting forage for housed animals or the use of anthelmintics. The cost of haemonchosis to the small ruminant industry has been estimated at US$ 95 million per year (DGLS, 1984), and US$ 16.6 million per year (Parsons and Vere, 1984).

5.46 Liver fluke infection (Fascioliasis) tends to be more acute in small ruminants than cattle and buffalo. As a result, the economic loss is proportionately greater. The flukes Fasciola gigantica and Gigantocotyle explanatum (which may be occasionally misdiagnosed as F. hepatica) infest both large and small ruminants throughout most of the wetter parts of Indonesia and cost the industry an estimated US$ 10 million per year (Parsons and Vere, 1984) due to loss of weight, loss of edible meat after slaughter, and some mortalities.

b. Mange

5.47 Mange of goats caused by Sarcoptic or Psoroptic mites (there is some confusion as to their true identity) can be very severe and there are several reports of high mortality from this disease in kids from Bali

Table V.7: Diseases of large ruminants in Indonesia

**Parasitic diseases**

Fascioliasis (F.gigantica and Gygantocotyl spp.)

Paramphistomum spp.
Gastro-intestinal worms
Stephanofilariasis
Boophilus microplus
Scabies

Cysticercosis
Demodectic mange
Screw fly

Trypanosomiasis

Babesiosis
Coccidiosis
Theileriosis

**Bacterial diseases**

Haemorrhagic Septicaemia

Brucellosis
Anthrax
Mastitis (various forms)
Actinobacillosis
Blackleg
Colibacillosis (neonatal infections)

Keratoconjunctivitis
Leptospirosis (various forms)
Salmonellosis (various forms)
Tuberculosis

**Toxic Diseases**

Lantana Poisoning
Pesticide Poisoning
Cyanide Poisoning
Mycotoxicosis

**Nutritional Diseases**

Phosphorus deficiency
Copper deficiency
Energy deficiency
Protein deficiency

**Unknown Etiology**

Jembrana disease

**Viral Diseases**

(Foot and Mouth Disease)
(Akabane)
Ephemeral Fever
Infectious bovine rhinotracheitis
Malignant catarrhal fever
Rabies

**Rickettsial Diseases**

Anaplamosis
Eperythrozoonosis
Haemobartonellosis

**Fungal Diseases**

Dermtomycosis
Aspergillosis

Sources:
1. Laporan Tahunan Hasil Penyelidikan Penyakit Hewan di Indonesia (1976 - 83)
2. Peta Penyakit Hewan di Indonesia
3. Reports of Keswan Sections in Provincial Annual Reports (1984)
4. Purnomo et al. (1985)



205

(Kertayadna et al., 1982: Agung and Gunawan, 1983) and Sumatra (Effendi et al., 1984). Death is possibly due to secondary bacterial infection of affected skin. The disease can be treated successfully with acaricides (Kentayadna et al., 1982) but these are not always available. Parsons and Vere (1984) estimate the cost of mange to goat production to be approximately US$ 4.8 million per year.

c. Virus diseases

5.48 The arbovirus infection "bluetongue" has been diagnosed from clinical, epidemiological and gross pathological evidence in sheep (Sudana and Malole, 1982), but its distribution and effects on production are not known. Another viral disease, *Contagious ecthyma* ("orf") caused by a poxvirus, is relatively common in goats and occasionally sheep. Nodules on the lips make feeding difficult in some cases. Secondary bacterial infection may also occur. Field veterinarians state that lambs and kids occasionally die of starvation from this disease.

d. Other diseases

5.49 *Coccidosis* is reported to be a problem where kids are heavily stocked on wet pastures, as is infectious "foot rot" (*Fusiformis nodosus* infection). A number of other diseases found in small ruminants are listed in Table V.8. However, there is surprisingly little factual data on disease prevalence in small ruminant populations in Indonesia.

Table V.8: Diseases of small ruminants in Indonesia

| | |
|---|---|
| **Helminth & ectoparasitic diseases** | **Bacterial diseases** |
| Haemonchosis | Pasteurellosis |
| Other gastrointestinal nematodes | (Haemorrhagic septicaemia and pneumonia) |
| Fascioliasis | Foot rot |
| Mange | Anthrax |
| Lice | Tetanus |
| Screwfly | Clostridial Entertoxaemia |
| **Viral Diseases** | **Protozoal Diseases** |
| Orbivirus infection | Coccidiosis |
| (Bluetongue) | Anaplasmosis |
| Contagious ecthyma (Orf) | Babesiosis |
| (Foot and Mouth Disease) | Theileriosis |
| | Eperythrozoonosis |

Sources: 1. Laporan Tahunan Hasil Penyelidikan Penyakit Hewan di Indonesia (1976 - 83).
2. Peta Penyakit Hewan di Indonesia (1983).
3. Reports of Keswan Sections in Provincial Annual Reports (1984).



206

## 3. Poultry diseases

### a. Viral diseases

5.50 Newcastle disease (ND) is generally considered to be the most important economic disease of poultry in Indonesia with estimates of annual losses reaching US$ 40.3 million per year (DGP, 1984). Many commercial layer and broiler producers protect their birds with lentogenic strain vaccines (La Sota, B1, F), many of which are imported and are readily available at poultry shops. A typical vaccination schedule is the "4s" system where birds are vaccinated at 4 days old, 4 weeks, 4 months and every 4 months until slaughter (Purnomo, 1984). Although this procedure adds to the cost of commercial production of poultry meat and eggs, a far greater loss from ND is sustained by un-vaccinated semi-commercial and Kampung chickens. Estimates of mortality due to ND in adult birds range from 30% to over 90% depending on the degree of previous exposure. Mortality in young chickens is generally higher. The frequency with which ND epidemics affect populations of village chickens is probably about once every 4 years (Ronohardjo, 1984), although field staff are convinced that annual epidemics, usually at the beginning of the wet season, are common.

5.51 The government provides free vaccinations each year for village birds using a Komarov strain vaccine produced in Indonesia but the proportion of birds which receive the vaccine is generally low in some provinces. There are a number of reasons for this. Provinces do not receive sufficient vaccines to cover the whole village poultry population due to financial constraints. In addition, vaccines are frequently distributed late in the season so that field staff cannot vaccinate sufficient birds before the beginning of the wet season, when traditionally ND outbreaks occur. Access to transport is generally inadequate in the field, limiting vaccine distribution. Finally, inadequate refrigeration may contribute. While refrigeration is generally available from the manufacturer to the kabupaten capital level, field staff have to rely on ice boxes to keep the live vaccine viable. Another method field staff use to keep ND vaccines is to submerge them in a well until required. The effect of submersion on vaccine viability is not known but reports of vaccine breakdowns are common.

### b. Respiratory disease complex

5.52 Respiratory disease complex is widespread in Indonesia's intensive poultry units (Ishii et al., 1984). Chronic respiratory disease (CRD) is a major component with up to 75% of poultry seropositive in some areas (Mudigdo, E. and Peronginangin, 1983; Purnomo, 1984). The organism responsible, *Mycoplasma gallisepticum*, can be excluded from large intensive poultry units, but the number of small producers and the ubiquitous presence of kampung chickens make this very difficult in Indonesia at present (Cumming, 1984). This disease accounts in part for the large volume of antibiotics consumed by the poultry industry. *Haemophilus paragallinarum* is also thought to be a contributor to the respiratory disease complex but its distribution, although suspected to be widespread,



207

is unknown (Cumming, 1984).

5.53 Of the respiratory tract virus infections, <u>infectious bronchitis</u> is common. Purnomo (1984) reports that it was introduced fairly recently by imported chicks. Intensive poultry producers frequently attempt to control the disease using imported vaccine (mostly from the USA). However, there are several strains of IB virus, and the strains used for the manufacture of vaccines overseas may not necessarily protect birds against Indonesian strains (Young, personal communication). This may explain some reports of vaccine breakdowns. <u>Infectious laryngotracheitus</u> (ILT) is also present and plays a role in respiratory disease problems (Cumming, 1984).

5.54 Although the respiratory disease complex is believed to cause a significant loss of production in intensive poultry production, no comprehensive evaluation has yet been made. In contrast to intensive systems, the organisms responsible for respiratory disease are less important in village poultry.

c. <u>Infectious bursal disease</u> (IBD or <u>Gumboro</u>)

5.55 Infectious bursal disease is also present and although infections are usually subclinical, they are believed to result in reduced growth rates in chicks (Partadiredja and Juniman 1985). The partial destruction of the immune mechanism caused by the disease may also affect the response of poultry to ND and other vaccines (Young, personal communication).

d. <u>Other diseases</u>

5.56 Diseases such as <u>coccidiosis, fowl pox, Marek's disease, Pullorum</u> and <u>Leucocytozoonosis</u> are common (Sutrisno et al., 1984; Purnomo, 1984; Mafiatiningsih and Arjono, 1982; Mudigdo and Peranginangin, 1983; and Chotiah, 1982), as well as predators (hawks, dogs, cats, and civet cats ("musang"), and weather changes take a heavy toll on young birds. Although vaccines are available for Marek's disease and fowl pox, they are rarely used in village poultry. On the other hand, many commercial producers are aware that coccidiosis can be treated and sulphonamides are readily available at poultry shops. Coccidiostats are usually incorporated in commercially prepared compound feeds, but as Cumming (1984) correctly points out, feed manufacturers are reluctant to divulge the type and quantity of drugs they include in rations. <u>Avian encephalomyelitis, Aspergillosis</u> and <u>lymphoid leucosis</u> are also present but of unknown significance, and the frequent reports of the latter may often be confused with Marek's disease.

5.57 The diseases of ducks do not appear to have been studied in any detail in Indonesia. <u>Insecticide poisoning</u> of ducks feeding on harvested rice fields is commonly reported and <u>fowl cholera</u> outbreaks have resulted in heavy mortalities (Sudana, 1982; Hartaningsih, et al, 1982). <u>Pasteurella antipestifer</u> is also present with mortality rates in ducklings reaching 75% (Akoso and Siregar, 1984) during epidemics. <u>Salmonellosis</u> is said to result in duckling losses. The last three can be treated with antibiotics. As an example, it seems to be common practice, even in small duck flocks grazed on harvested rice fields in remote areas, for farmers to dose birds with tetracycline obtained from a poultry shop at the first sign of trouble. Recent work is also demonstrating serious hepatotoxicity problems in some duck flocks due to mycotoxins, especially aflatoxicosis, (Stoltz - personal communication). Table V.9 details the recorded diseases of poultry in Indonesia.

Table V.9: Diseases of chickens and ducks in Indonesia

| | |
|---|---|
| **Viral diseases** | **Protozoal diseases** |
| Newcastle Disease<br>Marek's disease<br>Avian influenza<br>Fowl pox<br>Lymphoid leucosis<br>Infectious bronchitis<br>Infectious laryngotracheitis<br>Infectious bursal disease<br>Adenovirus (EDS 76) | Coccidiosis<br>Leucocytozoonosis<br>Aegyptianella pullorum<br>Plasmodium gallinarum |
| **Bacterial diseases** | **Parasitic diseases** |
| Salmonellosis (pullorum + others)<br>Pasteurellosis<br>Staphylococcosis<br>Tuberculosis<br>Colibacillosis | Intestinal helminths (numerous)<br>Argas persicus<br>Menopon gallinae<br>Cnemidocoptes gallinae |
| **Fungal diseases** | **Mixed infections** |
| Aspergillosis | Chronic Respiratory Diseases Complex (CRD) |
| **Nutritional diseases** | **Toxic diseases** |
| Calcium/Phosphorus deficiences<br>Vitamin A deficiency<br>Vitamin B deficiency | Mycotoxicosis<br>Pesticide poisoning |

Sources:
1. Laporan Hasil Penyelidikan Penyakit Hewan di Indonesia (1976-83).
2. Peta Penyakit Hewan di Indonesia (1980 - 1983).
3. Reports of Keswan Sections in Provincial Annual Reports (1984).
4. Purnomo (1984).
5. Cumming, R.B. (1984).



209

3. Pigs

a. Virus diseases

5.58 There is some uncertainty about the presence of hog cholera (swine fever) in Indonesia. The disease was suspected, but not confirmed, in Jakarta, Baturraden and Bali on clinical and histopathological grounds (Soehorsono et al., 1980; Dharma et al., 1982). If present, individual cases appear to be very rare which does not fit the usual epidemiological pattern. Its presence is not acknowledged by the Indonesian government (Sukobagyo - personal communication) although it appears in the official disease situation report (Anon, 1983). A similar situation exists with Aujeszky's disease.

b. Bacterial infections

5.59 Porcine brucellosis appears to be widespread in Java and Sulawesi (Alton, 1984; Soeroso et al., 1985). Of pigs sampled at abattoirs in West Java, 23% were seropositive using the Rose Bengal test (van de Giessen, 1985). The disease causes abortions and infertility in pigs. In man, infection results in undulant fever, and recent work at BALITVET in collaboration with local hospitals indicates that the public health risk from porcine brucellosis is high (Hirst - personal communication). No effective vaccine is available at present (Alton, 1984), and the high prevalence in some areas makes a test and slaughter program expensive.

5.60 Swine erysipelas is sporadic and farmers generally rely on treatment rather than vaccinations to reduce losses. Pasteurellosis (Haemorrhagic Septicaemia) is common and pigs are vaccinated with the same vaccine used for large and small ruminants. Anthrax is also seen in pigs, particularly in NTT. It has also recently been reported in Irian Jaya (Purnomo et al., 1984). Again, the Sterne vaccine used for large and small ruminants may be administered to pigs.

5.61 Colibacillosis is a common cause of enteritis is piglets and swine dysentery occurs in all classes of pigs, as does Salmonellosis and Leptospirosis. Swine influenza, Japanese B encephalitis and various internal and external parasites have been recorded but their overall significance to the pig industry is not certain.

c. Helminth infections

5.62 Cysticercus cellulosae, the intermediate stage of the tapeworm Taenia solium which infects man, is fairly common in those parts of Indonesia which have large pig populations. It is virtually nonpathogenic in pigs and has only minor public health significance in all provinces except Irian Jaya where it has become a serious zoonosis in the central highlands in recent years. Heavy infestations in these areas has resulted in humans acting not only as hosts for the tapeworm but also for larvae which encyst in various parts of the body, including the brain, causing severe medical problems in some cases. A joint program between the health and livestock departments is atempting to control the disease in Irian Jaya. For a checklist of swine diseases in Indonesia, see table V.10.



210

## C. Veterinary training and research

### 1. Training

5.63 The training of scientific and field veterinarians is the responsibility of university faculties. There are four veterinary medical institutions and one faculty of veterinary medicine and animal husbandry. They are located in the following universities: Syiah Kuala on north Sumatra, IPB, Gadjah Mada, Airlangga on Java and Udayana on Bali. They are located for the most part in areas of high animal (and human) population. As a result, faculty members are available to provide veterinary support to farmers regionally in cooperation with government field services.

Table V.10: Diseases of pigs in Indonesia

| Viral diseases | Bacterial diseases |
|---|---|
| (Swine fever) | Brucellosis |
| Aujezsky's diseases | Erysipelas |
| Japanese B encephalitis | Colibacillosis |
| Swine influenza | Salmonellosis |
| Swine pox | Pasteurellosis |
| (Frot and mouth disease) | Leptospirosis (various spp.) |
| | Enzootic preumonia |
| | (Mycoplasma hyopneumoniae) |
| | Swine dysentery |

**Parasitic Diseases**

Helminths:
- Cysticercosis
- Ascaris lumbricoides
- Metastrongylus apri

Ectoparasites:
- Sarcoptes spp.

Sources:
1. Laporan Tahunan Hasil Penyelidikan Hewan di Indonesia (1976 - 83).
2. Peta Penyakit Hewan di Indonesia (1983).
3. Reports of Keswan Sections in Provincial Annual Reports (1984).
4. Purnomo et al. (1985).

5.64 In 1975, the Directorate General of Higher Education carried out a survey and implemented a plan to encourage the orderly development of agriculturally related universities (Sukra, 1980). Consideration was given to student numbers, faculty strength and postgraduate needs in veterinary and other sciences. Since then, a new veterinary faculty has been created at Udayana University, Denpasar, from a formerly combined veterinary and animal husbandry institution. The plan recognized the need to increase the number and capability of graduates available for the livestock sector. Development from 1975 to 1985 has been realistic in relation to the national economy but must be disappointing to the veterinary services which recognize the need for greater expansion.

5.65 In keeping with national educational policy, resources are still being concentrated in universities targeted as centers of excellence (HUB universities). In veterinary science, they are located at the Institut Pertanian Bogor and Gadjah Mada University, Yogyakarta, both of which have faculty members equivalent in numbers and qualifications to many faculties in other countries. Nevertheless the schools remain under constraint in capital and recurrent funding for scientific equipment and research.

5.66 Selected centers, notably the HUB universities, have been encouraged to develop graduate programs at both masters and doctoral levels. Substantial numbers of students are now working their way through the system.

5.67 In a review of veterinary education in Asia, FAO (1976) notes that the demand for graduates is expected to remain large in the foreseeable future. The report recommends a greater amount of practical training with livestock in clinics and through field extension work, reinforced by improved laboratory equipment and library facilities. While there is evidence that practical methodology has been upgraded, the capital intensive infrastructure of veterinary schools still lags behind, a sign of the heavy demand on the Indonesian economy for development in education and other key sectors. However, some attempt has been made to establish extension activites to villages and farms in order to provide students with practical experience. Such ambulatory clinics are a well chosen and successful support service. In addition, SNAKMA institutions (see Chapter VI) train veterinary technologists, some of whom are employed by veterinary laboratories.

2. Research

5.68 Veterinary research activities are concentrated at the Research Institute for Animal Disease (BALITVET) at Bogor, West Java. Considerable development has taken place at BALITVET since 1981 when a large project supported by the Australian Development Assistance Bureau and managed by the James Cook University of North Queensland was established. This project was complemented by a two-man project funded by the British Overseas Development Agency.

5.69 The period 1981-1985 has seen substantial re-equipping of the institute, the development of a wide range of research projects in bacteriology, parasitology, pathology, toxicology and virology, and the initiation of a comprehensive training program for scientific, technical and administrative staff. At the same time, the library services have been upgraded. The diagnostic capability of BALITVET is also being progressively strengthened as are its epidemiological and communications functions.

5.70 Research projects administered by the institute involve all classes of livestock including fish. They are carried out in cooperation with DIC laboratories and DGLS field services from Sumatra to Irian Jaya.

They interact with other international projects, notably the small ruminant program at the Research Institute of Animal Production, Bogor (BPT) and USAID. A second Australian project at BALITVET, supported by the Australian Center for International Agricultural Research (ACIAR), specializes in studies of malignant catarrhal fever of cattle and buffaloes.

5.71 BALITVET is becoming one of the most vigorous and productive veterinary research centers in the Asian region. Notable advances have been made in its work on foot and mouth disease, trypanosomiasis (surra), mastitis in the dairy cattle sector, brucellosis and parasitism in small ruminants. New information and diagnostic technology is now filtering out to the DIC centres and field services. This trend may be expected to continue to the end of the decade.

5.72 The administrative separation of animal research and field service activities of the Ministry of Agriculture for a time inhibited communication between these two closely related sectors of the veterinary arm, but some improvement in the degree of liaison is now apparent.

5.73 The relationship will have a two way effect. Improved laboratory techniques for diagnosis and research will be adopted by the DIC laboratories which in turn will be encouraged to canvass the opinion of BALITVET staff more freely, and to submit a larger volume of problem material from field outbreaks to the institute at Bogor where there is a larger concentration of technological expertise.

### 3. Research Objectives

5.74 The aim of veterinary research in Indonesia, as in other countries, is to identify the major causes of economic loss in animal production and to devise better methods of diagnosis and control. Subsidiary functions which should be given proper status in national policy are 1) the maintenance of high standards of food hygiene in abattoirs of all classes, and 2) the identification of animal sources of human infectious disease (zoonoses). For this vital area of public health to be effective, closer liaison between veterinary and medical authorities should be encouraged. Major hazards include rabies, brucellosis, salmonellosis, leptospirosis, and other infectious diseases.

5.75 It is probable that new demands will be made of animal health services that require veterinary research. Already, environmental pollution by industrial wastes and pesticides is receiving the attention of staff at BALITVET.

5.76 In addition, the increasing importance of commercial fisheries and aquaculture in Indonesia as in other parts of Asia will pose a queston to agencies within the Ministry of Agriculture that should receive an answer if support services are to be optimized. Intensification of aquatic production inevitably brings more disease problems that must be countered by a combination of improved management and disease control. Veterinary services trained in pathology, infectious diseases and epidemiology may be best equipped to assess the situation and provide answers for production units concerned with fish, prawn and shellfish production.

## D. Strengths and weaknesses

### 1. Manpower and services

5.77 While there appears to be no shortage of veterinarians in administrative and support positions, there is little doubt that the field services are suffering from a deficiency in professional manpower which is afecting the implementation of health programs. It is recommended that future recruitment of government veterinarians be channelled into field activities.

5.78 Veterinary support institutions are now well provided, and it is suggested that when the newest DIC at Banjarbaru has been completed, attention should be given to improving the service provided by existing facilities. For example, the class B and C laboratories are generally less productive than they could be. They are poorly equipped, suffer from a chronic shortage of operating funds (usually no telephones or transport) and some staff have little training in laboratory techniques. If they are to fulfill their role as diagnostic laboratories, a program of re-equipping and re-training is required.

5.79 While the field veterinary service is probubly the weakest point in the government animal health delivery system, another link which requires immediate attention is the contact point with small farmers, the veterinary assistants. This group provides most of the vaccinations and treatments for village livestock. In addition, they are the main source of surveillance data. However, they suffer from three major deficiencies - training, equipment and transport. Although expected to attend six months of training, several assistants contacted during field visits had not undergone any formal training. Their equipment is minimal, and in particular, does not include a refrigerator. Large quantities of vaccine are believed to be lost each year for lack of refrigeration. Assistants are expected to walk, to use public tranport or to borrow motorcycles. As a result, villages some distance from the kecamatan capital where the veterinary assistant normally resides, receive less than adequate service.

5.80 Veterinary assistants should nevertheless be regarded as assistants rather than substitutes, and policies to encourage government veterinarians to do more active field work would be beneficial. In this respect, the provision of animal health centers and posts in areas of special need is strongly supported. Also, the trend for more cooperatives and private companies to employ veterinarians is encouraging, and may enable the veterinary profession to make a greater impact on the health of Indonesian livestock than it has in the past.

### 2. Disease status and control

5.81 Vaccination programs against haemorrhagic septicaemia, anthrax and Newcastle disease, together with treatments made by the field service, have undoubtedly reduced losses from disease. With the possible exception of foot and mouth disease, the list of pathogens affecting livestock has remained the same for the last 40 years. If anything, it has increased due to the discovery of previously unknown problems, e.g. Jembrana disease and infectious bovine rhinotracheitis, and the importation of others, e.g. infections bronchitis.

5.82 Knowledge of the disease status has increased signficantly in recent years, but there are still areas of uncertainty. For example, the presence or absence of swine fever should be determined; histopathological evidence suggests that it occurs, but the epidemiology of suspected outbreaks does not fit the expected pattern. The probability that Indonesia will soon begin exporting pigs to Singapore lends urgency to the need for an evaluation. Similary, the reported presence of virulent Bluetongue in sheep and Aujeszky's disease in pigs requires confirmation.

5.83 The containment and possible eradication of foot and mouth disease has given the veterinary authorities much greater confidence in their abilty to overcome many of the seemingly insurmountable problems involved with eradication programs in Indonesia. If the eradication of FMD is confirmed, this experience should be directed at other major disease problems. Haemorrhagic septicaemia (HS) and Newcastle disease (ND) are being considered. As mentioned earlier, there is some doubt that a saturation vaccination program will eradicate HS using existing vaccines, and more research combined with field trials needs to be carried out before the pilot program on Lombok is extended to other parts of Indonesia.

5.84 The situation with ND, however, is different. Overseas experience has shown that although difficult, eradication is possible. However, it is not recommended that the Indonesian government attempt a mass program against ND at this stage. It is suggested, however, that attempts be made now to gain a better understanding of the epidemiology and economics of ND in village poultry. If the benefit-cost ratio of eradication is favorable, as expected, the necessary supportive research should be undertaken, and a small pilot project implemented, to test vaccination procedures and quarantine measures. One of the smaller islands would be suitable for this. At a later stage, a slow island-by-island program might be considered.

5.85 The respiratory disease complex, which despite vaccination, is causing major losses for larger commercial poultry producers and requires further investigation.

5.86 Unfortunately, the study team did not get the opportunity to examine in detail the research on Jembrana disease being carried out on Bali cattle at the DIC in Denpasar. However, given the value of Bali cattle as an Indonesian livestock resource, a disease with the potential to decimate this resource clearly requires investigation even though its economic effect may not be great at present.

5.87 Bovine malignant catarrhal fever was reported with relatively high frequency during field trips throughout those areas of Indonesia where Bali cattle are common. Although some cases may be misdiagnosed, the number of laboratory confirmed cases would suggest that Indonesia may have a special problem with this disease.

5.88 The recent identification of a high incidence of bacterial mastitis in Java's dairy herds with estimated milk production losses of up to 15% to 20% indicates an urgent need to define the problem in both commercial units and small farms. Antibiotic resistance of pathogenic bacteria has shown that mastitis control may not be achieved by improved hygiene but may require better methods of therapy. Calf management and increased calving rates require investigation.

5.89 Because of the risk of infecting humans through contaminated milk and losses caused by obortion in cows, there is a case for eliminating Brucellosis from Indonesia's dairy herd. At the moment, the prevalence appears to be low, but this may change as the industry develops and animal movements among herds increase. Infected beef cattle represent a much smaller human risk than dairy cattle. Although common in Sulawesi, the cost of elimination would probably exceed losses, particularly in less productive ranching systems. It is recommended however, that breeding cattle leaving Sulawesi destined for other island be tested before shipment.

5.90 With suitable research and field trials, management strategies for reducing the impact of internal parasites on small ruminant production could be devised for the various climatic regions of Indonesia. Devising management strategies requires both careful planning and close monitoring. Until the effectiveness of the field veterinary service improves, there is little chance that these strategies could be applied on a wide scale.

5.91 Although the animal health status of Indonesia is becoming better understood, there is an urgent need for a better definition of the distribution, prevalence and economic effects of diseases. It is difficult for policy-makers in Jakarta or provincial capitals to make decisions or long-term plans without this information. For example, the values of economic losses quoted in preceeding sections are based on an estimation of "reported" outbreaks. It is likely that estimates are substantially underestimated because not all outbreaks are reported to veterinary assistants or laboratories. Subclinical diseases are unlikely to be reported at all.

5.92 A surveillance program has been designed by DGLS which is aimed at rectifying this lack of information. The livestock populations in four desas in each province are kept under close observation and daily occurrences such as deaths, births, etc are recorded. In addition a joint team from the DICs and the provincial Dinas Peternakan visit each village every month and collect blood and faeces for laboratory analysis. Reproductive data is collected at the same time. This information, together with the laboratory results, are then sent to Jakarta for analysis by the Bureau Of Agricultural Statistics' computer center.

5.93 Although well-designed, the system has encountered several problems, one of the greatest being the collection of daily information from the desa. Previous experience in Indonesia suggests that unless a paid employee is stationed in the village, these data are difficult to obtain (Banks 1985). Another problem is the rapid turnover of staff in the disease surveillance section at DGLS with a resulting lack of continuity.

5.94 Despite the problems, it is strongly recommended that the surveillance program be strengthened. Once operating effectively, it should be broadened in its scope to provide the critical material required for formulating animal health policies.



216

### 3. Disease constraints to production

5.95 Indonesia has made considerable progress in the past decade in the development of animal health services. The provision and maintenance of adequate veterinary support in such a large country with a diverse animal population is, however, a massive task which is being made more difficult by constraints at three levels:

Level 1: Disease control, undernutrition

Level 2: Research diagnostic services
Prophylaxis/treatment

Level 3: Training and finance

5.96 The following section attempts to identify some of the constraints beginning at the field level. Methods of tackling these constraints are summarized in the list of recommendations.

#### a. Level 1: Disease status

5.97 Information now issuing from field and laboratory services provides a general perspective of animal disease. Data are most detailed in the regions supported by the DICs (Sumatra, Java, Bali, Sulawesi). The disease status in Kalimantan and eastern Indonesia is less clear, at least in relation to endemic and sub-clinical conditions. Nevertheless, there is an urgent need to obtain more accurate data on both the total spectrum of disease in each livestock subsector, and to determine the real economic impact of the most common problems. To accomplish this task, it will be necessary to improve the efficiency of both field staff (veterinarians and veterinary assistants) and diagnostic laboratories.

5.98 Sufficient information is now available to identify some of the problems that require intensive investigation and to which more resources should be allocated. They include:

5.99 Protozoal diseases of ruminants (anaplasmosis, babesiosis, theileriosis): Laboratory data from West Sumatra indicates a high incidence of these infections in the region, especially in the wet season. Their related vectors and vector life cycles are not clear but they must be understood if the best control methods are to be devised. The possibilty of vaccination does not seem to have been considered, although expertise should be readily available from Australia.

5.100 There is a need to investigate the significance of *Theileria* infection in West Sumatra and elsewhere, to determine the real pathogenicity of local strains as primary or secondary infections.

5.101 Trypanosomiasis, *T. evansi*, is widespread in Indonesia and is already being investigated through joint research by BALITVET, Bogor and DGLS in Java, but the work should be extended to other areas where a clinical problem appears to exist (Sulawesi). Geographic distribution, incidence and its effect on production indices, all need to be determined.



1/1

5.102 Bacterial diseases of ruminants: Haemorrhagic septicaemia is reportedly common in parts of the country but laboratories of all types show few isolations of Pasteurella spp. More accurate information on the epidemiology of the disease is required. The development and use of vaccines giving longer immunity should be considered in areas where the disease is proved to be a problem.

5.103 Bacterial mastitis of dairy cattle is emerging as a significant problem requiring urgent attention. Following specific identification of the pathogens in a herd, extension support from DGLS will be required to advise on herd hygiene and appropriate methods of therapy.

5.104 Virus disease of ruminants: Several active research centers are now making progress. At Medan, infectious bovine rhinotracheitis has been intensively studied, and it appears to be common in North Sumatra. Further data on morbidity, mortality and general epidemiology should help to define the economic importance of the disease and any control measures that may be applied.

5.105 Malignant catarrhal fever is being investigated at several laboratories (BALITVET in Bogor, Medan, Denpasar) and some success in determining transmission of the disease has been acheived. More accurate information on the geographic distribution and disease prevalence is required because control may sometimes be achieved by changes in management, e.g. separation from small ruminants. A similar condition, Jembrana disease, is the subject of research on Bali supported by IFAD.

5.106 Arbovirus infections: There is a need to clarify the nationwide status of production -- limiting diseases such as ephemeral fever, Akabane disease and orbivirus infection ("Bluetongue") that are known to be present. Work in progress at BALITVET should be expanded.

5.107 Infertility: Low reproduction rates are commonly reported in cattle and buffalo, but little systematic work has been done on the problem. Laboratories should consider establishing multi-disciplinary studies in problem areas to define the nutritional, managerial and infectious factors that may be involved. The dairy industry and ranching operations need this service as much as the draft/beef system.

5.108 Neonatal mortality: Various authorities report serious losses in calves, small ruminants and poultry in the first few weeks of life. Such losses can be of great economic importance irrespective of the size of the production unit, and should be considered unacceptable. Most causes have proven methods of prevention which may not be expensive.

5.109 Mortality in imported cattle and buffaloes: Serious losses have been experienced among cattle imported from Australia and elsewhere. A 38.4% mortality rate from acute disease in buffaloes was reported from West Sumatra in 1984. Over a three-year period, 46% of a consignment of dairy cattle to the same region died. Such losses are unacceptable both in terms of animal and economic loss.

5.110 Closer collaboration should be developed between the exporting and importing authorities to select prophylactic methods against disease of the region. An intensive herd health program should be developed to



219

monitor the animals after distribution in rural areas. Causes of death need to be more accurately diagnosed if disease is to be prevented. Lack of immunity to indigenous infections probably contributes substantially to these losses, so that it is vital for the background of disease in the reception area to be accurately understood. Appropriate vaccination might reduce the losses substantially.

5.111 Regional disease patterns: Greater veterinary resources are required to monitor animal disease in Kalimantan and the area east of Lombok. The new DIC laboratory at Banjar Baru will assist the former areas significantly. Class B and C laboratories in the eastern islands should be strengthened by supplying basic diagnostic kits (microscopes, reagents, glassware).

b. Level 2: Veterinary services

5.112 Field services: Good communications (roads, telephone, radio, transport) are necessary if veterinarians and veterinary assistants are to be fully effective. It is here that one of the weakest links exists. Progressive improvement may be expected as part of national development but the process could be reinforced by including infrastructural components in bilateral veterinary aid programs. Vehicles and petrol, in particular, are needed to allow staff to reach the farmers and their livestock.

5.113 The service fullfils two essential roles: 1) diagnosis and 2) prevention or treatment. Diagnostic services involve clinical examination, and in some cases, sampling and dispatch of samples to the laboratory. There is evidence that the field-laboratory transfer is often ineffective because of the time taken for samples to reach the laboratory, e.g., 9 days in one program. Such samples are useless for laboratory culture and a large amount of professional time and money is wasted. Formalin fixed materials for pathological examination are usually satisfactory, but often less useful for acurate diagnosis.

5.114 Field staff should give careful consideration to the efficiency of their method of dispatch, and samples should only be sent if the laboratory is able to process them within a short period, e.g., 1 day. Training programs in basic diagnostic procedures would be helpful.

5.115 Vaccination programs will fail if the vaccine is not properly stored and handled. The success of the foot and mouth disease eradication campaign in 1973-83 depended heavily on the supply of refrigeration. Virus vaccines are especially vulnerable and programs for Newcastle disease and other avian diseases must be supported by coolers, if biologicals are not being used immediately. This problem occurs mainly at village level as larger commercial producers are well aware of the need for viable vaccine. Their economic survival depends on them. Use of oral vaccination with heat-resistant strains of ND virus is being tested in Malaysia, and may be applicable in Indonesia.

5.116 Research: Considerable impetus has been give to veterinary research by the establishment of Australian and British development projects at BALITVET, Bogor. A broad research portfolio is now directed at the solution of major disease problems in Indonesia (table V.11), and new information and techniques are being distributed to the DIC laboratories and field services by staff training and written material.

5.117 Because of the magnitude of the disease problem in Indonesia, however, other sections of the veterinary service should be encouraged to develop mission-oriented projects. Already, the DIC laboratories are active in this field, but the universities, field services and pharmaceutical industries have considerable potential either independently or through joint investigations. There is no reason why private consultants should not carry out minor research such as epidemiological surveys as part of their routine work, provided that they can obtain some laboratory support.

5.118 Diagnostic laboratories: Development of the DIC system is still in progress with the recent establishment of facilities in South Kalimantan. Many staff members are still in training and, when this phase is completed, the laboratories will have a good professional base.

5.119 It is essential that each laboratory should also have a corps of well-trained technologists. Their experience and skills are as important as those of the scientists. More formal training of laboratory technologists should be regarded as essential, if the DIC system is to be fully effective. Selected technical staff should be allowed to study overseas to at least diploma level to become familiar with both established and new techniques.

5.120 Since it is difficult for each laboratory to be proficient in all disciplines, consideration must be given to nominating individual DICs as specialist centers, e.g., in protozoology or toxicology. The higher level of technology at the central veterinary laboratory, BALITVET, Bogor, should be recognized, and a larger amount of material referred to it for identification or more detailed examination. The link with BALITVET should also be used to encourage joint research activities.

5.121 There is evidence from a number of centers that maintenance of equipment is seriously inadequate and must affect the quality of teaching, diagnosis and research. Microscopes in particular, are highly vulnerable to fungal infection in the Indonesian environment. If air-conditioning is not available in the laboratory, much greater care should be taken to protect instruments from contamination.

### c. Level 3: Training and finance

5.122 Training: Reference has already been made to the university sector and the need to strengthen both the teaching programs and the technical facilities at each faculty. Their role in graduate training and continuing education is of national importance. That role will remain difficult to fulfil as long as resources, including libraries, are inadequate.

5.123 Finance: Funding by central government in Indonesia, as in all other countries, will be influenced by its perception of the importance of animal disease in reducing food production, inhibiting exports, or affecting animal health. The case for giving increased funding is weakened by lack of economic data on the effects of disease. There is a need for intensifed epidemiological studies and economic analysis of the major animal diseases which cause death, infertility, reduced weight gain or output of milk or eggs. If DGLS were to assume responsibility for fish, prawns and shellfish, the same need would occur.

5.124 All parts of the veterinary services, research, laboratory diagnosis and field workers can assist in analyzing losses in the various production systems. It is essential that the "real" major causes of economic loss be identified.



221

Table V.11: Research portfolio at the Research Institute for Animal Diseases (BALITVET), BOGOR, 1985.

| | Title | Cooperating institutions |
|---|---|---|
| Large ruminants | Foot and mouth disease vaccine assay | Pusvetma, Surabaya |
| | Trypanosomiasis | DGLS |
| | Epidemiology of sentinel herds | DGLS |
| | Diseases of dairy cattle | DGLS |
| | Malignant catarrhal fever | BPT Ciawi; DGLS; DIC Yogyakarta; James Cook University; QDPI; ACIAR. |
| | Fascioliasis | DGLS |
| | Anaplasmosis | |
| | Infectious bovine-rhinotracheitis | Gajah Mada University; James Cook University. |
| Small ruminants | Disease survey | BPT Bogor, CRSP |
| | Fascioliasis | DGLS |
| | Cyanide toxicity | |
| Poultry | Newcastle disease (virology and pathology) | |
| | Infectious bronchitis | |
| | Aflatoxicosis | Int'l Agency for Cancer Research, Lyon, France. |
| | Avitaminosis A/ DDT Toxicity | |
| Swine | Brucella suis diagnosis | DGLS |

(Continued)

TABLE V.11 (Continued)

| | Title | Coopration institutions |
|---|---|---|
| General | : Rabies | Pusvetma, Surabaya; Department of Health |
| | : Brucella, reagent production | DIC laboratories |
| | : Clostridial diseases | |
| | : Leptospiral diagnosis | |
| | : Colibacillosis | |
| | : Mycrotoxins in feed-stuffs | |
| | : Heavy metals in livestock- and aquatic animals | |
| | : Pesticide toxicity | DGLS |
| | : Plant alkaloids | |
| | : Disease survey Kabupaten Bogor | DGLS |

ACIAR Australian Central for International Agricultural Research

CRSP Collaborative Support Research Program (USAID)

* Supported by the Australian Development Assistance Bureau and The Overseas Development Agency, UK.

QDPI Queensland Department of Primary Industries, Australia.



223

# PART III. SUPPORTING SERVICES FOR THE LIVESTOCK SECTOR

## CHAPTER VI. Support Services

### A. Institutional Background

6.1 This section describes formal institutions which influence the environment in which farmers make decisions, obtain inputs, and market their produce. In many cases, these institutions help determine rules governing farm operations. These institutions provide services that facilitate not only production but also processing, distribution and marketing of farm products.

6.2 For convenience of discussion, institutions are divided into two major groups:

- Public institutions
- Private institutions

#### 1. Public Institutions: Ministry of Agriculture

6.3 The Ministry Of Agriculture (MOA) is responsible to the Government Of Indonesia (GOI) for the formulation and implementation of agricultural policies. In order to carry out its mandate, the work of the Ministry of Agriculture is delegated by subject matter and function. There are four Directorates General based on the following subject matter specialties:

- food crops
- estate crops
- fisheries
- livestock

6.4 In addition, the Central Quarantine Service (see Chapter V) is a separate unit. The directorates are responsible for implementing GOI policies and programs within their specialized production area. Each Director General is responsible to the Minister. For subject matters, the Minister can delegate his responsibility to either of his two Junior Ministers -- one for Food and Estate Crops and one for Livestock and Fisheries.

6.5 In addition, there are two agencies based on function that supplement and support the subject matter directorates, the Agency for Agricultural Research and Development (AARD) and the Agency for Agricultural Education, Training and Extension (AAETE). A third unit, BIMAS (Bimbingan Massal Pertanian), is concerned with accelerating food production. Its role is primarily facilitating. The agencies serve the research, administrative and most of the training needs of the four directorates. Figure VI.1 illustrates the structure of the ministry.



1.2.1

6.6 The next sections discuss the roles of the Directorate General for Livestock Services (DGLS), AARD (research), AAETE (extension), and BIMAS (administration) in the livestock sector.

### a. Directorate General for Livestock Services

6.7 The Directorate General for Livestock Services (DGLS) is responsible for the formulation and implementation of GOI policies and programs in the livestock sector. The Directorate General is divided into six directorates. In addition, 23 units for technical management (UPT) dealing with livestock breeding, artificial insemination (A.I.), fodder development, and disease investigation are located in the provinces. Unlike provincial extension staff, the UPTs report directy to the DGLS. The UPTs are described in appendix 6.A.

6.8 DGLS staffing is presented in table VI.1. Nearly one-quarter of the staff is located in Jakarta. Out-posted staff is concentrated in the most populous areas. Coverage in the less-densely populated areas may be inadequate.

6.9 Directorate of Planning and Programs: The Directorate of Planning and Programs prepares and evaluates livestock development programs. The same agency collects, collates and publishes essential statistical data. This data is used for planning the five-year development plans (REPELITA). In addition, the data is used in budget discussions with the Ministry of Agriculture and BAPPENAS, Indonesia's budgeting agency. The budget planning process is illustrated in figures VI.2 and VI.3. Appendix table 6.1 shows a budget.

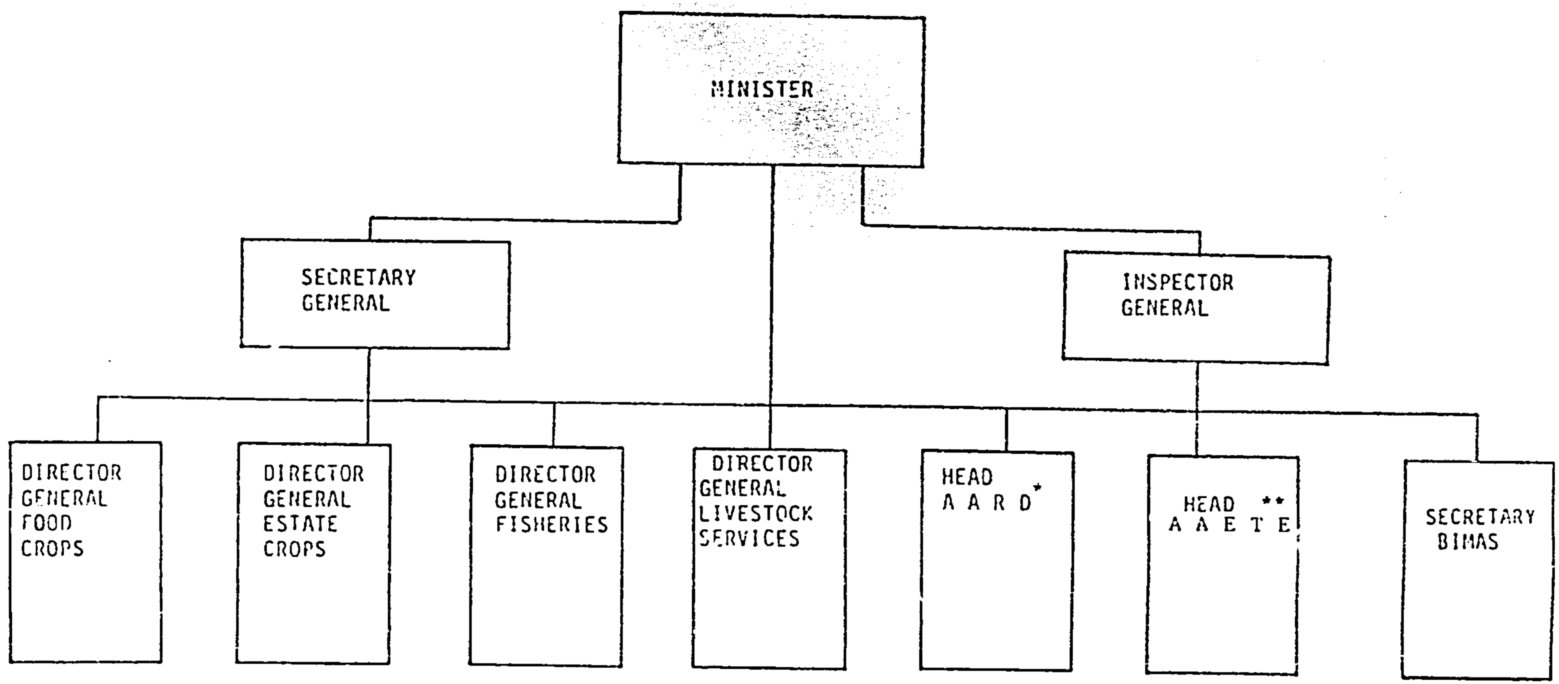
6.10 Directorate of Livestock Production: The Directorate of Livestock Production is responsible for overall improvement of livestock production. Eleven UPTs, two artificial insemination centers, and nine fodder and livestock productions centers work through the directorate which is also responsible for the control of mixed concentrate feeds, complete rations, and feed additives.

6.11 Directorate of Livestock Development and Distribution: Since the GOI has established a policy for distributing livestock to smallholders under a number of different programs (transmigration, inpres and others), the DGLS has been made responsible for building distribution facilities and quarantine stations, and distributing beef/draft cattle, sheep/goats, dairy cattle, and buffalo. This directorate has been instrumental in identifying and implementing livestock distribution schemes suitable for resettlement programs.

#### 4) Directorate of Livestock Industry and Smallholder Development

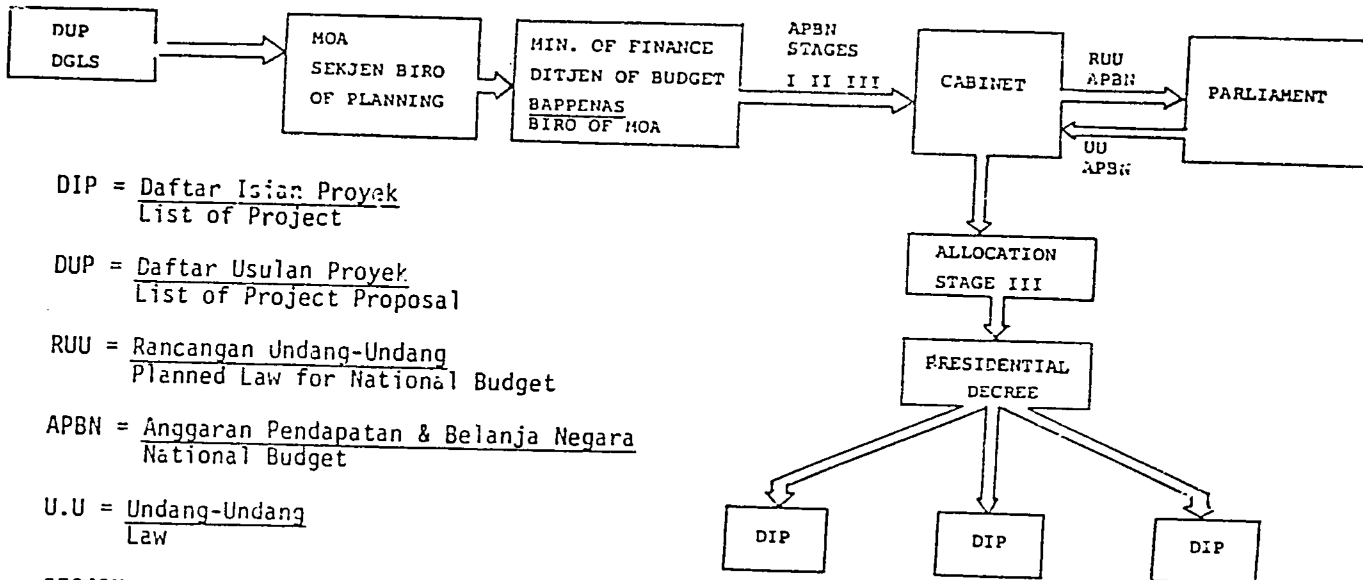
6.12 This directorate is responsible for livestock business and smallholder development. It provides assistance to livestock producers, processors and marketing agencies. Its purpose is to increase farm income from livestock products, and facilitate market activity. It provides direct assistance to livestock producers, processors and marketing agencies. It collects and distributes market information. In addition, it regulates the industry, issuing permits and licenses.

Figure VI.1 : Organization arrangement of the Ministry of Agriculture




* Agency for Agricultural Research and Development
** Agency for Agricultural Education, Training and Extensions

Figure VI.2: Preparation of National Budget for the DGLS




DIP = Daftar Isian Proyek
List of Project

DUP = Daftar Usulan Proyek
List of Project Proposal

RUU = Rancangan Undang-Undang
Planned Law for National Budget

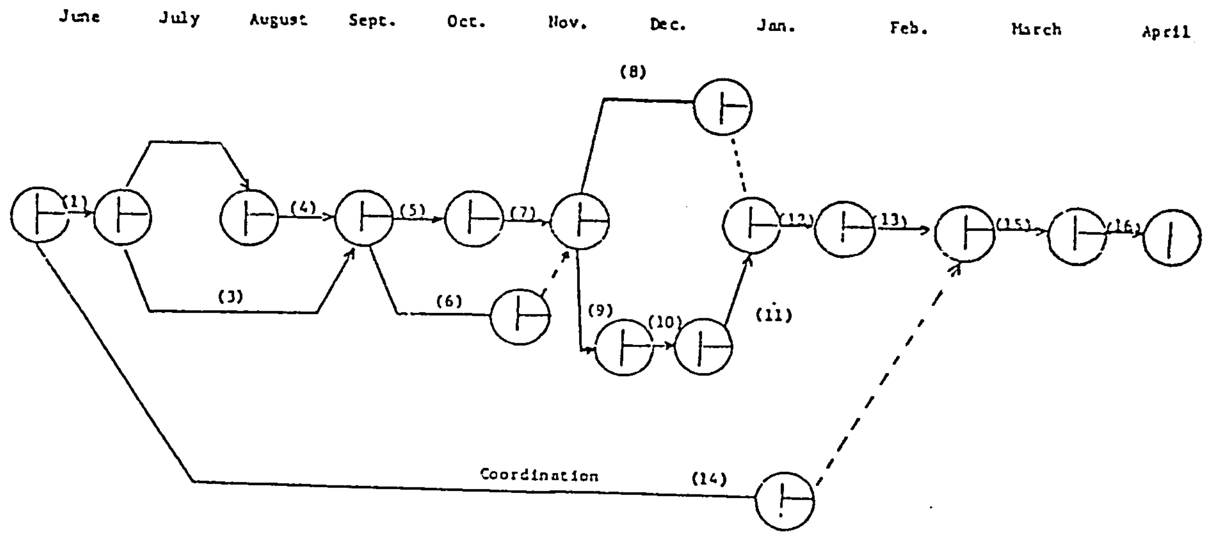
APBN = Anggaran Pendapatan & Belanja Negara
National Budget

U.U = Undang-Undang
Law

SECJON = Secretary General
Bureau of Planning

DIRGEN = Budget
Director General Budget

Figure VI.3: Chart-Time Schedule for Preparation of National Budget for DGLS




Clarification:

(1) Preparation/Form for Working Paper
(2) Provincial Working Paper
(3) D.G.L.S. Financial Statement
(4) Data Inventorization
(5) Submission of Working paper and list of project proposal to DGLS
(6) Discussion on the working paper and project proposal between DGLS and Provincial
(7) Submission working paper and list of project proposal to the Ministry of Agriculture Bureau of Planning
(8) Platform for stage III list of project
(9) Draft of list of proposal and working paper
(10) Discussion of project official with DGLS
(11) List of project proposal and operational guidance prepared by DGLS
(12) Submission of DIPA P.O. to M.O.A. / Bureau of Planning
(13) Discussion on list of project proposal with Bappenas and Ministry of Finance
(14) Coordination
(15) Approval of DIPA P.O.
(16) Submission of DIPA P.O. to the project

Table VI.1: Number of professionals and non-professionals serving the livestock services in Indonesia

| Province | Veterinary medicine graduates | Animal husbandry graduates | Total non-professional | Total |
|---|---|---|---|---|
| Aceh | 10 | 8 | 89 | 107 |
| North Sumatra | 28 | 18 | 208 | 254 |
| West Sumatra | 11 | 18 | 142 | 171 |
| Riau | 10 | 8 | 48 | 66 |
| Jambi | 6 | 5 | 27 | 38 |
| South Sumatra | 7 | 17 | 66 | 90 |
| Bengkulu | 5 | 12 | 21 | 38 |
| Lampung | 17 | 11 | 83 | 101 |
| DKI Jakarta | 123 | 137 | 491 | 751 |
| West Java | 26 | 38 | 130 | 194 |
| Central Java | 33 | 25 | 101 | 159 |
| DKI Yogyakarta | 21 | 11 | 53 | 85 |
| East Java | 71 | 32 | 401 | 504 |
| Bali | 26 | 20 | 230 | 276 |
| West Nusa Tenggara (NTB) | 11 | 8 | 37 | 56 |
| East Nusa Tenggara (NTT) | 6 | 7 | 60 | 73 |
| East Timur | 1 | 1 | 2 | 3 |
| West Kalimantan | 5 | 4 | 9 | 18 |
| Central Kalimantan | 3 | 4 | 10 | 17 |
| South Kalimantan | 10 | 21 | 126 | 157 |
| East Kalimantan | 6 | 7 | 15 | 28 |
| North Sulawesi | 4 | 7 | 15 | 26 |
| Central Sulawesi | 6 | 8 | 19 | 33 |
| South Sulawesi | 16 | 35 | 183 | 234 |
| Southeast Sulawesi | 3 | 12 | 48 | 63 |
| Maluku | 3 | 5 | 38 | 46 |
| Irian Jaya | 9 | 3 | 12 | 24 |
| Total | 467 | 482 | 2216 | 3165 |
| Percent in Jakarta | 26.3 | 28.4 | 22.2 | 23.7 |

6.13 Directorate of Animal Health: The Directorate of Animal Health is divided into five departments. Disease Prevention, Eradication and Control formulates national policy for disease control, including vaccination programs and disease eradication campaigns. It also responds to major disease outbreaks. Disease Surveillance collates surveillance information from the field and estimates cost and benefits of disease control measures. This sub-department also controls the activities of the seven UPT Disease Investigation Centers. Veterinary Public Health regulates abattoir hygiene, inspects meat, milk and eggs, and controls the slaughter of productive females. Disease Repulsion supports the Department



229.

of Agricultural Quarantine. Finally, Veterinary Drug Supply and Supervision controls the importation, production, distribution and marketing of veterinary drugs.

6.14 Directorate of Livestock Extension: This directorate is responsible for DGLS's livestock extension activities. The directorate works through the AAETE and the provincial livestock extension staff, discussed later, to extend livestock production and marketing information to farmers. The directorate works through the AAETE's Rural Extension Centers (REC) and their contact farmers. The Rural Extension Centers have been utilized for support of the field extension workers, especially to formulate their operational activities based on the extension program. Besides the farmers group visit, the REC is always open for conducting discussions, consultations, or meetings among extension workers and co act farmers.

6.15 All training courses of less than 100 hours for extension workers and contact farmers are conducted by the Directorate, while longer training programs, especially for officials, have been conducted by AAETE. The animal training program is especially concerned with livestock and is governed by the Department of Livestock Extension.

b. Central Quarantine Service

6.16 Quite recently the MOA consolidated all quarantine services under an Agricultural Quarantine Center (AQC), which is responsible to the secretary general of MOA for all quarantine activities that affect plants and animals. The DGLS, through its Directorate of Animal Health, provides technical services to the AQC for livestock.

c. Agency for Agricultural Education, Training and Extension

6.17 The AAETE is an agency of the MOA established in 1974 to support the education, training and extension functions of the four directorates. It replaced the Rural Education Center which was established in 1950. The AAETA has benefitted since 1976 from the Agricultural Extension Project under the DG of Foodcrops. Only 11 years old, the agency accomplished the following:

- recruiting professional and nonprofessional staff especially needed for the regional training centers, information centers, and agricultural high schools, while simultaneously strengthening the central office

- establishing 11 Agriculture Information Centers, which will be increased by 16 more, so that each province will have its own AIC. Each center collects technical information and prepares information packages for the REC's and farmer's use

- establishing 22 regional training centers The number will be increased to train the agricultural staff as well as the extension workers and, in some cases, the contact farmers

- constructing or rehabilitating 22 public agricultural high schools to produce qualified candidates for the field extension workers or the private sector

- increasing the number of REC's throughout the country to be utilized as the operational base for the field extension workers

- promoting the active role of contact farmers by establishing consultation farms at the regional and national levels to encourage farmers to participate more actively in agricultural development

The following paragraphs describe the education, inservice, and extension activities of the AAETE in greater detail:

6.18 Education: AAETE's primary function in formal educational institutions is in the Sekolah Pembangunan Pertanian (SPP), the agricultural development schools. These schools train the field extension workers (PPL -- Penyuluhan Pertanian lampangan) who work directly with contact farmers in the "training and visit" extension system commonly used in Indonesia.

6.19 Sekolah Pembangunan Pertanian (SPP) schools admit graduates of junior high schools for a three-year senior high school program for training as agricultural technicians. There are 22 national SPP schools under the direct administrative control of AAETE. In addition, there are 122 SPP schools sponsored by provincial governments, foundations, religious groups, and other private groups. AAETE sets the curriculum, prepares and administers entrance and final examinations, inspects instructional adherence to curriculum and accredits all non-national SPP schools. There are two major types of SPP school curricula: general agriculture (including food crops, animal husbandry and inland fisheries) and marine fisheries.

6.20 Seven national SPP schools specialize in animal husbandry, (SNAKMA). Table VI.2 lists names and locations of the SPP SNAKMA schools. However, the AAETE is in the process of phasing out the SPP SNAKMA schools to offer basic training in food crops, livestock and general agriculture. General agriculture graduates will be trained in specialty areas through inservice training in the DGLS before assuming extension responsibilities in the field.

6.21 Inservice Training: Before 1974, each department conducted its own inservice training programs when a need arose and if funds were available. Since 1974, AAETE runs most inservice training when more than 100 hours of training is involved. AAETE offers the following inservice training:

For extension workers (other than animal health workers):

- An orientation school for one month to introduce extension workers (PPL) to extension methodology

Table VI.2: Animal husbandry schools (SNAKMA) in Indonesia

| Location | Area served |
|---|---|
| Malang | East Java |
| Padang Mangates | West Sumatra |
| Negeri Tegal Rejo, Magelang | Central Java |
| Ujung Padang | Sulawesi and Eastern Islands |
| Bogor | West Java and South Sumatra |
| Negeri Saree Aceh, Aceh | Aceh, North Sumatra |
| Pleihari, South Kalimantan | Kalimantan |

- Basic extension training for those extension workers who have had the orientation course for an additional one month

- A one-month training course in extension methodology for university graduates who will become subject matter specialists (PPS)

For extension animal health workers (all programs one month long):

- A basic course, for the animal health officer covering basic responsibilities

- A training course for veterinary technologists

- A course in veterinary public health for technicians. The course covers milk testing, meat inspection and others topics.

6.22 General laboratory training is a month-long course covering the essentials duties and techniques used by laboratory technicians.

6.23 Special courses in animal production: These variable length courses are often labelled "upgrading" courses. Each course covers one of the following subjects:

- Animal feeds
- Forage production



232

- Statistical analysis
- Beef/draft animal production
- Buffalo production
- Poultry production
- Dairy production
- Small ruminants production

6.24 A specical course in poultry production: This course is under the administrative control of the AAETE and is conducted with the assistance of the Government of the Netherlands.

6.25 Courses for professional civil service personnel: Three 3-1/2 month courses are offered, each one describing the duties of section (SEPALA), (SEPADYA) and department heads. Personnel in line for promotion participate.

3) Extension

6.26 The extension service of DGLS is responsible for channelling technical and other information to farmers. The relationship among AAETE, directorate generals and other agencies is shown in Figures VI.4, VI.5, and VI.6. Appendix VI.B describes the organizational structure and flow of information from DGLS Directorate of Livestock Extension Services and AAETE from the national level to the provincial, regency (or wilayah) and subdistrict levels.

d. Agency for Agricultural Research and Development (AARD)

6.27 The AARD is the research agency of the MOA. Its structure is illustrated in Figure VI.7. AARD research focuses on three main disciplines: livestock, coordinated by the Central Research Institute for Animal Sciences (CRIAS), crops, coordinated by the Central Research Institute for Food Crops (CRIFC) and Fisheries. All three are located at Bogor. CRIAS coordinates the research activities of two other institutes, the Research Institute for Animal Diseases (RIAD) and the Research Institute for Animal Production (or Balai Penelitian Ternak (BPT), located in Bogor and Ciawi respectively. BPT has substations at Sei Putih (North Sumatra), Klepu (Central Java), Grati (East Java) and Gowa (South Sulawesi), with another projected for Kupang (West Timor). Technology developed by CRIAS is transferred to farmers through DGLS.

6.28 Research in BPT focuses on examining the nutritive values of indigenous feeds in Indonesia, as well as means of improving these by supplementation or treatment. The laboratory is well-equipped for this kind of research. BPT is also studying differences in trace mineral levels in forages produced on different soils. Since reproductive performance of all indigenous animals in Indonesia is low, one BPT research project concentrates on overall reproductive performance of indigenous cattle, the swamp buffalo and small ruminants in order to find out why reproductive performance is low and how to improve it. Farming systems research is another major interest within BPT.

Figure VI.4: : Operational chart of agricultural extension in Indonesia from the national level to the field level.

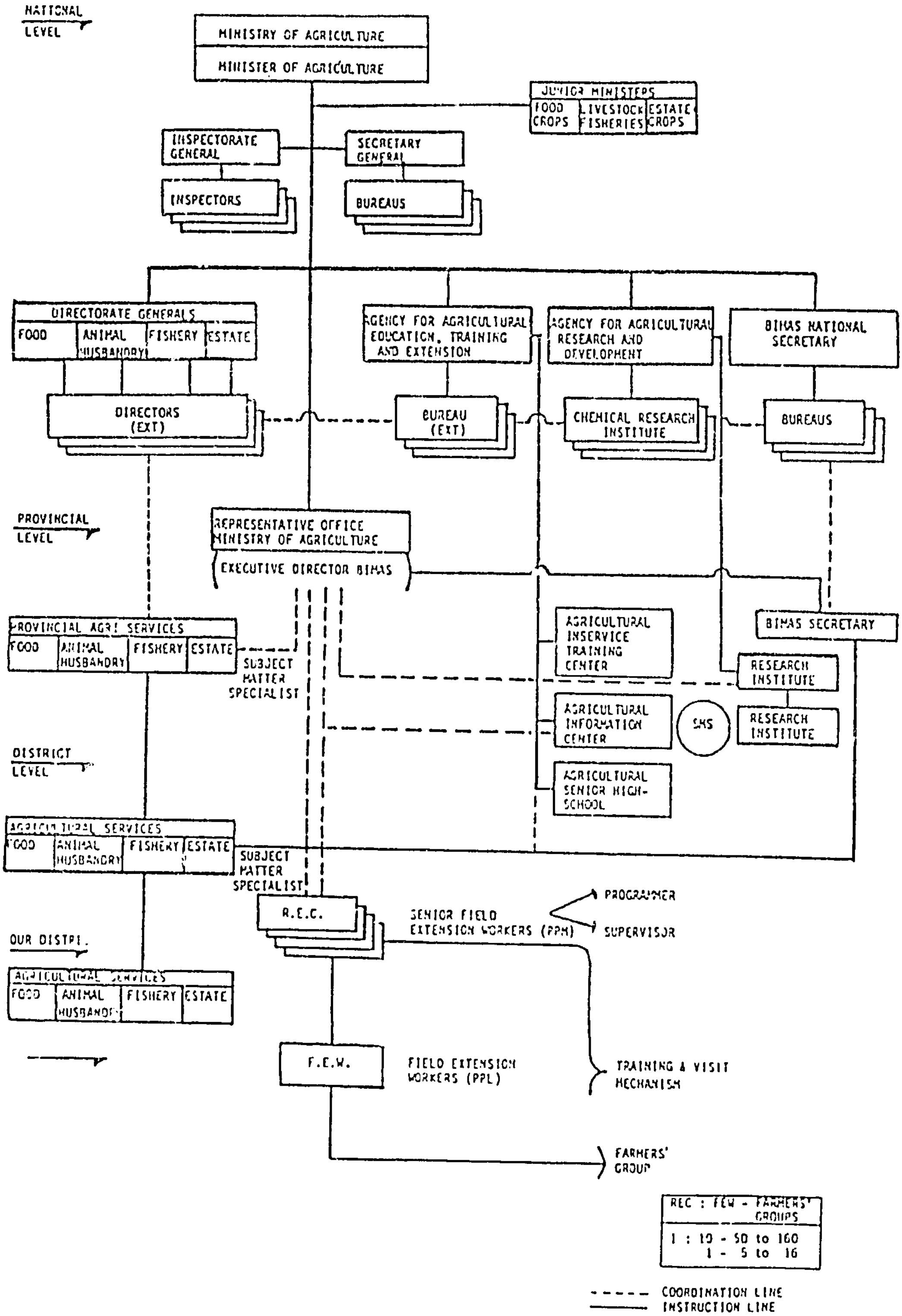
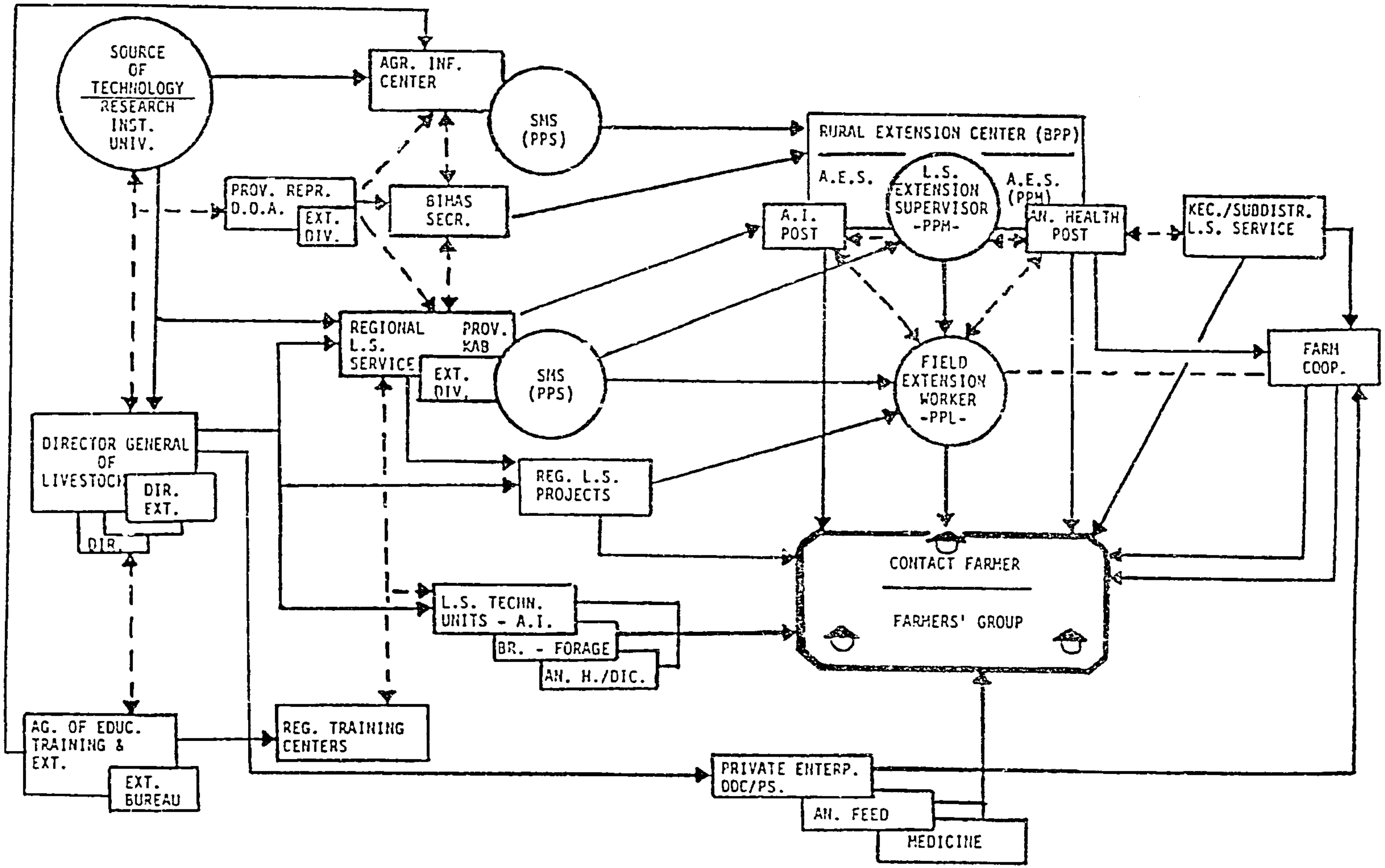


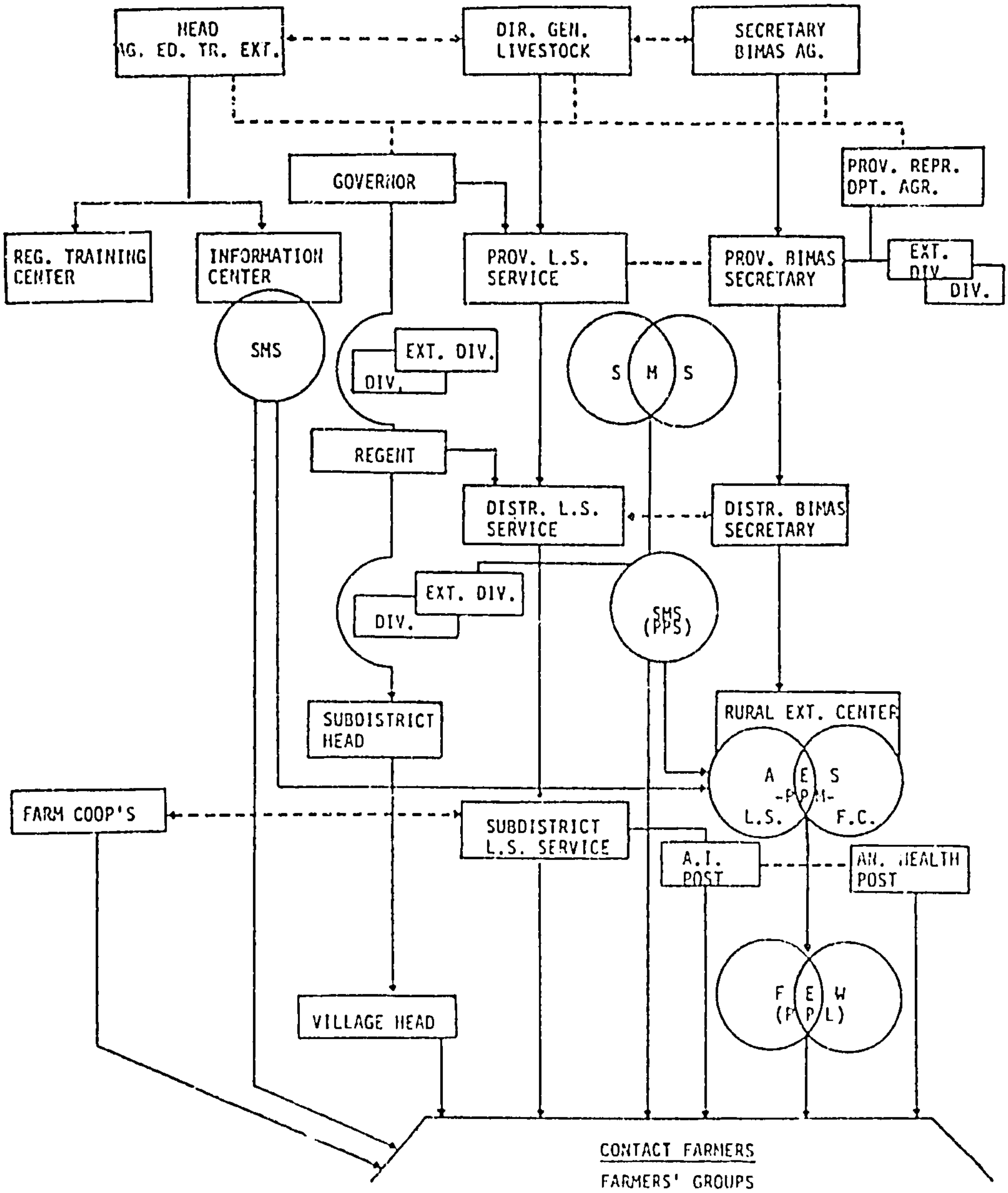
Figure VI.5: : The working mechanism of livestock extension and services.






235

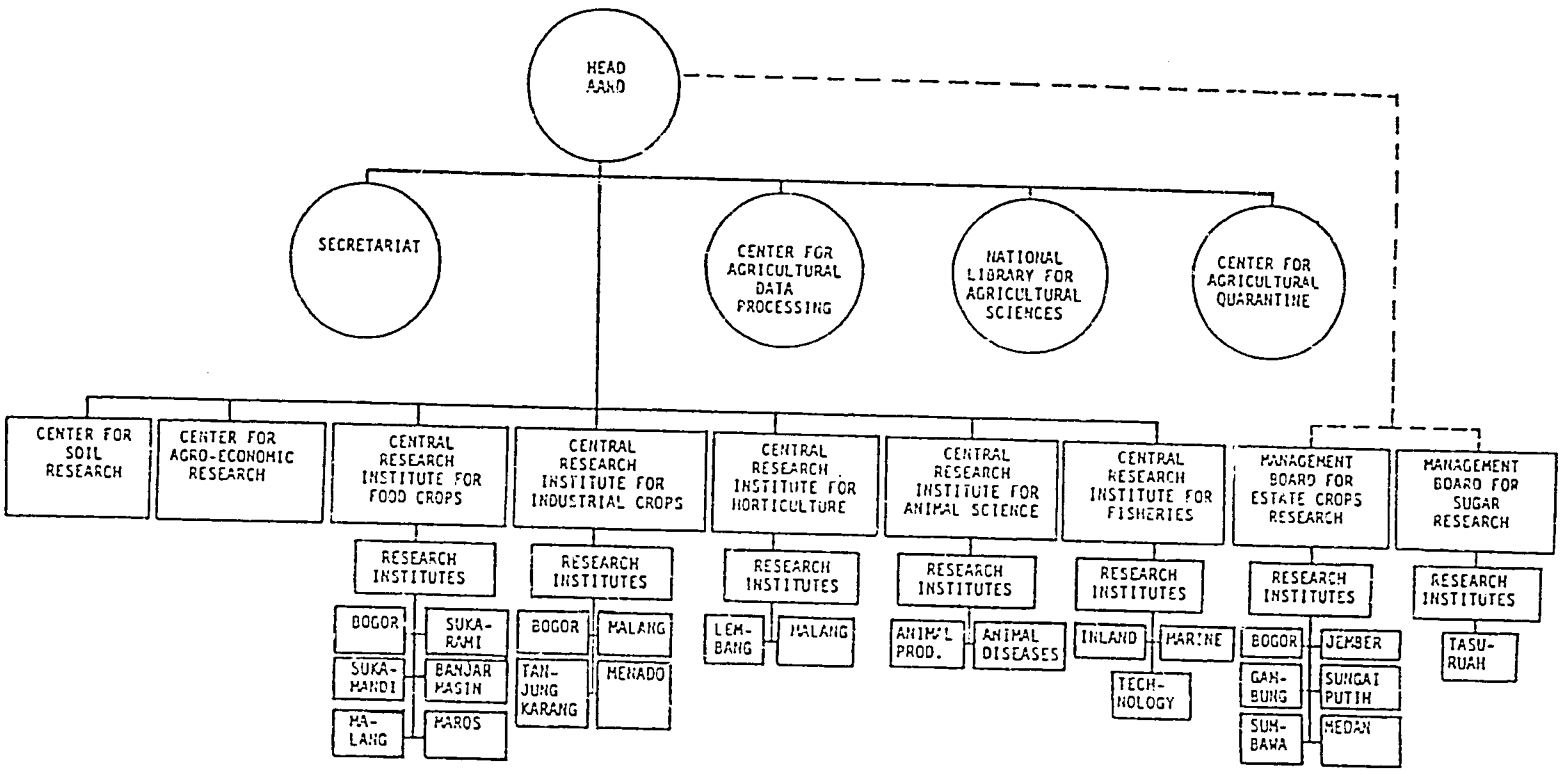
Figure VI.6: Organization of livestock extension and services.






236

Figure VI.7 : Organizational structure of AARD



6.29 BPT has facilities for making longtime genetic studies in poultry, but such facilities are lacking for large ruminants. There is an interest in collaborative research with the DGLS, which has land and facilities, and the universities which have well-trained geneticists who could conduct such research. (See appendix 6.A describing the DGLS's research centers, UPTs).

6.30 Livestock research in Indonesia has not received sufficient GOI funding for several reasons. Historically, food crop research has been given higher priority. Moreover, livestock research requires more time to obtain useful results, and may be more expensive than food crop research.

6.31 CRIAS has benefitted from three large and two small projects that were partially funded by foreign assistance. The large projects are 1) collaborative animal health research with James Cook University in RIAD; 2) animal production and nutrition research with CSIRO at Ciawi in BPT; and 3) forage research with New England University in BPT.

6.32 The Overseas Development Agency (ODA) of the United Kingdom has funded a project in Animal Disease Research at RIAD, and USAID has funded the Small Ruminants-Collaborative Research Support Program (SR-CRSP) based in Bogor and Sei Putih. The latter project focuses on small holders in West Java and has a strong social science component. These support programs have strengthened the CRIAS livestock research institutes to the point that they are now assuming nation-wide responsibility for livestock research and development.

e. <u>BIMAS (Bimbingan Massal Pertanian)</u>

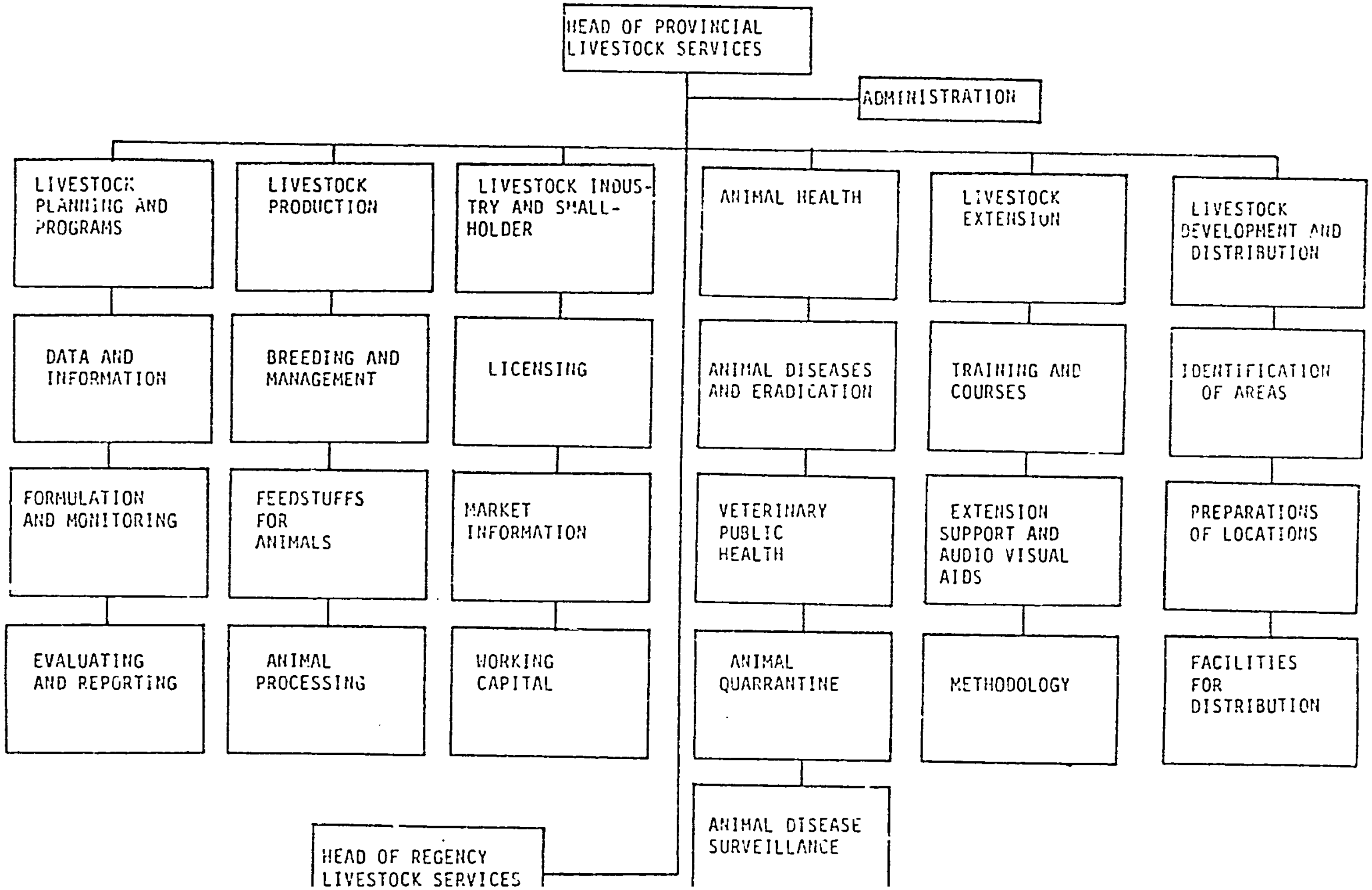
6.33 BIMAS was initiated in 1965 to accelerate agricultural development and increase output of food crops, primarily rice. Through the cooperation of BIMAS, the MOA was able to intensify education, training, and extension activities, introducing the 'training and visit system" in which key farmers are used to train farmer groups. Extension activities were combined with other input distribution and service programs providing improved high-yielding seed, additional credit, better irrigation, cooperatives for supplying inputs and marketing services. As a result of the combination of activities, Indonesia is now more than self-sufficient in rice production.

6.34 As a result of surplus rice production, BIMAS's focus is shifting to other programs aimed at increasing secondary crop and livestock production. Beginning April 1, 1986, BIMAS will be given administrative control of the field extension workers. The extension departments within each Directorate General and the AAETE will continue to provide technical information and assistance in education, training and extension.

f. <u>Provincial Livestock Services (Dinas Peternakan)</u>

6.35 The organization and structure of the Provincial Livestock Services (PLS) are shown in Figure VI.8, and described in greater detail in Appendix VI.B. The provincial livestock services have sub-directorates similar to those in DGLS.

Figure VI.8: Provincial organization for livestock services






239

6.36 The provincial livestock service is responsible to DGLS for carrying out national policies in animal production and health at the provincial level. It is, however, under the administrative control of the provincial governor. As a result, it is also responsible for carrying out provincial livestock development policies and implementing provincially sponsored projects identified by the governor's planning body, BAPEDA.

2. Public educational institutions

6.37 The academies and universities discussed in this report provide training for professionals or technicians in animal husbandry. Training for veterinary professionals and technicians is discussed in Chapter V.

a. Academies

6.38 Academies offer diploma-level training, providing technicians for agriculture and other fields. The animal husbandry academy is located at Yogyakarta. The academy admits high school or SPP school graduates for a three-year course. It trains senior field extension workers (PPMs) in animal husbandry for the extension service. PPMs supervise extension workers (PPLs) and serve as planning specialists in the rural extension centers, working with contact farmers.

b. Universities

6.39 The Ministry of Education (MOE) is responsible for educational policy, and maintains administrative control of universities through the Director General of Higher Education.

6.40 Table VI.3 lists the names of provincial and national universities that offer degrees in animal husbandry or veterinary medicine. The two universities that intend to offer veterinary medicine training in the future (U. Syah Kuala and U. Udayana) are listed as having combined animal husbandry and veterinary medicine programs. All universities, except the Institute Pertainian Bogor (IPB), offer degrees in other fields as well as in animal husbandry or veterinary medicine. IPB is considered to be the national agricultural university of Indonesia.

6.41 All universities with animal husbandry or veterinary medicine programs offer a Bachelor of Science degree in the indicated fields. In addition, IPB and University of Gadjah Mada (UGM) have been approved by the MOE to offer MSc and PhD programs.

6.42 The World Bank Team (1981) reviewed the kinds and quality of training offered in animal husbandry and veterinary medicine. They projected future needs in these fields as well as the capabilities of the universities to meet these needs. In general, the team found that training in both fields was quite academic and that educational quality was in need of great improvement. Recognizing deficiencies, the MOE appointed consortiums in each area of specialization to guide the universities in setting requirements, curricula, and establishing standards.

6.43 The universities have made great progress in standardizing and improving curricula in both animal husbandry and veterinary medicine since the consortiums started making recommendations in the late 1970s.



245

Table VI.3: Indonesian universities offering degrees in animal husbandry or veterinary medicine

| | Faculty | Location |
|---|---|---|
| U. Syah Kuala | Vet. Medicine and An. Husb. | Banda Aceh |
| U. Andalas | An. Husb. | Padang |
| Inst. Pertanian Bogor | An. Husb. Vet. Medicine | Bogor |
| U. Pajajaran | An. Husb. | Bandung |
| U. Gen. Sudirman | An. Husb. | Purwokerto |
| U. Diponegoro | An. Husb. | Semarang |
| U. Gadjah Mada | An. Husb. Vet. Medicine | Yogyakarta |
| U. Airlangga | Vet. Medicine | Surabaya |
| U. Brawijaya | An. Husb. | Malang |
| U. Sam Ratulangi | An. Husb. | Manado |
| U. Tadulako | An. Husb. | Palu |
| U. Hasanuddin | An. Husb. | Ujung Pandang |
| U. Udayana | An. Husb. and Vet. Medicine | Denpasar |
| U. Mataram | An. Husb. | Mataram |
| Nusa Cendana | An. Husb. | Kupang |
| Pattimura | An. Husb. | Ambon |

Source: Statistical Yearbook for Animal Husbandry 1984, p. 100.
Note: The U. Syah Kuala and Udayana are in a transition stage in establishing faculties of Veterinary Medicine.

6.44 Despite the fact that all universities are required to serve teaching, research, and extension functions, the major role of MOE is teaching. Consequently, it provides very little money for research and extension functions, and all funds provided are short term. Due to restrictions on use of funds outside of the ministry, all research work done for the AARD by university personnel is on a contract basis. Consequently, the universities, which have the greatest number of Ph.D. researchers, do very little long-term research on problems facing Indonesian livestock. Tillman (1980) pointed to the need for long-term research projects for training of Indonesian livestock researchers for work affecting the sector.

6.45 In addition, MOA contracts with the universities to conduct short-term extension training. As a result, several universities offer S-0 training (similar to a diploma program) for special jobs, such as agricultural extension. Diploma-type training programs may extend over one to three years.

### 3. Public Institutions: BULOG (price stabilization body)

6.46 BULOG is a price stabilization body which acts to stabilize the prices of selected agricultural commodities, the most important of which is rice. Rice is purchased and stored when supply is high and the price is weakening. BULOG sells rice from storage when supply begins to wane and prices are increasing. This procedure ensures that Indonesia maintains a supply of rice as a safety valve if a natural disaster should occur.

6.47 BULOG plays three roles in livestock markets. Its poultry processing unit in Jakarta can process and freeze 3,600 broilers/day for sale if supply should drop. It has a similar supply stabilization program for beef. The large Bila River ranch in South Sulawesi grows and fattens 600 young male animals each year. In addition, it operates a feed lot near Bogor and fattens 3,600 young bulls a year. These animals are slaughtered and the meat is frozen at its Jakarta slaughter house. Meat demand is very high during Idul Fitri and prices rise dramatically. BULOG releases much of its supply of frozen meat at this time in order to increase supply and stabilize prices.

6.48 Finally, BULOG imports feed ingredients that are needed in the commercial feed industry. The commodities purchased are soybean meal, fish meal and maize. Feed manufacturers estimate their quarterly needs, and the Indonesian Millers Association distributes the imports. Smaller mills work through a trade association (ABIMPTI) which acts as the agent for BULOG. Both the large and small mills complain that under the above arrangements, their imported feeds are higher-priced and lower quality than if they were permitted to select and purchase their own imports in a free market. GOI control of imported feed ingredients seems to have increased the cost of producing both broilers and layers. Certainly, GOI control of imports represents a major policy shift from the free-market philosophy that prevailed in the 1960s and 1970s, and possibly a step backwards for the developing poultry industry. Additional analysis is carried out in Chapter VIII.

### 4. BAPPENAS (national budgeting agency)

6.49 BAPPENAS is the development planning agency that considers all plans that will require funds from the national budget. It reviews and approves or disapproves all budget requests, loans, and foreign assistance programs. It has been compared to the Bureau of the Budget in the U.S. and other countries, and it has tremendous power over all matters pertaining to the budget.

6.50 The DGLS submits its plans and budgets to the MOA, as discussed above. MOA, in conjunction with DGLS, negotiates with BAPPENAS to develop the DGLS program and budget.

### 5. Public institutions: Department of Transmigration

6.51 It was shown in Chapter II that within the transmigration program, livestock plays a significant role. Until 1984/85, livestock were distributed to transmigrants only to support food and plantation crop production. Livestock's supporting role was initiated in 1978/79 as a joint undertaking of Ministry of Transmigration and Directorate General of

Livestock Service (DGLS). In 1979/80, DGLS was assigned the full responsibility for implementing the livestock programs in the transmigration schemes. Livestock programs in transmigration schemes have the following objectives. (Direktorat Penyebaran dan Pengembangan Peternakan, 1985):

- increasing income of transmigrated farmers through the use of draft animals
- increasing livestock population and production
- generating additional employment opportunities
- providing fertilizer in order to maintain soil fertility and to expand new areas for livestock development

6.52 To achieve these objectives, the following policies were adopted:

- livestock are distributed to transmigrants within one year after transmigrants are settled in the transmigration sites

- large and small ruminant development is implemented through selective distribution to the recipients. Credit for recipients is through gadohan arrangements

- only livestock suitable to specific sites is distributed

- implementing the panca usaha peternakan at the transmigration sites

6.53 By the end of the third Five Year Development Plan, 876 transmigrant locations were settled within 73 regencies of 20 provincies. From 1979/80 to 1984/85, the DGLS had an operating budget of Rp 16,186.00 million from the State Annual Budget (APGN), Rp 4,441.1 million as loans from IBRD, and Rp 6,338.0 million from ADB/ISDB. About 76.96 percent of the IBRD loan has been spent for livestock development in transmigration locations. It was estimated that only 22.48 percent of the ADB/ISDB loan has been spent (Direktorat Penyebaran dan Pengembangan Peternakan, 1985).

6.54 The funds generated from the various sources were used for distributing large and small ruminants; developing infrastructure for livestock distribution and development such as quarantine, holding-grounds, etc.; livestock protection at transmigration locations such as vaccination and veterinary medical treatment; providing means of transportation and other working facilities for field officials; and providing field personnel to implement the Panca Usaha Peternakan.

6.55 During 1979/80 and 1984/85, infrastucture, facilities and personnel were provided. In addition to the 876 sites, further efforts are expected to be made in order to support livestock development in transmigration programs. During the same period, 3.6 million doses of Newcastle Disease (ND) vaccine were distributed, 0.2 million of haemorraghic septicaemia, and 0.7 million of Anthrax.



142.

6.56 Under present conditions, there is a shortage of 262,690 draft animals. This number would be needed to prepare 328,362 ha of cultivable land. This estimation must be taken into account for the development of livestock production.

### 6. Public Institutions: Abattoirs

6.57 Most animal slaughtering units outside of Jakarta and Surabaya are owned by the municipal or provincial governments. These are discussed in the next section of this chapter.

### 7. Private Institutions: Industry Associations

6.58 For the purposes of this report, the term "private institutions" refers to those companies or organizations which are managed and operated without the use of government funds or management. In other words, they are in the private sector, where the setting of policies and management concerns private capital and where owners expect a reasonable rate of return on their capital and other inputs. The study team quickly found that such a clear distinction does not necessarily apply to all organizations bearing the prefix "PT", which in Indonesia refers to private companies. As will be seen later, some PT companies serve as operating arms for GOI bodies for carrying out their functions. For example, BULOG has a PT large ranch, a large PT feedlot and a dairy breeding center (using embryo transplants), and several abattoirs with units for processing, freezing and storage of meat in carrying out its policies on price stabilization of beef. The study team was unable to obtain information on the extent of GOI involvement in terms of providing working capital, setting of policies, and decision-making at the operation level of these "PT units". Therefore, for lack of better information, these are all treated as private institutions, even though in other societies these could be parastatal bodies.

6.59 In view of the above, private institutions as used in this report include industry associations, cooperatives, private foundations, private universities, and private companies or individuals that are engaged in the operation of ranches, feedlots, feedmills, transportation systems (primarily ships), abattoirs for slaughtering, processing, freezing and storage of meat, milk factories, poultry breeding and for the extension of credit to farmers in the villages.

#### a. The Indonesian Poultry Breeder Association

6.60 This association is licensed by the GOI and it represents all companies and individuals engaged in the poultry industry as breeders, as feed manufacturers, as producers, etc. As a result, it is a large organization representing about 500 members. Most of the members are located on Java (Jakarta, Bandung, Surabaya, and Semarang) with a few in North Sumatera (Medan). The Association serves as a "sounding board" as regards fair prices paid for day-old chicks, feeds, and poultry products. However, the association has no real authority in these matters.



2441

b. The Indonesian Feed Millers Association

6.61 This is a loose organization composed of companies which manufacture formula feeds. The major function of the association is to distribute feeds that are imported by BULOG to its member millers. In addition, the association acts as a sounding board for problems that concern the industry and its operations. Since most of the manufactured formula feeds are consumed by the hybrid chicken industry, most millers are members of the much larger Poultry Breeders Association.

c. Other organizations

6.62 Two other private organizations are the Indonesian Veterinary Drug Association and the Indonesian Milk Processing Industry Association.

8. Private institutions: cooperatives

6.63 The GOI is encouraging cooperative development in order to increase limited resource farmers' access to inputs and markets, and to ensure fair input and output prices, thereby increasing rural incomes. Therefore, GOI gives priority to primary cooperative development. Between 1978 and 1983, the number of livestock farmers joining the cooperatives increased tremendously.

6.64 Study team members visited a number of cooperatives during their travels around Indonesia. They obtained the impression from the results of their interviews that participation of the very small and economically weak farmers was quite minimal in contrast to the larger farmers. When questions about this phenomenon were asked, the usual response was that they were too small to benefit from the services provided by the cooperative. In an interview with one farmer, it was his opinion that many farmers become suspicious when there is much GOI involvement in an organization that should represent the private sector. He felt that some of the previous activities of the GOI, through BULOG were not appropriate, as they include the purchase of rice during the periods of shortage when demands exceed supplies and that these are factors why participation is low.

a. Association of Milk Cooperatives of Indonesia (GKSI)

6.65 GKSI was chartered in 1980 for the purposes of rendering services to their primary members, to promote good relations among all member cooperatives and cooperative movements, and to promote prosperity within its membership and the total community. The interest in developing an equitable and prosperous community is based upon the principles of the Pancasila. In these endeavors, it has had strong and continuing GOI support during its developmental stages.

6.66 The GKSI members include livestock/dairy cooperatives, village unit cooperatives and dairy cooperatives at the village level, locally called Kooperative Unit Desa (KUD). GKSI is involved in dairy production,in the processing and marketing of milk, and in providing credit for primary cooperatives (KUD) as well as secondary cooperatives.

6.67 GKSI is involved in dairy production through the provision of technical services to their dairy farmers including extension, animal health, animal nutrition and feeding, animal breeding, primarily by the use of A.I., and by keeping accurate records of inputs and outputs. They feel that this recordkeeping benefits the farmer by helping to teach him how a business practice should be operated on business principles. In addition, the production manager aids farmers in obtaining credit and in establishing an insurance fund for minimizing risk. The marketing manager monitors the marketing of milk, use of feeds and purchasing of the equipment needed in production. The industrial plant manager carries out the management and maintenance of plants owned by the GKSI.

6.68 The membership of GKSI includes the dairy cooperatives, the KUD for milk and livestock cooperatives, and other cooperatives working in the dairy field. Membership in primary cooperatives has grown from 11 in 1978 to 183 in 1982, and the number of livestock farmers having membership in GKSI has grown from 2,174 in 1978 to over 40,000 in 1984, constituting a phenomenal rate of growth.

6.69 GKSI has now established four milk treatment centers and 2 cooperative feed mixing units. The GKSI has strong GOI support and continues to grow because of their service to the dairy industry as shown in Table VI.4.

Table VI.4: Activities of GKSI at the end of 1981

| | |
|---|---|
| Member Cooperatives | 133 |
| Member/livestock Farmer | 28,590 |
| Total milk production | 46.7 million liters |
| Imported dairy cattle | 35,100 |
| Local cattle | 47,200 |
| Foreign Exchange Savings | Rp 3,075,000 |
| Meat production | 298,000 kg |
| Farmer Income from meat | Rp 3,075,000 |
| Farmer Income from manure | Rp 745,000 |
| Credit | Rp 15,800,000 |
| Value of imported cattle and their offsprings | Rp 26,331,810 |

Source: GKSI Annual Reports, various issues.

6.70 The GKSI leadership has agreed to establish three milk powder producing factories with private industry participation on an equal basis with GKSI at the following locations:

- West Java (Bandung area) 5000 tons capacity/year
- Central Java (Salatiga) 5000 tons capacity/year
- East Java (Malang area) 15,000 tons capacity/year

Priority went to the Salatiga plant which went into operation in 1985.



246

b. <u>Cooperative League of the United States of America (CLUSA)</u>

6.71 CLUSA, with headquarters in Washington, D.C., collaborates in the development of milk production projects in Indonesia. In 1980, PL 480 funds were obtained through USAID to develop a cooperative service unit (Pusat Pelayanan Petani - PUSPETA) in cooperation with the GOI. The unit was located near Klaten, DIY to provide support for the local village Cooperative Unit (Koperasi Unit Desa). The members received Holstein cows imported from New Zealand (two cows/member).

6.72 The main objective of CLUSA is to assist farmers by providing feed to balance rations for their cattle. Silage was envisioned as the main source of feed. Upright cement silos of about 50 ton capacity were erected at the PUSPETA headquarters and in two villages and equipment for silage making was imported from the USA. In addition, two milking parlors were constructed. It was proposed that the small farmers bring their milking cows to the parlor, thereby permitting the cows to be fed during milking. Also, farmers were to receive additional feed based on levels of milk production/cow. This plan was not successful.

6.73 In the beginning, great difficulty was encountered in locating sufficient maize to fill the silos. Maize is grown in the area but in small fields and primarily for human food. There was a subsequent change in administration, and it appears that the entire operation has improved with notable progress in assisting farmers with their milk production enterprise. At present, small farmers are contracted to grow hybrid maize, and they are being provided with seeds, fertilizer, technology, and a guaranteed market. The maize matures in about 90 days, producing about 50 tons/ha, and three crops per year can be harvested with irrigation. The practice has proven to be more profitable than rice production. Farmers cut the maize and transport is provided by PUSPETA for processing and filling the silos. After fermentation and curing, the silage is mixed with a PUSPETA concentrate, bagged as a complete feed and sold to farmers at Rp 60/kg.

6.74 The unused milking parlors were converted to fattening stalls by removing the stanchions. PUSPETA now buys bull calves from the farmers for fattening in an operation that appears to be successful.

6.75 A new 5-year contract was recently negotiated with USAID-GOI to continue the Klaten project and to establish other cooperative service units at Boyolali, Malang, and Luwu (South Sulawesi).

9. <u>The private foundations</u>

6.76 There are a number of private foundations in Indonesia that perform many functions in the society. It is beyond the scope of this report to identify and describe all of these. A notable example is the Irian Jaya Livestock Development Foundation in Jaya Pura. It was formed for the purpose of distributing Bali Cattle, imported from the NTB and NTT, to the indigenous people, not tranmigrants, in Irian Jaya. To date, the foundation has distributed 200 cattle to farmers using a modified Sumba plan for payment. It is a small organization with a small staff that selects groups of people and then extends credit for the purchase 5 cows and one bull for each group. The payback scheme extends over 6 years rather than the usual five years of the Sumba plans. The group makes no payment for the first two years and then pays back two calves in each of the 3rd, 4th and 5th years, and finally four at the end of the 6th year, for a total of 10 animals. The demand for cattle under this scheme is so high that the the Provincial Government of Irian Jaya is now participating in the Foundation, further expanding its activities.

6.77 The private foundation that was initiated as a strictly private unit is now more complicated as it now has public financial support. However, the administration and policies are still in private hands.

6.78 The study team also met with various church-affiliated groups who are distributing cattle under yet other modified Sumba plans. One of these groups makes a cash loan to a group of farmers to purchase 3 cows and one bull. The value of the loan is calculated at Rp 800,000 (Rp.200.000 each) and the recipient's payback is made over a 36 month period at an interect rate of one percent per month. This particular group reported that their participants prefer this arrangement over other Sumba plans.

10. The private universities

6.79 For a particular region or segment of the industry, the private universities are very important. However, their contributions to the overall livestock industry are small. Only one university, Satya Wacana Christian University in Salatiga, Central Java, has a well-rounded program in food crops, horticulture, and animal husbandry, particularly in dairy production. It is making significant contributions in these fields. It accepts students from all over Indonesia and many of these return to work with church-affiliated organizations that are involved in agricultural development.

6.80 GOI, under the auspices of its MOE, assumes some of the costs for the training of the students at the Satya Wacana Christian University but is not involved in setting policies or in the decision-making process in the operation of the University. However, the MOE does set accreditation standards and evaluates the University as regards these standards. For example, Sateya Wacana University adheres to KIP requirements for core curricula of agriculture and animal husbandry students as well as the practical training requirements for these students.

11. Private companies

6.81 As noted earlier the study team includes all companies bearing the prefix "PT" as private companies even though these might very well be parastatal bodies. These points will be borne out further in the description of individual PT companies.

a. Ranching

6.82 Since ranches account for only about one percent of the cattle in Indonesia, their importance depends upon other contributions such as the development of management systems for similer large-scale livestock operations. There are two large ranches in South Sulawesi, and both have such strong GOI connections that they probably should be designated as parastatal bodies; however, study team members do not have sufficient data in order to make this distinction.

6.83 P.T. Berdikari United Livestock, which is a subsidiary for PT PP Berdikari, operates a 12,000 ha ranch in South Sulawesi on which there are about 6000 mother cows. The ranch is closely tied to BULOG, sending its male animals, which are fattened on the Bila River Ranch, to Jakarta to be slaughtered, processed and frozen by the PT Sampico ADHI abattoir. This abattoir unit is closely tied to BULOG, and is under the same general manager.

6.84 P.T. Bina Mulya Ternak is also located in South Sulawesi and it is closely tied to the DGLS, having an office in the DGLS headquarters building in Jakarta. In fact, it appears that this ranching scheme, which has two large ranches; one in South Sulawesi and one in Sumba is, in reality, a GOI corporation. The ranches have an area of about 85,000 ha on which are about 50,000 cattle plus a small herd of swamp buffalo on the Sumba ranch.

6.85 Both ranches could be important sites for forage studies on different soil types, comparative genetic studies on cattle, field studies on animal reproduction and other problems associated with operating large ranches. In fact, some studies of this nature are underway and there are plans for expansion. Major constraints are finances, lack of trained personnel, and failure to recognize the values of research data generated on such ranches to the overall livestock industry. However, one must keep in mind that Indonesian experiences in ranching and livestock production other than smallholder operations are limited.

6.86 Both P.T. Bina Mulna Ternak and P.T. Berdikari United Livestock are important sources of cows and bulls that are greatly needed for beef cattle expansion in Indonesia.

6.87 It is estimated that there are 50 cattle ranches in Indonesia, varying in size from medium to large. The experiences gained in South Sulawesi on the two large ranches which were discussed above will be of value as ranching expands to other areas of large land masses, Kalimantan, Irian Jaya and Sumatra.

b. Feedlot and embryo transplant operations

6.88 Smallholder feedlot operations were discussed elsewhere in this report and will not receive further consideration here. An example of a large operation is PT Berdikari Kariyana Beef Feedlot, which is a subsidiary of the holding company PT PP Berdikari. This unit is located in West Java in Sukabumi, which is near the demand source Jakarta. As discussed before, it has a close association with BULOG as its major purpose is to produce "prime beef" for the hotel and restaurant trade in Jakarta. Their company aim is to produce a source of this beef so as to reduce the importation of prime beef from abroad and it has a close association with the U.S. Feed Grains Council in the preliminary phases of the operation. Grains and protein feeds from the United States are fed in rations containing 90% concentrate feeds plus 10% chopped green forages, both on a dry matter basis. The capacity of the feedlot is 3600 animals and the present procedure is to buy Friesian bulls that weigh about 200-250 kg when put in the feedlot at 6 to 9 months of age. These animals are fed the ration free choice for about one year to gain about 0.7 kg/day, weighing about 450 kg when sent to PT Sampico Adhi Abattoir for slaughter. Another source of animals for the feedlot is Ongole bulls of about one year of age weighing 200-250 kg. It is of interest to note that they are obtaining quite similar results with the two animal sources, an important fact for further expansion of feedlots because of limited numbers of Friesian bulls. Because of their good results, many private companies are now expressing interest in establishing feedlots in the Jakarta and Surabaya areas.

6.89 At present, prices of feed ingredients relative to beef prices are such that input/output relations are favorable. Therefore, one could make a cautious prediction that the feedlot industry in selected regions will grow.

c. Embryo transfer in dairy cattle

6.90 PT PP Berdikari, in combination with its feedlot and under the same management as PT Berdikari Beef Feedlot, is doing embryo transplant work with the Ministry of Cooperatives and American Breeder's Service. Embryos resulting from the mating of production-tested bulls and cows in the U.S. are transplanted into dairy cows kept at the site. As of August, 1985, they have produced 70 offspring that were 3, 6 and 9 months of age. The cost of each calf is estimated to be about $US 3,200. Feeding and management of these offspring are excellent with the result that size or weight for age are in excess of any dairy animals in the hands of smallholders.

6.91 The management of PT PP Berdikari feels that the high cost of these animals is justified because, by using this procedure they can quickly obtain production-tested animals in a country where production testing has not been initiated. Also, since some immunity to local parasites and diseases is obtained when animals are young, the system has the advantage of growing out superior animals in the environment that they will encounter during their adult lives. The counter argument, of course, is that feeding and management are the first-limiting constraints on milk production in Indonesia. In this light, the gene pool present in Indonesia already exceeds the limitations imposed by feeding and management conditions. Given the apparent imbalance in technology applications it would be useless to introduce superior genes into the present feeding and management system. Since Indonesia is a large country and already has many different production systems in the dairy sector there might very well be a place for superior animals fed to produce up to their potential. The system will succeed or fail depending on the prevailing economic conditions. If the economic situation were to justify the feeding of dairy cows for much higher production than is possible by use of the gene pool now present in Indonesia, the small number of animals obtained by embryo transplant could be used to increase the numbers of animals that have genes for higher milk production. The management of the embryo transplant operation indicated that the bulls resulting from their operation, will be utilized at the two A.I. centers in Indonesia (Lembang and Singosari), while the cows will be used to produce additional ova, by use of super ovulation techniques, for carrying on the embryo operation. As Indonesian technicians are being trained in the technique, the cost of future calves resulting from the operations will be much lower.

d. Feed mills

6.92 The volume of mixed feeds and the major industry served, poultry, is covered in Chapter IV, The Feed Resource Base. This is one industry that is almost entirely dominated by the private sector, either by Indonesian companies or by joint venture enterprises with foreign private capital.

6.93 As in the United States and Western Europe, some feed mixing units in Indonesia provide various modified forms of vertical integration to poultry producers. For example, PT Pokphand Indonesia Animal Feed Mill Co. LTD, the largest feed mill in Indonesia with mills both in Jakarta and Surabaya furnishes baby chicks of U.S. and European hybrid lines, the feed and some financing to selected producers. In addition, this mill has an extension service that offers service and advice to its customers. It was reported that this milling operation has collected excellent data on rates of growth of broilers and layers as well as feed conversion figures for meat and egg production.

6.94 There are about 57 feed mills in Indonesia ranging from the very large units such as PT Charoen Pokphand and P.T. Cargill to small units that mix only a few tons per day. All feed mill officials that study team members interviewed were concerned about the regulations which designates BULOG as the sole importer of imported grains, soybean meal and fish meal. They contend that prices for these ingredients have increased while the quality of each product imported has decreased in comparison with previous times when the feed mills did their own purchasing of imports.

e. Sea transportation of animals

6.95 A number of live animals are transported from Sulawesi to South, Central and East Kalimantan, and to Jakarta. In addition, animals are being transported from NTT to the Moluccas and Irian Jaya while both NTB and NTT ship live animals to both Jakarta and Surabaya. It is the study team's understanding that transport is handled by private companies. However, in discussion with officials of the Molucca Development Project, there were apparent plans in the making for a government-sponsored inter-island transport system that would facilitate the transport of animals from the various islands in the Moluccas to Ambon, and to other islands as needed. It appears that the present ships available are too small and that the animal loading facilities are less than adequate. Many authorities are now questioning the relative economics of transport of live animals as compared to transport of carcass beef. It would appear that the latter is more economical but other factors bear on the question such as the demand for fresh meat by the urban population on Java, availability of labor and capital on the outer islands, and economics of scale in individual exporting sites.

f. Slaughtering/processing

6.96 As mentioned previously, most abattoirs in Indonesia are owned by the municipal or provincial governments, primarily to provide the space, equipment, and inspection for the meat. The actual slaughtering is done by the private sector on a custom basis and further details on the process are found in the processing/marketing sections of this chapter.

6.97 In the large cities, such as Jakarta, there are a number of abattoirs bearing the "PT" prefix. For example, the PT Sampico Adhi Abbatoir identified earlier slaughters all beef animals fattened in the PT PP Berdikari operations in Java and south Sulawesi. Also, BULOG has a poultry processing unit in Jakarta that can dress and freeze 3600 broilers per day. There are other private units in Jakarta but they were not operating when the study team was in Indonesia. It appears that most chickens and many small ruminants are still slaughtered by traditional procedures outside of abattoirs by private butchers and restaurants.

g. Milk Processing

6.98 Indonesia has had, for many years, relied on private companies to import milk powders for reconstitution of liquid milk. UHT milk is available all over Indonesia. As is discussed in the section on dairying, milk produced in Indonesia is now being used in these factories, and the level of local milk being used is subject to GOI decrees. Cooperatives are now in the process of working with private companies in the building and operation of milk powder factories.

h. Poultry Breeders

6.99 Most of the leading hybrid chicken producing companies of Western Europe, Australia and the United States are represented in Indonesia. These companies at the present time provide the parent stock to other companies in Indonesia for the production of hybrids locally. Both broiler and layer day-old hybrid chicks are produced and distributed by these companies. In most cases, the foreign companies have joint venture arrangements with individual Indonesians or companies that involve Indonesians.

6.100 As pointed out previously, some poultry breeders have agreements with large feed mills for vertically-integrated poultry operations, resulting in the establishment of some large and efficient operations in the production of eggs or meat. Future GOI regulations covering the sizes of poultry units and the importation of parent stock for the hybrid chick units is of concern to these breeders.

12. Strengths and Weaknesses

a. Strengths

6.101 Indonesia has in place a Ministry of Agriculture that is assisted by three junior ministers, four directorate generals and two agencies -- BIMAS, and a central quarantine laboratory. These are well-organized, funded, and are functioning. The Ministry is staffed by dedicated people.

6.102 The Directorate General of Livestock Services (DGLS) is in place and is assisted by six Directorates that are also staffed by dedicated personnel with knowledge of the organizational structure, the provinces and their needs, and of needed developmental plans.

6.103 The provincial Livestock Services (Dinas Peternakan) organizational structures are in place and functioning in keeping with needs and plans in each province. At the leadership levels, all are staffed by dedicated people although total staffing is deficient in many provinces of the outer islands.

6.104 The AARD is a young agency, being only 11 years old. However, it has established a good organization in all aspects of agricultural research. Its success in identifying high-yielding varieties of rice suitable for Indonesia, and in application of needed technology in the production of rice is notable. Although achievement in livestock research has lagged behind food crop research for reasons already discussed, there is presently much interest in livestock research. The research staff is now addressing both short- and long-time research priorities for increasing animal production, representing a major step forward. Even though the research staff is weak in some specific areas, especially in animal genetics and animal breeding, there are definite strength's in other areas, and these strengths are being exploited, especially in nutrition and reproduction.

6.105 The AAETE, like AARD, is also only 11 years old and its progress in setting up an organization, in recruiting a competent staff, and in using overseas training for increasing the qualifications of leaders, in training of both officers and technicians in extension methodology has been remarkable. The planning for an effective flow of information from AARD, from Universities and from other sources to the DGLS, and then on down to the ATC, and finally down to the farmers is in place and appears to be working. Again, the achievement of this in such a short time is remarkable and the AAETE deserves credit for this achievement.

6.106 The educational institutions include 14 public universities that offer first degrees in animal husbandry and three in veterinary medicine, a private university, and 144 SPP secondary schools. In addition, two additional universities have been approved for veterinary training and will have their first graduates within the next several years. Two universities offer graduate training in various specialized areas in animal science and veterinary medicine, and other universities are in the process of becoming qualified to offer MS and PhD degrees.

6.107 The universities are still quite young to acheive progress in establishing reputations and in building quality programs that can be offered by qualified and competent staffs. However, some progress has been made and these universities are to be congratulated for these improvements, much of which was done with limited funds.

6.108 Private industry is continuing to develop in many areas of livestock production, feed milling, processing, and marketing. Some private organizations have developed modern production units, particularly for poultry and swine production. Progress has been achieved in spite of GOI regulations that tend to hinder private sector development.

6.109 It appears that there are some linkages formed between the DGLS and other organizations within the MOA, while others are still developing. Some established linkages are becoming stronger. These accomplishments are commendable and it is hoped that linkages will continue to grow stronger. Also, the linkages among the DGLS, transmigration, BULOG, universities and



253

other departments appear to be growing and strengthening.

6.110 Indonesia has in place two A.I. Centers that are well-equipped and adequately staffed. The two bull studs in the country, Lembang and Singosari, appear to be well supported although problems remain (Appendix 6A).

b. Weaknesses

6.111 The study team is of the opinion that the production orientation needs to be strengthened in all institutions involved in the livestock sector. This is not unexpected because animal production is a complex endeavor requiring the close coordination of technologies that cut across many disciplines.

6.112 The universities provide training for both animal husbandry and veterinary medicine. In both cases, the training appears to be too academic with too little practical work. However, the veterinary medicine curriculum is stronger in this regard than animal husbandry. There is a problem that veterinary medicine is not concentrating their efforts in their own field and too much on animal production.

6.113 Students entering both animal husbandry and veterinary medicine university training programs tend to be weak in the basic sciences. Efforts to remedy this weaknesses after they enter the curriculum appear to be minimum in many institutions.

6.114 The animal husbandry curriculum presently lacks effective integration of animal husbandry with food and estate crop production. Large ruminants are already a vital part of food crop production and has potential to be a growing part of estate crop production, thus this weakness should be remedied. Animal husbandry graduates simply need to know more about food and estate crop production and the use of residues and by-products for animal feeding.

6.115 The animal science curriculum is weak in the management phase of animal production, the only reason for its existence. For this reason, it needs improvement in its emphasis on crop production and the management of both crop and animal resources for effective animal production along with an effective integration.

6.116 The research needs for efficient animal production are great, perhaps the greatest for all countries in Southeast Asia. There are two sources of trained manpower for research in Indonesia, AARD and the universities. The universities have by far the greatest number of PhD degree-holders. However, this source of research manpower is doing very little research, as funding is low and of short-term nature. As a result, research personnel are used by DGLS and others to perform tasks that others could do as well, or in some cases better. It is fully realized that low salaries paid to Indonesian civil servants partially explains the situation. When this fact is combined with the loose work rules at the universities, this research source becomes a source of trained manpower for consultations on many projects. Some is needed while some is not.



254

6.117 Indonesia needs a plan or program that will permit the university personnel to participate in a National Agricultural Research and Development Program. The Team recommends that Indonesian officials in the MOA and MOE study the method used in India of using the Indian Council of Agricultural Research (ICAR) for Coordination of Teaching, Research and Extension by the universities and research institutes. Many students of international development feel that ICAR which, represents close cooperation of MOA and MOE in Agricultural Teaching, Research and Extension could serve as a "role mcde" for most developing countries. The Team feels that Indonesia's agricultural research programs would be greatly improved by use of this role model. For example, Indonesia greatly needs records of performance data on the indigenous cattle. To initiate and carry out such a program so as to collect good genetic data on the livestock will require the combined guidance of geneticists and animal breeding experts. Neither AARD nor DGLS has expertise in this area while the universities have several PhD holders in that field. The Indian model would permit the direct involvement of all experts in this area as well as in other areas.

6.118 The study team was favorably impressed by the AAETE extension system. However, as they visited the farmers in the field, it appears that many farmers are not being impacted upon by extension. This is probably due, if true, to a shortage of personnel. Hopefully, this will be improved. In this same vein, we must question the quality of information given to farmers regarding feeding and environmental physiology of animals. In travels across the country, only one dairy farmer was identified that was feeding his cows according to the level of milk production. The majority of the large draft/beef animals that the team observed were underfed and neither the farmer nor the PPL seemed to have any idea of quantitative requirements of larger animals. Also, many animals were tethered in the sun and away from a source of water. When the question was raised, the farmer or PPL said the animals were watered at night. The employment of more subject matter specialists would be one way to help the situation. In time, the subject matter specialist in animal husbandry should be supported with other individual specializations, e.g. nutrition, breeding, environmental physiology, reproductive physiology and others. This is a severe deficiency in current livestock management.

6.119 It is unfortunate that to complement the excellent A.I. program, the DGLS has not, up to the present, set up a production-testing system for its beef and dairy animals. A program is expected to be initiated in 1986 with assistance from the Government of Japan.

6.120 Field visits, even though not as extensive as the study team would have preferred, indicate that GOI support, training and monitoring of inseminators in the field is inadequate. Several farmers reported that their cows were not inseminated because the inseminator did not have petrol for his motor bike.

6.121 The separation of the administration of the field extension workers (PPL) and verterinary assistants at the farmer contact level is considered a mistake and a step backwards. Both perform services for livestock producers, thus their efforts must be closely coordinated.

## B. Marketing and processing

### 1. Marketing patterns and structure

#### a. Large ruminants

6.122 Marketing channels for live cattle and buffalo are well-developed in nearly all parts of Indonesia. The main market outlets for farmers are (a) the village collectors and (b) the local markets. Alternative marketing channels are shown in Figure VI.9. Even in isolated areas, farmers generally have access to one or more village collectors. On Java, where farmers have easy access to daily or weekly markets, farmers more commonly trade through the local village collector.

6.123 Where farmers rely on village market places to sell their livestock, the main determinants of marketing efficiency are road quality, transport availability, and distance from local market. Distance from the local market depends largely on the market volume (for all goods) in a given region. Where volume is limited, markets may be spread some distance apart. In areas where the large ruminant population is low but showing sustained growth, such as in the district of Sikka on Flores, the establishment of a specialized livestock market should be considered seriously.

6.124 Large ruminants and small ruminants follow similar marketing channels. As a result, the next subsection on village collectors and other middlemen is relevant for sheep and goats as well as large ruminants.

6.125 Village collectors and other middlemen: Smallholder sales are most commonly made to the village collector. The village collector is a key figure. He buys and sells animals often as a secondary activity. Sometimes he keeps animals for fattening, or in anticipation of price hikes (on religious holidays). The skill of trading lies in the examination of the animals. Traders (as well as butchers) estimate the value of an animal by sight and touch. This system of carcass estimation is largely subjective, and therefore enters into the bargaining process.

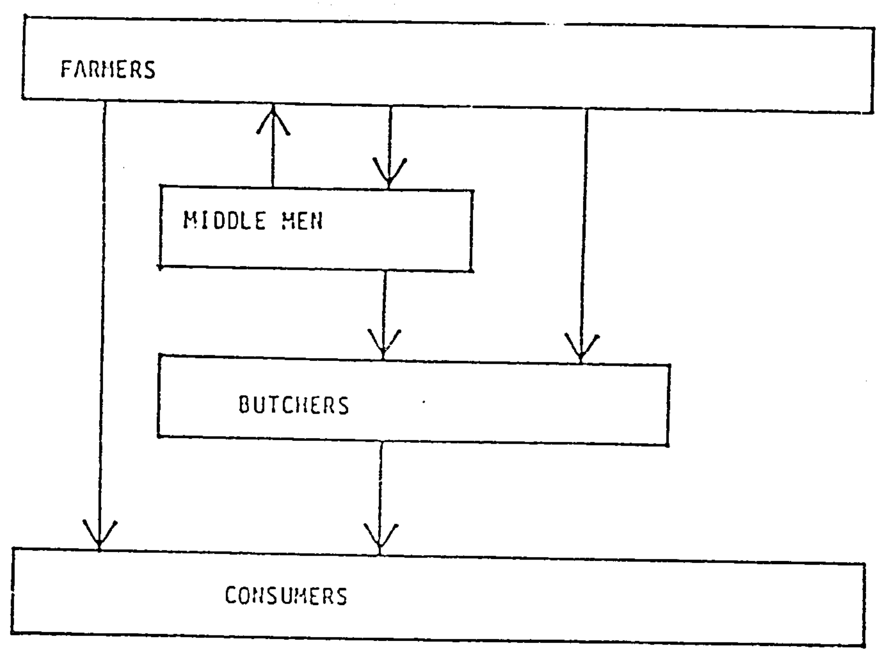
6.126 Village collectors often have learned the trade from their fathers. This indicates that the skill of estimation and bargaining is not an easy one, and therefore, restricts the farmer participation in open market trade (Sabrani et al., 1982). It also demonstrates a stable patron-client relationship, typical for traditional market systems (Anderson, 1980), and visible in cash/credit payment arrrangements.

6.127 For example, Hasan Basri (1984) reported on payment arrangements between farmers and middlemen in Aceh. The payment to farmers occurred in installments depending on the type of middlemen. Their village collector ("muge") generally pays only 50% of the agreed price and the balance the next market day. Cash payments between farmers and regional or long-distance traders were 100 percent. Village collectors generally demand 75% cash when dealing with regional traders, but only 50% when dealing with long-distance traders. Cash payments between regional and long-distance traders were only 25%. Similar payment arrangements are found on Java and elsewhere in Indonesia (Sabrani & Knipscheer, 1982; Soedjana et al., 1984).



256

Figure VI.9. <u>Market Structure for Large Ruminants</u>




Sources: Team
D.P. Bengkulu (83-84)
Ramm *et al* (1984)

6.128 There are also strict economic reasons why individual producers prefer to deal with the village collector rather than trade in the village market. The high cost of transporting and selling one animal at a time to the local market is an incentive to sell to the village collector (Mink, 1982). These costs are compounded by the risk of not selling the animal at all. For example, in 1981 only 45% of the sheep and goats offered for sale at the Cirebon (West Java) markets on a given day were sold. In contrast, 75% were sold on any given day in Garut, but this still illustrates the risk of not being able to sell the animal on one particular day. Thus, a farmer might have to choose between accepting a lower price than anticipated or returning to the village with his animal (at considerable cost in transport and time). On the other hand, the village collector who trades several animals at a time and has a stronger financial position is in a much better bargaining position to accept the risk. He expects to take a few animals back home.

6.129 Village collectors are often specialized by livestock type (for example, large ruminants, small ruminants, and egg collectors). Some of the village collectors are also shop operators who are engaged in food retailing. Therefore, the exchange of goods and animals (or animal products) can be carried out by barter. This is, however, not common.

6.130 Market brokers: A farmer who wants to sell his animal directly to the local market can deal with a variety of middlemen. In large parts of Indonesia, certainly on Java, livestock traders are labeled blantik. This term is generally limited to cattle, buffalo and small ruminant traders, including those who facilitate the market trade, the so-called brokers ("makelar").

6.131 Sabrani et al (1982) distinguishes between village collectors and brokers. The broker only occasionally risks full ownership of animals, while the village collector assumes full ownership over the animals he trades. The broker operates at the market site and seldom holds animals for any time, but turns over the animal the same day. The village collector is well known by the farmers, while the broker is only superficially known at the nearby market place.

6.132 Brokers can be differentiated according to the type of contracts they have with their clients, the farmers. Three types of brokers are discussed: the commission broker, the floor price broker, and the price fixing broker.

6.133 The commission broker helps farmers sell their animals for a flat commission. This system is common in Madura where brokers receive Rp 500 per head (cattle). The farmer accompanies "his" broker until a clear price is set between him and the buyer. If the animal is not sold, the farmer takes it home, and does not pay any commission to the broker.

6.134 The floor price broker negotiates a floor price with the farmer. The difference between the floor price and the actual price constitute the broker's profit. If the animal is not sold, the farmer takes it home.

6.135 The price fixing broker is really a one day trader (and not a broker). He purchases the animal, becoming full owner. The price is pre-fixed between broker and farmer on the market day. Loss or profit is the



258

risk of the broker. If the animal is not sold, the broker takes the animal home and waits for the next market day, possibly in another town. The price fixing broker pays part of the fixed price as advance payment and the remainder after the animal is sold. By keeping the advances as low as possible, and buying and selling as fast as possible on the same day, this "market facilitator" can achieve a high turnover of animals per unit of capital.

6.136 Soedjana et al. (1984) also distinguishes among the village collector, the sedentary trader, and the itinerant or traveling trader. The sedentary broker is similar to the "price fixing broker". He often intercepts farmers as they approach a local market. He prefers not to trade between markets, but between farmers and a given local market.

6.137 In contrast, itinerant traders operate between markets. These include short and long distance traders. Itinerant traders collect, hold and stock animals. These activities improve market efficiency, taking advantage of economies of scale, especially in transport. Itinerant traders might also be butchers, or act as agents for butchers located in distant markets, such as in Jakarta.

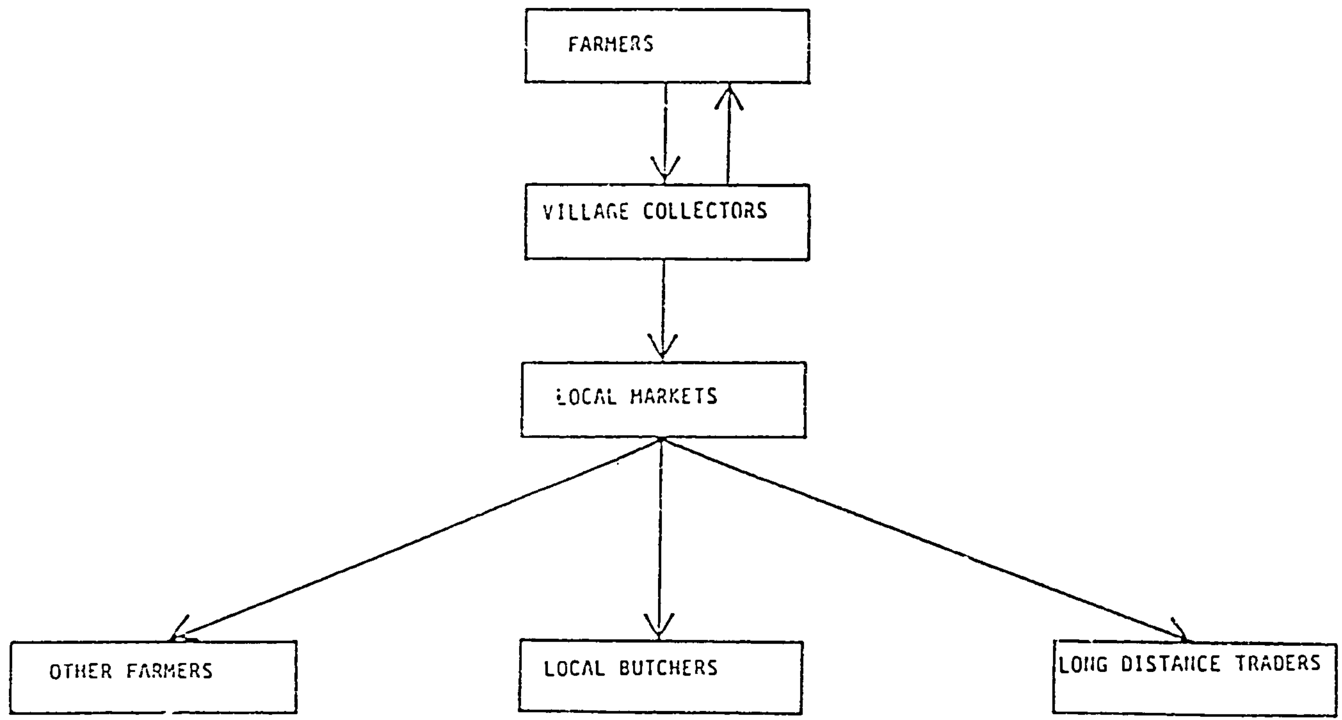
6.138 Traders and brokers alike are very competitive at a given market. Each eagerly offers his services to arriving farmers. The variety of contracts between farmer and middleman provides the farmer with a choice between different type of contracts, thereby increasing his market alternatives.

6.139 Marketing patterns (live large ruminants): This section discusses the trade in dual-purpose large ruminants and other large ruminants sold primarily for slaughter purposes (including dairy cattle for slaughter and, of course, pure beef cattle).

6.140 A simplified market structure is illustrated in Figure VI.10. The animals may change hands between middlemen more than once, depending on the distance to the market. With the growing urbanization of parts of Indonesia, and parallel specialization in animal husbandry in other areas, long distance trade has become increasingly important. Jakarta is the market center, where most consumption occurs. Cattle, and to a lesser degree, buffalo, are imported from all provinces on Java, Bali, NTB, NTT and Sulawesi. Additional important flows of animals are from Aceh to Medan and from South Sulawesi to East Kalimantan. Imports to Moloccas and Jayapura (Irian Jaya) also occur, all from NTT.

6.141 Interprovincial livestock trade statistics are not always fully reliable. As in the case of population data, different sources provide estimates which are at variance with each other. For example, the Provincial Livestock Service in North Sumatra reported cattle imports of more than 4,000 head for 1982, while national statistics showed only 1,012 head exported from Aceh. Other provincial data yield similar contradictions, but general trends are still evident. Exports from NTT, South Sulawesi, D.I. Yogyakarta, West Java, and Lampung (to Palembang) are increasing. On the other hand, exports from Central Java and East Java, although high and varying year by year, seem to be stable, having reached an average annual flow of about 105,000 head for Central Java and 150,000 head for East Java during the period 1979-1982.

Figure VI.10. <u>Generalized Market Chains for Livestock Marketing</u>




Sources: Team Observations
Dinas Peternaken Bengkulu (83-84)
Sabrani *et al* (1982)
Basri (1984)
Ramm *et al* (1984)

6.142 Markets for frozen beef: Frozen beef is being exported from Bali, as well as from Ujung Pandang. At both locations, carcasses are deboned and first class meat (about 18% of carcass) is stripped. In Bali, the remaining edible parts are processed into canned corned beef, while in Ujung Pandang, the remaining 70 percent of carcass weight is sold locally.

6.143 On two occasions in the last 25 years, an effort was made to export frozen beef from Kupang. Both attempts were unsuccessful. One of the problems was the marketing of the offal. Other problems encountered were "lack of a price premium, limited outlets for frozen beef in Jakarta; high freezing and transport costs compounded by limited backloading in larger containers returning to the abattoir; and low volume of shipments" (ACIL, 1983).

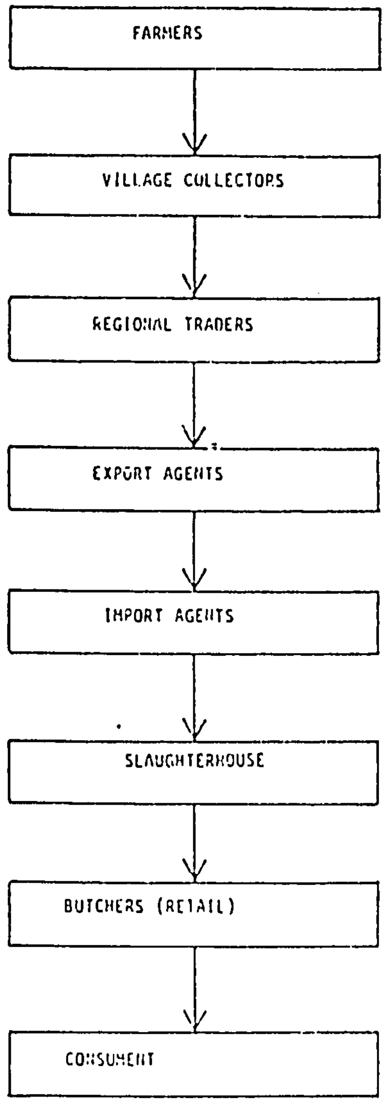
6.144 Transport: Means of transport depends on the size and number of animals and the distance. If the farmer is close to the market, he will walk his animal or hire a small van. Village collectors may hire a small truck for one or more days and make the rounds among their potential sellers.

6.145 Transport from rural markets to urban markets is efficient. The main indication of this efficiency is the obvious competition between transport agencies. Certainly on Java, a large number of trucks of various sizes are available for transport on livestock market days. Departing trucks are nearly always loaded to full capacity. The number of animals per truck is maximized (10-14 head) while the number of stops is kept as low as possible. In this way, a long distance can be covered in a relatively short time.

6.146 The transport of cattle from Bali to Jakarta (about 20,000 head/year) may serve as an example. Cattle arrive at the quarantine station in Denpasar via village collector and/or regional assembly traders. The animals are quarantined for at least two weeks. Subsequently, ten or eleven animals are loaded into a four ton truck. After crossing the sea by ferry, there is a short stop in Banyuwangi to provide feed and water to the animals, which do not leave the truck. The next stop is in Batang, Central Java, where the animals are unloaded on a holding ground managed by the Directorate General of Livestock Services. After one night of rest, the animals are re-loaded and continue without major stops to Jakarta. The total trip takes only two days and two nights. Short stops occur every eight hours. Cost of transport is Rp 300,000 per truck and Rp 30,000 for the cattle caretaker per trip.

6.147 Inter-island transport: The market structure for inter-island trade is shown in Figure VI.11. Sulawesi exports to East Kalimantan and NTT exports to Jakarta. Export and import agents generally work for the same trading company, working for fixed salaries or commission. Export traders often employ regional assemblers, whom they provide with capital to purchase cattle or buffalo. Similar long duration relationships exist with butchers at the wholesale or retail level.

Figure VI.11. Market Chain for Interisland Trade (Live Animals)




Sources: Team
Acil
Ramm *et al*

6.148 Inter-island trade is less competitive than provincial trade because generally fewer than ten companies per export location are involved. Nevertheless, there are no indications that an alternative market structure would be more efficient. A breakdown in the price of NTT cattle at the Jakarta market (table VI.5) does not show exhorbitant losses, nor unreasonable cost items.

6.149 The tremendous improvements in inter-island transport is shown if one compares transport margins over a long period of time. Knaap (1935) reports a transport margin for cattle of 40% between Madura and Surabaya, compared with 200% for transport between Madura and Jakarta (Batavia). Table VI.5 illustrates a present transport margin of only 40% between Kupang and Jakarta.

6.150 The CLUSA project supports the use of cooperative marketing. However, Mittendorf (1981) in a review of livestock marketing in Asian countries concludes, with some authority, that livestock marketing cooperatives have proven to be a poor substitute for private trade. He argues that the livestock sector (with the possible exception of the dairy subsector) produces a commodity "with characteristics that make it less adaptable to cooperative marketing." These characteristics include the perishability of production, the difficulty of quality measurements, and the risk of price fluctuations. More price information seems to be the only way to improve competition between long distance traders and the bargaining position of farmers and village collectors.

6.151 While inter-island transport is by boat, they are not equipped to carry livestock. Presently, one trading company is experimenting with a ship specifically designed for cattle transport, the "Kota Ternak". In discussions with the traders' association in Kupang, both advantages and disadvantages of the "Kota Ternak" were listed.

6.152 The ship's arrival time is reliable. Therefore, arrangements can be made in advance so that cattle spend a minimum number of days in holding grounds or at the quarantine station. Secondly, loading and unloading is faster, and fewer accidents occur. Thirdly, transport time to Jakarta is faster. In addition, facilities (feed, water, ventilation) during transport are better and, consequently, mortality rates are lower by 50% (one instead of two percent) while liveweight loss is halved (five instead of ten percent). Also the ship's large size is appreciated. The "Kota Ternak" (which is leased from a Singapore company) carries 1,200 head of cattle.

6.153 The major disadvantage of using this cattle transport ship is that it returns empty from Jakarta to Kupang. A few traders referred to dual-purpose ships that were operated by the KPM during the Dutch administration. Dual-purpose ships solve two of the three present problems of live animal shipping, i.e. capacity and ventilation. The foremost problem of "timing" would still remain.

Table VI.5: Purchase, transport, and shipping costs (Rp/head) of cattle for inter-island trade from Timor to Jakarta via Surabaya, 1981 a/

| | Cost | Total |
|---|---|---|
| Cattle from village livestock owner at average weight of 300 kg @ Rp 700/kg | 210,000 | 210,000 |
| General costs: | | |
| Keeping in village for 7-10 days @ Rp 100/day | 1,000 | |
| Tethering rope | 500 | |
| Transport from village to quarantine | 5,000 | |
| Droving and feeding | 500 | |
| Quarantine for 14 days @ Rp 800/day | 11,200 | |
| Wages for livestock handlers in quarantine | 50 | 18,250 |
| Dinas Peternakan costs: | | |
| Inspection, injection, and quarantine hire | 1,500 | |
| Anitbiotic serum | 1,350 | |
| Inspection and hay | 5 | |
| Exporting | 2.5 | 2,857.50 |
| Hay and loading costs (for five day journey to Surabaya): | | |
| Five days @ Rp 1,000/head/day | 5,000 | |
| OPP (Ongkos Pemuatan Pelabuham, ship loading osts) Callee | 1,516 | |
| Transporting hay to ship | 40 | |
| OPP hay | 327 | |
| Harbor hire | 80 | |
| Harbor watchmen plus food and overtime | 100 | |
| Wages for harbor crew | 50 | |
| Harbor cleaning | 75 | |
| Documentation | 17.50 | |
| Vessel hire | 1,310 | |
| Wages for vessel crew, tickets, and food | 3,000 | 11,515.50 |
| Vessel requirements: | | |
| Cage materials, bamboo and rope | 500 | |
| Cage construction | 250 | |
| Buckets and troughing | 50 | |
| Hose for vessel | 150 | 950 |

(continued)

Table VI.5: (Continued)

| | Cost | Total |
|---|---|---|
| Taxes: | | |
| Harbor retribution | 3,500 | |
| P.P.N. (Pajah Penuapstan Negara, sales tax) | 2,000 | |
| K.U.D. (Koperari Unit Desa) | 5,000 | |
| Cattle market retribution (Dinas Peternakan) | 5,000 | 15,500 |
| Freight and transport: | | |
| Kupang to Surabaya | 12,500 | |
| Road transport Surabaya/Jakarta | 15,000 | |
| Keeping of cattle for 4 days in Jakarta @ Rp 1,000/day | 4,000 | |
| Quarantine hire, 4 days @ Rp 250/day | 1,000 | |
| Feed costs | 50 | |
| Bonus for vessel crew | 1,500 | 34,050 |
| Total | | 293,123 |

Source: Cattle Exporters Association, Kupang, July 1981. In ACIL (1983).

a/ Average weight loss is 10%, resulting in a liveweight at slaughter of 270/kg. Hence, delivered cost is Rp 1.086/kg compared with the highest price in Jakarta 21/7/81 of Rp 1.060 kg. The costs do not include runaways, broken legs, mortality in transit and bank interest at 1 1/2%.



205

6.154 Dicks (1985), in a recent review of inter-island shipping, concludes that much progress was made during the 1970s to improve the efficiency of inter-island shipping. He advocates improvement in port operations and management. Rather than expanding the present cargo fleet, he suggests that better use of existing resources is the best way to improve the efficiency of inter-island transport. Therefore, possible alterations of the present fleet to better accommodate live animals should be explored.

### b. Poultry Marketing

6.155 Village chickens are mainly kept for meat production, to be consumed in the village and/or sold when cash needs arise. Often farmers bring their own chickens to the general market, selling them to middlemen or directly to retailers. Small chickens are preferred to large ones, as the latter are generally commercially produced and less tasty (Lepley, 1981).

6.156 The market for input-intensive poultry (layers and broilers) is well-organized. Large poultry farmers may develop their own outlets directly to wholesalers and retailers, but smaller ones have to depend on collecting traders. Imas Nur'Aini (1983) conducted a comprehensive study of the poultry input and output markets in West Java. His findings confirm the importance of the "poultry shop" as an input supplier, especially for smaller commercial units (table VI.6).

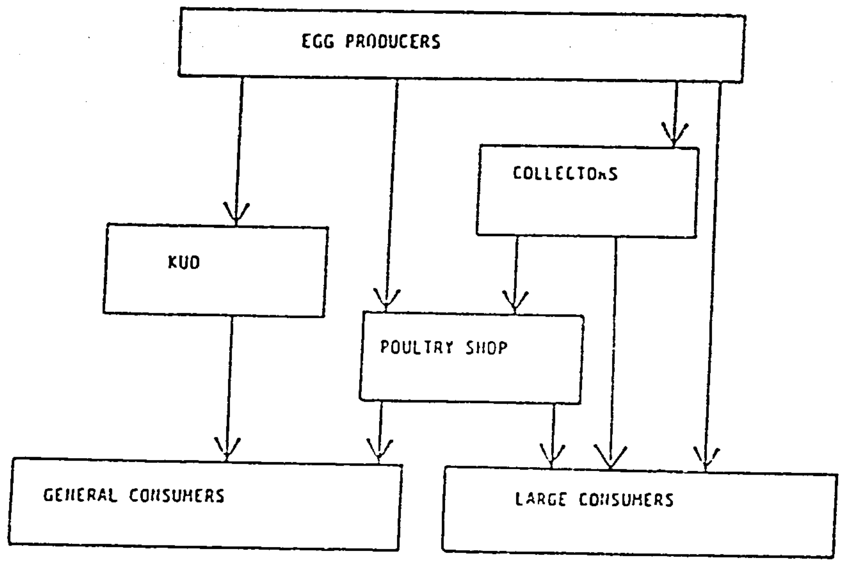
6.157 Poultry shops also play an important role in the output markets for poultry products. Market structures for egg and poultry meat sales are shown in Figures VI.12 and VI.13.

Table VI.6: Sources of feed supply according to size of farm for commercial poultry producers (% of operations)

| Source | Size of operation: Small [a] | Size of operation: Large [b] |
|---|---|---|
| Poultry shop | 60 | 30 |
| Feedmills | 15 | 40 |
| Other | 25 | 30 |
| Total | 100 | 100 |

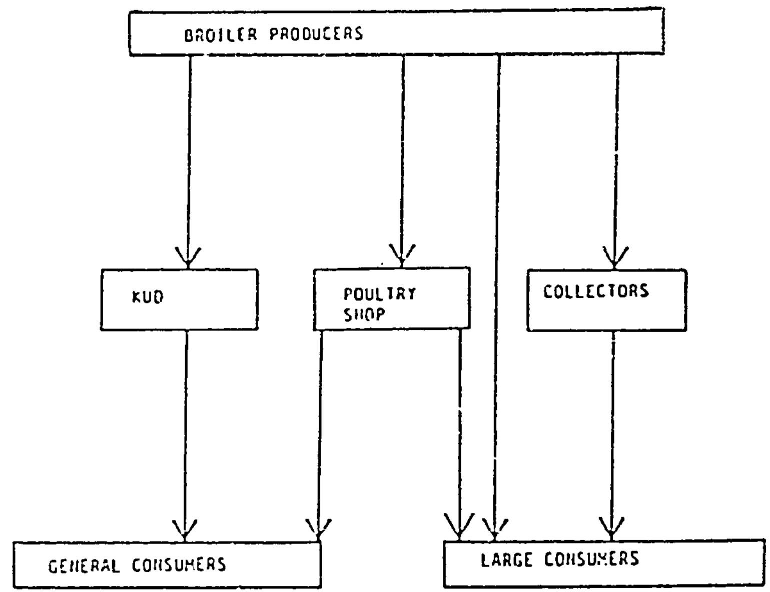
Source: adapted from Imas Nur' Aini (1983)
[a] less than 5000 layers or 700 broilers
[b] more than 5000 layers or 700 broilers

Figure VI.12. <u>Market Structure for Eggs</u>




Sources: Team
Ramm *et al*
I.N.A.

Figure VI.13. <u>Market Structure for Broilers</u>




Sources: Team
Ramm *et al* (1985)
I.N.A. (1983)

c. Dairy Marketing

6.158 Milk production in Indonesia has expanded rapidly in recent years, rising from about 62,000 tons in 1978 to 180,000 tons in 1984. Chapter III contains some summary figures of program impact during Replita III. Prior to 1980, imports represented up to 96% of total consumption. With expansion of the local industry and implementation of the ratio policy (see below) in 1982, imports as a proportion of consumption (in whole milk equivalent, WME) has declined to 77% in 1984 and is targeted to decline to a 50:50 ratio by the end of Repelita IV (1988). Total consumption of milk products in 1984 is estimated at 626,000 tons WME with 483,000 tons WME from imports and 143,000 tons WME from locally produced milk. The difference between production (180,000 tons) and consumption (143,000 tons represents calf feeding and spoilage.

6.159 Per capita milk consumption is estimated at 3.9 liters. This results from a high proportion of households not using any kind of dairy products, from low levels of consumption by households that do use dairy products, from negative attitudes towards fresh milk because of smell and perceived possibilities of adulteration and price. The AMC study (1985) found that the cost of consuming one liter per day per household (whole-milk equivalent: WME) from sweetened condensed milk (SCM) was Rp 500/liter, (WME basis). The outlay for milk ranged from 61% of total daily household expenditures for the lowest income strata to 9% at the highest strata. For the majority of the income stratas, the figure would be 15-25%. The cost is much higher using pasteurized milk since the cost doubles to Rp 1,000/liter WME making consumption of one liter per day per household cost 122% of total daily household expenditures in the lowest group, if they had to purchase pasteurized milk, to 18% in the highest group. Typical percentages would range from 25-50%. Even with positive perceptions regarding health, taste and status considerations, the vast majority of Indonesian households cannot afford to consume even modest amounts of dairy products on a regular basis.

5.160 Continued implementation of the ratio policy (see below) will gradually increase dairy product costs because of the large difference between the WME costs of imported products and locally produced milk. In the case of SCM, milk solids in one liter SCM would cost Rp 296 in WME terms if purchased locally versus Rp 178 if the same product was based upon imported skim milk powder and butter oil. Also, slower than projected growth in income (Chapter I) will reduce projected increases in dairy product consumption by reducing the income effect on consumption. The AMC (1985) study estimated demand for all milk products, on a WME basis, as 720,000 tons in 1988 compared with DGLS estimates of 869,000 tons. Consumption is projected by this same study to expand at 4.5% per annum between 1984 and 1993. Slower growth of income (see Chapter 1) will probably reduce the actual consumption levels even further.

6.161 SCM is the major consumer product. Appendix table 6.2 gives recent industry output figures. SCM represents about 44% of the market followed by whole milk powders (26%), baby foods (11%), raw milk sales direct to consumers (5%) and only 2% for pasteurized and sterile (UHT) milk. Butter, cheese and specialty powder are between 10-15 % of total consumption.

6.162 The major policy instrument available to the government is the ratio method which requires milk factories to link imports of milk solids with locally purchased liquid milk. Purchases of local milk thus act as an entitlement to import a certain quantity of milk solids. The ratio started off at 1 local : 5 imported (WME basis), and was changed to 1:2 by 1985. The target is a ratio of 1:1 by the end of Repelita IV in 1988. Given the difference in cost between sources and differing ability of factories to purchased local supplies, a blending scheme was developed to compensate factories purchasing a large proportion of expensive local milk. Figures that follow were for the end of 1983 :

- Production costs from imported NFDM and butter oil, 3% b.f., liquid milk price = Rp 151.26/liter.

- Local factory purchase price, fresh milk = Rp 300.25/liter.

- Import licensing scheme : 1 liter fresh milk per 5 kg (liquid equivalent) imported powder.

- Blended cost = $\frac{300.25 + 5(151.26)}{6}$ = Rp 176.09

- Equilization price for fresh milk surplus factories:

  300.25
  -176.09
  --------
  Rp 124.16/liter of fresh milk purchased in excess of 1:5 ratio requirements.

6.163 The rationale for the above pricing mechanism is that West Java is a fresh milk deficit area because total demand exceeds fresh milk needed to achieve 1:5 ratio. The actual ratio is close to 1:9. It is impractical to transport fresh milk from Central and East Java to West Java so factories in Central and East Java are compensated in this cost disadvantage.

6.164 The government also plays a major role in setting the factory door price which is periodically negotiated between milk factories (the processors) and the cooperative movement (the suppliers). Table VI.7 gives the range of prices prevailing in September, 1985. Import duties are also levied on imported milk solids. Although retail prices are uncontrolled, the government controls licensing of new milk factories. Glassburner (1985) estimates the rate of protection at 221 per cent.

6.165 Milk Production The majority of the Indonesian milk producers are smallholders with 1.0 or less hectares of land. The average number of cows milked is 2 head but herd sizes including followers range up to 10 to 15 head. A few large commercial dairies have been developed such as the CLUSA dairy at Boyolali but, by-and-large, the domestic milk industry is based on the 2-cow, KUD-member dairyman.



270

6.166 All dairyman who produce milk which flows into commercial processing and distribution channels must be a member of a KUD. All KUDs are part of the GKSI which manages the domestic milk industry and regulates the flow of milk to the private processing sector.

6.167 Farmers' average supply to KUD collecting centers is reported to be 4.5 liters/cow. Low production results from factors noted in Chapters III and IV. Farmers who obtain dairy cows through credit programs are expected to repay loans in kind, paying three liters a day. This leaves little revenue for the farmer to buy concentrate feed.

Table VI.7: Price and cost for milk in Indonesia, 1st Semester, 1985

| Province | Milk Price at farm level [a] | KUD selling price to milk factory | | KUD milk treatment plant | Treatment Costs [b] |
|---|---|---|---|---|---|
| | (Rp/liter) | (Rp/kg) | (Rp/liter) | | (Rp/liter) |
| Jakarta | 294 | 328.89 | 337.55 | Pengalengan, Bandung | 25 |
| West Java | 240-285 | 300.25-328.89 | 308.16-337.55 | Ujung Berung, Bandung | 47 |
| Central Java/ Yogyakarta | 210-235 | 300.25 | 308.16 | Boyolali, C. Java | 28 |
| E. Java | 220-280 | 300.25 | 308.16 | Pandaan, E. Java | 28 |
| | | | | Batu, E. Java | 28 |

Source: Milk treatment plant monitoring study, DGLS, 1985.
[a] Does not include money subtracted for loan repayment scheme covering animals and facilities.
[b] Cost of collection, chilling, pasteurization and transport.

6.168 To increase milk supplied by farmers, milk replacer could be provided to loan recipients with dairy cattle. The milk replacer would be used for calf rearing freeing fresh milk for marketing. One may question, however, the rationale for limiting milk imports while allowing milk replacer imports. Milk replacer is available at Rp 200/liter, while farmers receive Rp 230-250/liter for their milk.

6.169 Milk processing and marketing topics are covered extensively in the 1983 study by Ashworth-Morrison Cooper (AMC). The main points are summarized below. Milk collection is at either the sub-collection centers or collection-chilling centers. Milk is collected twice a day and checked with the alcohol test, the specific gravity test and the milk strainer test. At the collection-chilling centers, the fat content is also measured. Current standard is 2.8% butterfat. The milk treatment centers collect milk from primary cooperatives twice a day and in addition to the checks listed above, they check temperature and use a methylene blue test.

6.170 Milk is delivered to factories from collection-chilling centers or milk treatment plants in either 40 liter cans or tankers of various



271

sizes. Haulage distances vary from 80 km to over 600 kg. Figure VI.14 gives the flow of milk through the marketing system. Appendix tables 6.3 and 6.4 give production costs and a summary of handling costs at Cooperative/KUD centers with procesisng capacities per day. Handling costs range from Rp 44/liter to Rp 64/liter and represent about 19-20% of the farm price. The AMC report suggests that, based on experience in other countries, these margins are reasonable. The team did not have time to conduct the type of detailed analysis needed to assess whether these costs represented an efficient milk marketing system.

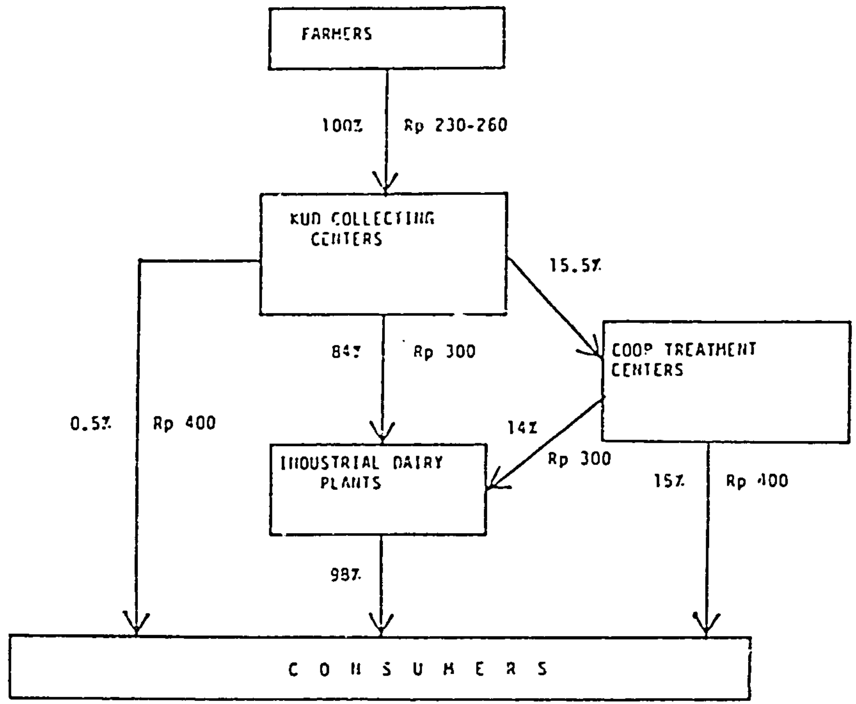
6.171 Processing capacity is well in excess of current or future needs. A new factory in Salatiga, Central Java started operation in late 1985 producing skim milk powder/anhydrous milk fat. This added further to industry over-capacity and increased costs compared to hauling local milk to existing, underutilized factories. The plant is reported to be incurring heavy losses because of inadequate local milk supplies. As local milk supplies continue to expand, new investment will be needed in milk handling facilities needed by the KUD's and milk treatment centers.

6.172 Market growth projections were made by the AMC study using a combination of secondary data and primary data collected by a survey carried out on Java. The survey was used to construct an econometric model of consumer demand. While the survey procedures, sampling frame, and some of the summary results are questionable, the market growth projections seem quite reasonable. The slower growth rate of the Indonesian economy and a gradual increase in the real (i.e. inflation adjusted) price of dairy products due to increases in the ratio will result in a moderate rate of demand growth with the most likely estimate of 4.5% per annum. The proportion of fresh and pasteurized whole milk, a market that local producers could fill effectively, will grow very slowly. Sweetened condensed milk will remain the dominant product. Further work is needed on demand aspects and on the most cost-effective methods to expand dairy product consumption for target populations such as school children.

6.173 The planning and implementation of the dairy development program, even with all the problems cited, again represents the considerable implementation capacity of the GOI. However, like most other programs reviewed, follow-up has been inadequate on the production side and productivity is at very low levels. These low productivity levels from cows with a reasonable genetic potential represents a gap that should be filled. The first project proposed in Chapter IX should be able to take a more in-depth look at these problems and issues. It would be more cost effective to channel some of the resources targeted for dairy cow imports towards doubling or tripling production levels of existing animals.

6.174 Numerous weaknesses also are evident in milk marketing. High handling/marketing costs reduce prices paid to the farmer and reduce incentive to improve productivity. They also increase consumer costs and reduce growth in demand. Poor product quality was also shown to influence consumer demand for fresh and pasteurized liquid milk products. A concerted effort is needed to tackle problems on both the production and marketing/consumption side.

Figure VI.14. Dairy Market Structure



### d. Small ruminants marketing

6.175 As noted earlier, marketing channels for small ruminants vary little from marketing channels for large ruminants. However, small ruminants are much easier to transport than large ruminants. Generally, sheep and goats are transported by public transport for a fee that is never higher than that for one passenger, and sometimes lower. The animals can also be transported by bicycle and by foot.

6.176 Most of the demand in Jakarta is supplied by other provinces on Java. An example of the market structure for sheep and goats in East Java is given by Soedjana, et al., 1984 (Figure VI.15).

6.177 Small ruminant markets are relatively stable throughout the year except for the dramatic increase in consumption and prices during Idul Adha. Good looking male animals carry a considerable price premium during this holiday. Generally middlemen, but also more commerciallly-oriented farmers, will hold animals for Idul Adha. Market volume during the month of Idul Adha doubles, if not triples, and prices tend to increase by as much as 25%.

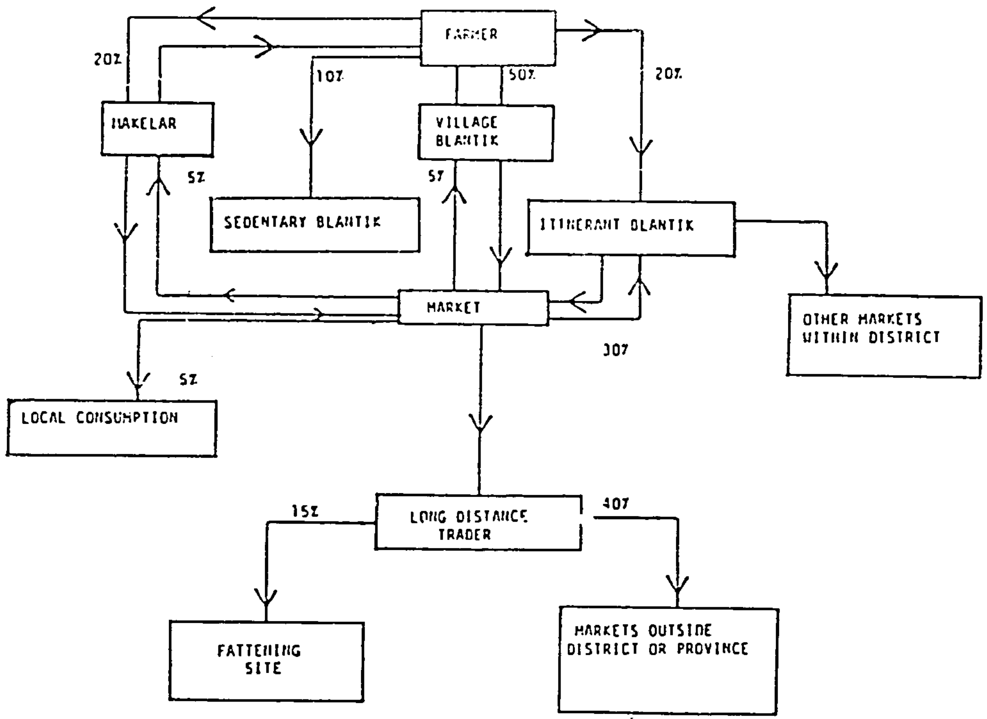
6.178 Farmers on Java have excellent access to the small ruminant market because of the relatively small size of the animal, and their ease of transport. In other parts of Indonesia (especially in areas where pig-raising is common), the sheep and goat populations are more sparse, local demand for the meat is weaker, and the number of small ruminants to be found on regular market days is small.

### e. Swine marketing

6.179 Swine production on Java is controlled primarily by large-scale, input intensive operators. These large pig producers are financially strong and are generally strategically located. They have developed their own marketing channels and deliver pigs directly to wholesalers or large retailers which have agents at the urban slaughter houses. Based on 1979 Dinas slaughter statistics for Java, 291,406 pigs were slaughtered out of a swine population of 168,337. BPS, however, published an estimated 621,650 slaughtered out of a population of 139,906 pigs for the same year. The provincial livestock slaughtering data support the Dinas data, which are also closer to the calculations based on the reproductive parameters surveyed by the study team (about 330,000 slaughterings for 1979, yielding about 19,500 tons, carcass weight.

6.180 Swine production outside Java is largely in the hands of smallholders. General characteristics of smallholder swine production are presented in appendix table 3.53. Reproductive performance is difficult to estimate. The market system is generally not well-developed because many of the areas where pork is popular are thinly populated. Farmers use their animals for ceremonies, but also sell them to local village collectors who have their own links with retailers (butchers). In the rural areas of these provinces, one finds pigs being sold at the general market, just like village chickens and other small animals. In urban centers, where there is firm demand for pork (such as Medan and presumably Palembang), pigs are generally supplied by large commercial producers.

Figure VI.15. <u>Market Structure for Small Ruminants at Four Markets (Dampit, Turen, Pasirian and Sukorejo) in East Java 1983.</u>




Source: Soedjana *et al* (1984)

## 2. Slaughtering and processing

### a. Slaughterhouses

6.181 The meat processing industry in Indonesia encompasses over 1000 slaughter houses, summarized in table VI.8. In addition, there are numerous meat processors making sausage, bakso, abon, dendeng, etc. Slaughtering and fresh meat marketing are discussed in this subsection. The next subsection discusses processing.

6.182 There are three types of slaughter houses: public slaughterhouses managed by local government, one modern slaughterhouse with mechanized line dressing facilities, and private slaughterhouses.

6.183 Public slaughterhouses: Public slaughterhouses are managed by local governments under the supervision of a provincial meat inspector controlled by DGLS in the Ministry of Agriculture. The majority of the slaughterhouses outside of Jakarta operate under this system.

6.184 Fresh meat is a highly perishable commodity which must be consumed immediately after slaughter or preserved through refrigeration or processing. The infrastructure necessary for refrigerated distribution and marketing of meat is not available in many areas outside of Jakarta. Moreover, food habits, preferences and religious requirements vary from one area to another. Decentralized slaughtering facilities ensure that small communities have a supply of fresh meat.

6.185 The number of animals slaughtered at public facilities varies depending on the size of the community and demand from adjacent larger towns and cities for fresh meat. From 10 to 25% of all animals slaughtered are cull cows.

6.186 At these slaughterhouses, the butchers/meat traders supply their own labor and pay a fee for the use of the facilities and services provided by the government such as cleaning, waste discharge, and veterinary meat inspection. Teams of workers, employed by a butcher or meat trader, are generally allocated a position in the larger slaughterhouses and operate independently, sharing some common facilities such as hoists, overhead rails, and scalding and dehairing equipment. Fees for use of public slaughter house facilities and services are set by local government, and vary substantially. Table VI.9 shows public slaughter house fees.

6.187 Slaughtering generally takes place during the cooler early hours of the morning. Warm carcasses or hot deboned meat, bones and offal are transported to the meat markets for sale on the same day. Although regulations often require hanging meat at least 8-10 hours before distribution to the markets, lack of facilities precludes hanging in many cases. In any case, most consumers are unaware of the benefits of hanging, and more concerned with obtaining fresh meat.

Table VI.8: Existing abuttoirs And slaughter capacity 1983

| Province | Public abbatoirs | Private abattoirs | Total | Average slaughter capacity Cattle/ buffalo | Goat/ sheep | hogs |
|---|---|---|---|---|---|---|
| | (no) | (no) | | ---- (head/day) ---- | | |
| Aceh | 18 | 1 | 19 | 58 | 37 | 11 |
| North Sumatra | 45 | 15 | 60 | 76 | 74 | 288 |
| West Sumatra | 6 | - | 6 | 117 | 107 | 20 |
| Riau | 7 | 1 | 8 | 26 | 8 | 83 |
| Jambi | 1 | 1 | 2 | 24 | 11 | 42 |
| South Sumatra | 15 | 7 | 22 | 96 | 35 | 88 |
| Lampung | 3 | - | 3 | 40 | 91 | 13 |
| Bengkulu | 1 | 1 | 2 | 15 | 34 | - |
| Jakarta | 7 | - | 7 | 562 | 283 | 535 |
| West Java | 69 | 110 | 179 | 384 | 721 | 115 |
| Central Java | 94 | 9 | 103 | 380 | 782 | 150 |
| Yogjakarta | 8 | 13 | 21 | 43 | 114 | 22 |
| East Java | 199 | 63 | 262 | 798 | 1383 | 219 |
| South Kalimantan | 5 | 2 | 7 | 35 | 7 | 2 |
| Central Kalimantan | 1 | 2 | 3 | 14 | 7 | 20 |
| East Kalimantan | 5 | 3 | 8 | 34 | 8 | 12 |
| West Kalimantan | 7 | 13 | 20 | 29 | 7 | 121 |
| South Sulawesi | 28 | 20 | 48 | 151 | 20 | 74 |
| Central Sulawesi | 2 | 4 | 6 | 36 | 36 | 16 |
| North Sulawesi | 1 | 2 | 3 | 11 | 4 | 32 |
| South East Sulawesi | 1 | - | 1 | 9 | 12 | 3 |
| Bali | 7 | 28 | 35 | 117 | 262 | 270 |
| West Nusa Tenggara | 19 | 24 | 43 | 55 | 11 | 16 |
| East Nusa Tenggara | 15 | 6 | 21 | 36 | 15 | 45 |
| Moluccas | 2 | - | 2 | 8 | 3 | 12 |
| Irian | 5 | - | 5 | 9 | 4 | 58 |
| East Timor | 1 | - | 1 | - | - | - |
| Total | 572 | 325 | 897 | 3,164 | 4,076 | 2,407 |

Source: DGLS, 1984.



277

6.188 Some of these slaughterhouses (Semarang, Bogor, Bandung, Surabaya, etc.) built in the 1940's are still in good operating condition both physically and hygenically. But most of the slaughterhouses in small communities are in a very poor condition (Palu, Kendari, Ambon, etc.). Basic facilities are almost absent and they are very unhygenic. This results, in part, because public slaughterhouse personnel are responsible both to local government and to DGLS, a situation which often leads to problems in maintaining high standards of hygiene and facilities. Despite these problems, antemortem inspection of animals and postmortem inspection of carcasses takes place on a regular basis.

Table VI.9. Slaughter and inspection fees at selected slaughter houses

| Location | Slaughter/inspection fee per animal (Rp) | Facilities/service provided |
|---|---|---|
| Jakarta | 11,900 cattle/buffalo | overnight chilling, refrigerated transport to the markets. |
| Bandung | 2675 cattle/buffalo<br>425 goat/sheep<br>3250 pig | carcass hanging |
| Semarang | 5750 cattle/buffalo | carcass chilling |
| Palau | 2550 cattle | none |
| Jayapura | 4600 cattle | transport to markets by truck |
| Ambon | 5800 cattle | none |
| Aceh | 6500 cattle | transport to markets by truck |
| Solok | 4350 cattle | none |
| Padang | 7000 buffalo/pig<br>5000 cattle | none |

Source: Survey by study team members

6.189 Jakarta slaughter facility: Modern slaughter houses with mechanized line dressing facilities are found in Jakarta, replacing four public slaughterhouses similar to those described above. The new facilities were built to cope with the rapidly increasing and concentrated demand in the Jakarta market and for environmental considerations, primarily waste disposal.

6.190 This new facility is designed to handle 1100 head of cattle and buffalo per day. The slaughter house charges Rp 11,900 per head slaughtered, including overnight chilling of carcasses and refrigerated



278

transport of carcasses to the meat markets.

6.191 Meat traders and butchers deliver their animals to the slaughter house. Animals are identified so that meat traders pick up the carcass, organs, and by-products from their own animal. Maintaining identification throughout the slaughtering operation sometimes creates problems. After resting animals overnight in the pens provided, slaughter starts at 1 p.m. After bleeding, the carcasses are hoisted and move along an overhead rail system where dressing takes place on a line. Carcasses are chilled overnight, quartered, and delivered to the meat market early the next day where traders and butchers pick up their carcasses and offal.

6.192 Additional processing takes place in the local markets, generally under unhygienic conditions. Chilled meat begins to thaw quickly with handling, resulting in moist surfaces which encourage rapid multiplication of contaminating bacteria. Meat which has been contaminated continues to deteriorate even after rechilling. Consequently, retailers are forced to sell at lower prices near the end of the day. While cold storage facilities are available for unsold meat, storage is expensive at Rp 50 per kilogram for four days.

6.193 Private slaughterhouses: Most private slaughter is conducted on a small scale. While some private facilities are recognized in the community (e.g. local restaurants) and meat is inspected for a fee, others are not (e.g. a private dwelling). While only a small percentage of large animals are slaughtered in the informal sector, this process accounts for most of the productive cows illegally slaughtered. Most goats, sheep, some pigs, and almost all of the local chickens are slaughtered in the informal sector. Private slaughtering is not illegal when the meat is consumed by the owners or forms part of a festival or celebration. However, the small-scale informal sector facilities used for slaughtering outnumber the formal sector slaughterhouses.

6.194 On the other hand, there are a few relatively large, modern and hygienic private sector slaughterhouses specializing in the long-range distribution of chilled or frozen meat to quality conscious customers such as hotels, supermarkets and processed meat manufacturers.

6.195 For example, PT Berdikari has slaughter and dressing facilities at several locations in the country. They buy the livestock (cattle and buffalo) from small farmers and private ranchers, paying premium prices to assure supply. Cattle are transported to the slaughter house's holding grounds where they feed the animals before slaughter. They buy cattle on a liveweight basis, paying higher prices for heavier animals. They operate modern slaughter facilities with cold storage and freezing capabilities. They sell meat on contract through their agents in the larger cities and inter-island markets. They market special cuts, aged beef, and boneless cuts (chilled or frozen). Meat is packaged in polyethylene bags, cartoned in plastic-lined cardboard boxes, and shipped by PT Berdikari refrigerated trucks or ships. Meat is also shipped by regularly scheduled passenger airlines.

6.196 Slaughter of female animals: Even though slaughtering of productive females is prohibited by law, high prices and economic necessity induce farmers to sell young and productive females for slaughter illegally (appendix table 6.5). For example, about 31% of beef cattle and 21% of buffalo slaughtered in South Sulawesi were females. In Southcentral Timor, 71% of cattle and 33% of buffalo slaughtered were females. (Cows already delivered to slaughterhouses are tested for pregnancy rather than reproductive capacity.)

6.197 The regulation on female slaughtering has or could have a number of negative aspects. Firstly, as the slaughtering of female animals is discouraged, the price of these animals is discounted as it is difficult to sell the females. It is known, however, that the farmers place great value on the savings aspect of livestock, i.e., they appreciate the possibility to turn their stock into cash whenever the need arises. If females cannot fulfill this role of cash generation, the farmers might opt for buying a larger number of males, or, as the regulations generally involve pregnancy testing, delay the mating of females. Both strategies would lead to a decrease in production.

6.198 Secondly, the farmers are discouraged to cull their less desirable animals. The general result of the regulation is, therefore, a weakening of the bargaining position of the farmers versus the middlemen because of the illegality of the trade. At the same time, the positive effects of this regulation are by no means proven. An evaluation of the regulation is difficult, as marketing statistics in some provinces already seem to be biased so as to conform with the regulation, rather than actually reflecting the sex composition of the animals traded.

6.199 As farmers generally will have the tendency to maintain ownership of their most productive animals, it is doubtful if the present ban on slaughtering of females contributes positively to the Indonesian livestock economy.

6.200 Meat Hygiene and Public Health: The supervision of slaughterhouse hygiene through antemortem and post mortem inspection is under the control of the Directorate of Livestock Services. DGLS is responsible for monitoring and updating the national regulations for the livestock products industry. Many of the regulations need updating in order to conform to modern standards. For social and economic reasons, some of the existing regulations are not rigidly or uniformly enforced. The local inspection staff is associated with DGLS, but administered and paid by local authorities, who in turn are supervised centrally by the Ministry of Home Affairs. Consequently, the specialist livestock industry staff lacks the necesary authority to enforce standards, especially where the expenditure of local authorized funds is necessary to resolve problems.

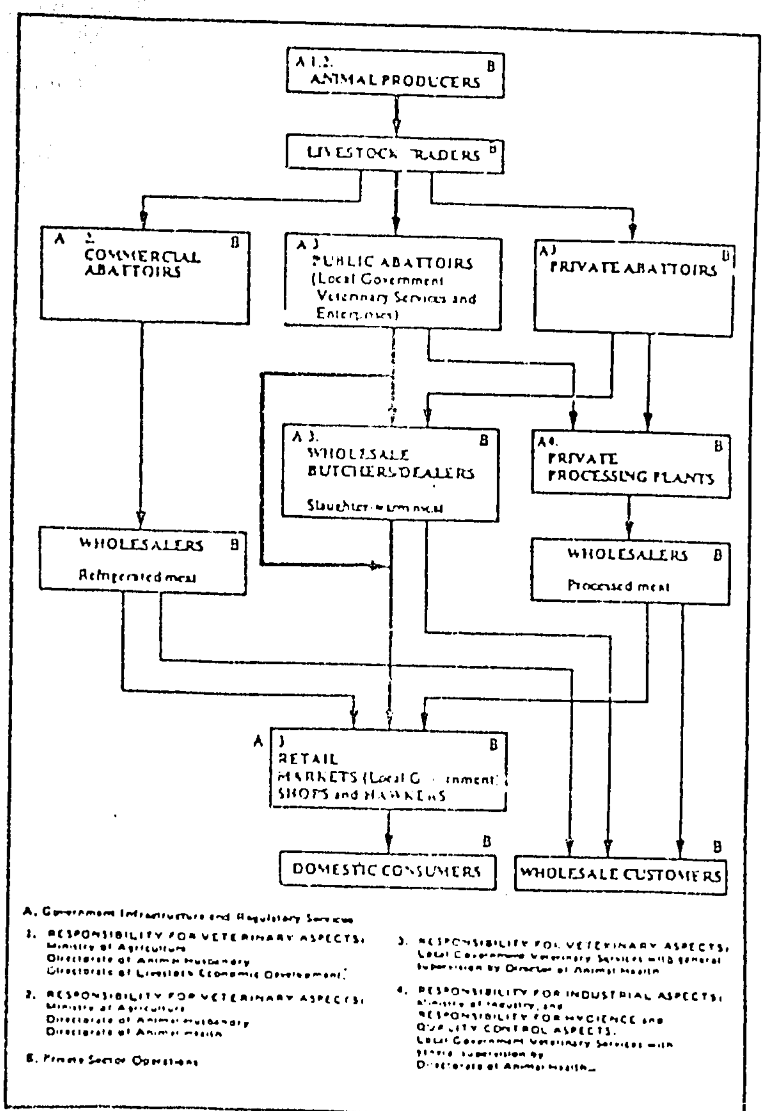
6.201 Even though much of the meat is produced in unhygienic slaughterhouses, meat generally does not cause serious illness, because of local practices. Deydration of the meat surface before it is marketed (4-6 hours after slaughter) reduces the multiplication of contaminating bacteria. Generally meat is thoroughly cooked before eating, destroying harmful bacteria. Finally, slaughter house meat inspection removes diseased meat from the supply. These are relatively very small quantities.

6.202 Figure VI.16 illustrates the organization of the supply and distribution system for red meat together with the responsibilities of various government and private agencies.



280

Figure VI.16 The Red Meat Supply Chain in Indonesia




Source: Proposal for the Livestock Slaughterhouse and Marketing Subproject (Working Oraft) DGLS, Feb. 1985



281

6.203 Export of by-products: The 1984 export of animal by-products totalled 9.91 million kg valued at about $36.8 million (appendix table 6.6). Skins and hides are collected from the slaughter houses by specialized traders. Sheep and goat skins are sold for Rp 2500/piece and beef hides for Rp 800 to 900/kg. Skin processors either sun-dry or salt-cure the hides. The dried and salted skins are sent to hide processing plants. Bones are purchased by meat merchants at the local slaughter-house or meat market at prices ranging from Rp 45-120/kg, and shipped to bonemeal factories or to shipping agents for export.

b. Retail fresh meat markets

6.204 Meat generally is transported to markets either as warm carcasses cut into quarters or as hot boned meat immediately after slaughter. Pickup trucks and bicycles are used to transport the meat, which is covered with a plastic sheet or cloth. Meat may be transported over long distances this way. While the meat is warm, it is exposed to dust and dirt but usually the surface dries. The meat is sold the same day for cooking and consumption.

6.205 Prices obtained for carcasses are comparable except in Irian Jaya where deboned meat is sold at a very high price (appendix table 6.7). The high price is justified since slaughter animals are shipped at a very high cost from Kupang and road transport facilities are poor.

6.206 The average dressing percentage for beef is 49 to 52 percent, buffalo, 45%; goat and sheep, 40 to 45%; and pig, 60 to 65%. The relative prices of meat, organs and offals at different markets are about the same throughout the country (appendix tables 6.8 and 6.9).

6.207 Meat is sold to consumers in four types of retail outlets: open meat markets, meat shops, supermarkets and restaurants.

6.208 Open meat markets: Most meat is retailed in open meat markets which generally form a part of a municipal food and general produce market. Stall holders pay a fee to the local government for use of an area and for minimal facilities and services. Pork retailing is generally separated from other meat stalls. Chickens are usually slaughtered, dressed and sold in a separate area of the market as well.

Open markets typically suffer from many of the following problems:

- severe overcrowding of stalls and customer areas
- inadequate access for the delivery of meat
- poor ventilation and lighting
- inadequate water suppliers and waste disposal
- contamination by flies
- inadequate overnight storage facilities for meat

6.209 Meat shops: These are specialty shops owned by butchers, their agents or local retailers who sell meat on commission. They transport carcasses, organs, offals from slaughter houses, make deboned meat cuts, special cuts, minced meat, etc. Some have facilities to process bacon, ham, smoked meat, etc. These shops are reasonably clean, and are protected from flies. Some have chest-type freezers. Most of the chilled and frozen meat is for trade to restaurants and caterers. The shops also sell traditional processed meat items like bakso, dendeng, abon, etc.

6.210 Supermarkets: In large cities and towns, there are supermarkets which often have a meat counter. They sell fresh, chilled, frozen, and processed meats, and organ meats like tongue, liver, kidney, brain, etc. While supermarkets are generally hygienic, prices are high.

6.211 Restaurants: Some big and medium-sized restaurants, especially in provincial towns, slaughter their own animals, particularly goats, sheep, and chickens. Local authorities inspect them for a fee. In addition, thousands of small roadside restaurants and stands ("warung") also slaughter meat.

### c. Meat processing

6.212 The common processed meats are: bakso (meat balls), dendeng (sun-dried beef), abon (dry shredded beef), sausages (beef, pork, or chicken), bacon, ham, and beef chips (made from lung, endloins, cartilage, etc). Processed meats are made in small-scale facilities for local consumption or prepared in a semi-mechanized small factory.

6.213 Fresh warm meat is preferred for making bakso because of its high binding properties. At Bandung, about 70% of all fresh meat goes into bakso production. One semi-mechanized factory manufactures about two tons of bakso per day. The cost of the meat balls varies from Rp 30 to 135 per ball depending on quality. There are about 20 such factories in the Bandung area. Dried beef products, dendeng and abon, are also very popular. In Bandung, the estimated sales are 1.5 tons dendeng and 3 tons abon per month.

6.214 Dendeng is a dried, sweet meat. It is cured with sugar, salt and spices. One kilogram of fresh meat yields about 400 grams of dendeng. Abon is shredded meat, similar to flaked coconut in consistency, which is sprinkled on top of rice dishes.

6.215 Some processed meat products have a short life if not refrigerated (bakso lasts two days). Sausages, bacon, and ham have just a few days of refrigerated shelf life. The cost of processed meat products varies depending on demand. In general, the price of dendeng is Rp 10,000/kg, and abon Rp 15,000/kg. There is no inspection for these products.

### d. Coordination of the meat industry

6.216 The meat industry in general is fragmented and uncoordinated in terms of capacity. Authority and responsibility for regulation is decentralized. Generally, demand is for fresh slaughter-warm meat. Even in large cities, people often prefer fresh meat to chilled or frozen meat. In Jakarta, this has encouraged illegal slaughter (an estimated 30% of total slaughterings).

## 3. Strengths and weaknesses

### a. General observations

6.217 Expenditures surveys indicate that demand for livestock products is increasing rapidly. This is confirmed by trends in regional liveweight prices which have tripled in just five years (1977-1982).

6.218 National animal population statistics and livestock production figures are not reliable enough to be used for planning purposes. Provincial data do not add up to national data, and provincial import and export data do not balance nationally. Figures from the Sensus Pertanian 1983 do not match DGLS data. Also the meat conversion coefficients (converting slaughterings into meat production) need revision, especially for pigs.

6.219 The marketing of livestock products is generally satisfactory and, at most locations, the conditions for competition among traders are in place. Depending on the estimated market volume, a number of new market sites may be established, but needs should be determined based on local conditions. Plans for market sites should be standardized and developed using detailed studies.

6.220 The government plays a minor role in the marketing of most livestock species, except for poultry and dairy marketing. The development of poultry shops has proven to be very successful. Poultry shops have allowed smaller poultry farmers in particular to intensify their operations.

6.221 The marketing of dairy products is almost completely dependent on government support and regulation. The maintenance of quality is a problem. A low minimum standard for fat (2.8%) may encourage producers and/or processors to dilute milk.

### b. Strengths of the systems

6.222 Communication has improved tremendously in the last decade. Road transport has reduced marketing costs, while good telephone connections allow more efficient long distance trading. The volume of inter-island trade in cattle has increased to the point that one trading company recently chartered a ship specialized in livestock shipping (the "Kota Ternak").

6.223 Holding grounds are well established, and well utilized, if not over-crowded. Farmers generally have access to more than one village collector, and often have access to transport to deliver directly to the local market. In many cases, farmers have the choice of by-passing one or more middlemen. Strategies to improve the market information system should be explored. Farmers would benefit from livestock market price quotations by radio and newspapers. Jakarta prices in particular should be routinely quoted.

### c. Points of discussion

6.224 Female slaughterings: The ban on female slaughtering is generally enforced at the provincial borders. Within the province, pregnancy tests are sometimes conducted. Consequently, females are slaughtered locally. Slaughterhouses report on the numbers of females and males slaughtered, but the totals seldomly add up to the 50% male: 50% female ratio as one would expect in provinces with a stable animal population.

6.225 The impact of the ban is difficult to assess. In Madura, it was reported to cause lower market prices for females. This is one of the objectives of the ban (i.e. making the sale of productive females less attractive.)

6.226 Extraction of superior bulls: In exporting provinces (Bali, NTT, for example), people have commented on the seemingly smaller sizes of animals. Some of the reports relate this to the extraction of fast growing, superior bulls for export to Jakarta. The argument is that smaller inferior bulls are left behind for breeding. The counter argument is that the smaller size of animals is related to their age, rather than their genetic basis. Indeed, it is questionable whether or not the genetic basis of a provincial herd can change over a ten year-period.

6.227 Frozen beef: Local processing of animals into frozen meat is an alternative to long distance animal transport. This is being done successfully in Bali and Ujung Pandang, but has failed in Kupang. Limiting factors are: (a) the limited market for frozen beef, (b) the cost of transport, and (c) the use of edible offal.

6.228 Comparative advantage: All provincial livestock services seem to have an objective to minimize the inputs of livestock and livestock products and to maximize exports. On a national level, however, the comparative production advantages of regions should be evaluated in order to determine whether or not the same program should be implemented in all provinces. If not, alternative programs should be targeted.

6.229 Competition among provinces may limit the development of the livestock industry in newer areas. For example, egg producers in Moluccas have a difficult time competing with imported eggs from Surabaya. The Surabaya egg producers benefit from the lower priced feed available on Java.

6.230 Milk replacer imports: One means of increasing local milk production is to put calves on imported milk replacer. However, one may question the wisdom of substituting milk replacer imports for milk powder imports. The loss in foreign currency may offset the benefits of increased milk production.

6.231 Cooperative versus private marketing: For agricultural products that (1) are heterogenous and for which it is difficult to estimate the quality and value, (2) have no stable price, and (3) are perishable, cooperative marketing has proven to be extremely difficult. Calls by CLUSA and others for cooperative production and marketing of live animals should be critically evaluated.

6.232 Slaughterhouse facilities: Most of the provincial slaughter houses, especially those in small towns, do not meet high standards of hygiene and public health. However, the best equipped slaughter houses also tend to be the most expensive ones. Lack of hygienic facilities is partly compensated by the rapid turnaround between slaughter and consumption.

6.233 Local governments operate slaughter houses and meat markets and collect fees from butchers, from meat traders, and from meat retailers for the facilities offered. The need to upgrade slaughter facilities is often recognized by the livestock service, but not by the local government. Variation in slaughter facilities and fees is therefore high.

6.234 Lack of technical skills for slaughtering and processing: Training of technical personnel for processing, marketing, management, extension, and public public health information and training is limited to veterinary meat inspectors who examine carcasses to detect dangerous animal diseases. Expansion of training facilities therefore should be seriously explored.

## C. Financial institutions

### 1 Institutional sources of credit

6.235 The initial parts of this section are based upon a recent ABD report dealing with the Fisheries Industry Credit Project (ADB, 1985). Latter parts deal more specifically with financial institutions, both formal and informal, that impact most directly upon the livestock sector.

6.236 The financial system in Indonesia includes: (1) the central bank (Bank Indonesia - BI); (2) 118 deposit money banks (DMBs); (3) 5,928 rural banks; (4) 14 non-bank financial institutions; and (5) 127 insurance companies and leasing companies. The financial system has exhibited rapid growth in strength and size over the last decade. The system is dominated by the public sector banks (particularly BI and the public sector DMBs), as illustrated in table VI.10 below.

6.237 Bank Indonesia accounts for about 40% of the assets of the financial system with the DMBs accounting for nearly 55%. The DMBs also account for over 94% of loans outstanding and 99% of deposits. The DMBs comprise: (1) five state-owned commercial banks; (2) 70 private commercial banks; (3) 29 development banks, including one state-owned development bank (Bank Pembangunan Indonesia - BAPINDO) and 28 regional development banks; and (4) 11 branches of foreign banks. The DMBs greatly vary in size and strength.

6.238 The five state-owned commercial banks (SOCBs) -- Bank Negara Indonesia 1946 (BNI-46), Bank Bumi Daya (BBD), Bank Dagang Negara (BDN), Bank Rakyat Indonesia (BRI), and Bank Ekspor Impor Indonesia (BEII) -- are the largest DMBs in terms of assets. They control 70% of DMB assets, 66% of DMB deposits, and have over 700 branches. Further, they account for 64% of the total loans by the financial system, and 80% of term credit. This dominance has been partially built up due to GOI regulations that require state enterprises to maintain deposits with SOCBs, insurance companies to maintain 4.5% of their statutory reserves in the form of deposits with the banks, and low interest rediscounting facilities of BI. In return, SOCBs have supported GOI priority programs.

Table VI.10: Share of financial institutions in assets, loans and deposits, December, 1984

| | Assets | Loans | Deposits |
|---|---|---|---|
| | ---------- (%) ------------ | | |
| Bank Indonesia | 39.8 | 4.6 [a] | |
| Deposit Money Banks (DMBs) | | | |
| State commercial banks | 38.4 | 64.2 | 65.6 |
| Private commercial banks | 8.1 | 16.0 | 17.6 |
| Foreign banks | 4.0 | 5.5 | 10.9 |
| Development banks | 4.2 | 8.7 | 5.3 |
| Subtotal | 54.7 | 94.4 | 99.4 |
| Other financial institutions [b] | 5.5 | 1.1 | 0.6 |

Source: BI and ADB estimate.
[a] Direct credit only (excluding credits to the banks).
[b] Includes rural and savings banks.

6.239 Among the development banks, the 27 regional development banks are by law restricted to their respective provinces and they largely operate as provincial commercial banks performing limited development banking functions. The largest of these institutions is BAPINDO, which is a state development bank operating nationally. BAPINDO has emerged as a very important source of long-term funds for project financing, and has rapidly increased lending in the 1970's and in the early 1980's. All of the development banks in Indonesia rely heavily on the GOI and BI for the bulk of their resources. Until recently, resource mobilization has not been among the objectives set for these banks. The total share of agriculture, although having accounted for approximately 8% of total credit between 1981 and 1983, had declined to approximately 7% of the total by 1984.

6.240 The four state-owned commercial banks were established in their present forms following the enactment of the the Bank Indonesia Act in 1968. Founded under various Presidential Decrees in 1968, the four state-owned commercial banks are wholly owned by the GOI and they maintain a dominant role in the Indonesian financial system, particularly in respect to term lending. The original concept was to develop institutions that had primary responsibility for specific sectors of the economy including BNI-46 (industry), BRI (smallholder and rural credit), BDN (mining), and BBD (estates and forestry). However, these distinctions have gradually been removed. These banks fall under the general control of the Ministry of Finance.

6.241 These four PBs have a total staff of about 58,000, of which BRI accounts for aver 30,700 staff (over 14,300 of which are employed in its village units). Thus, of the 58,000 staff, 43,800 are employed in non-village operations out of which approximately 6,000 are in professional/managerial grades. The salary structure and compensation packages of the four PBs are more or less competitive, but below those of the private banking sector. In spite of this, staff turnover is generally low (below 2%) largely because of security of tenure and other benefits, notably a pension, offered to the employees. As the PBs are trying to diversify their portfolios and are operating in a non-regulated environment, the need for technical staff (vs. economists, financial analysts) is increasing. The PBs are gradually recruiting more technical staff.

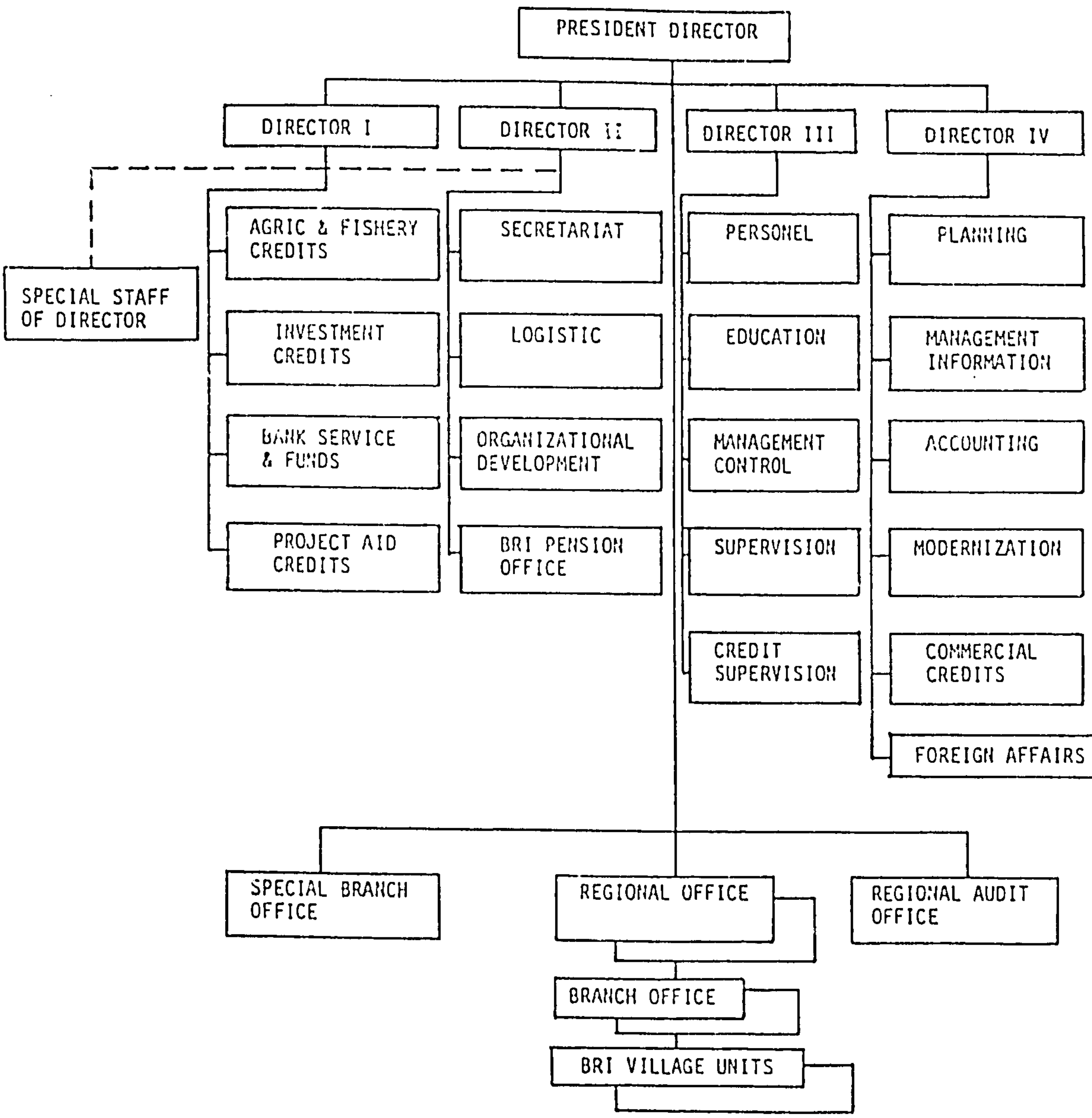
6.242 Lending terms differ only slightly between the state-owned commercial banks. Lending rates at present vary between 17% to 20% for ordinary non-priority loans. Term maturities are typically from 7 to 12 years inclusive of a 1 to 4-year grace period. Maximum financing is 65% to 70% of total project cost. The financed item, in addition to other assets, is required as collateral; coverage of up to 150% of the loan may be required. Credit committees review loan applications before they are presented to Boards of Managing Directors. Smaller loans of $100,000 to $400,000 are sanctioned by managing directors and regional managers in accordance with each bank's internal procedure.

6.243 Loans, except those issued under BI priority programs, are not insured, and a grace period up to four years is allowed based on cash flow. However, interest is recovered during the grace period but may be capitalized under exceptional circumstances. Penalty interest of up to 1.5 times normal interest is charged on overdue loans. Short term loans usually finance up to 70% of the working capital needs, and at present carry interest rates of 21-24% per annum, depending upon the risk.

6.244 The Bank Rakyat Indonesia (BRI) provides the majority of institutional credit to the rural sector in general, and to the livestock sector in particular. An organization chart is given in Figure VI.17.

6.245 Loan appraisal procedures of BRI reflect the dominance of small-scale investment and working capital priority credits in its lending. BRI has adopted similar procedures for its priority as well as its non-priority lending. These comprise the evaluation of marketing, management, and technical aspects of a proposal, and a comprehensive financial evaluation. At BRI's head office, there are three divisions: (1) agriculture and fisheries; (2) general investment credits; and (3) commercial credit (mainly trade financing). Each division is responsible for loan appraisal and the preparation of reports, with recommendations for submission to its management. Loans of up to Rp 200.0 million may be approved by the department director concerned. Loans above this limit require board approval. The credit divisions are staffed with a mix of financial analysts and technical staff. BRI employs the largest number of technical staff among the state banks and has more than 75 fisheries staff who have also been trained in banking. Financial analysts and technical staff are also employed in the branch and regional offices.

Figure VI.17: Organization chart of Bank Rakyat Indonesia.



6.246 Non-priority loans of up to Rp 50.0 million, and priority loans (refinanced by BI) of less than Rp 75.0 million are sanctioned at regional offices. Working capital and investment loans below Rp 50.0 million can be approved by the branch managers. Each regional office has three departments which are responsible for handling loans operations for: (1) investment credits; (2) commercial (trade) credits; and (3) mass credits (mainly Government-sponsored small credits to groups, cooperatives, etc.). These regional credit departments report to the credit divisions at headquarters, supervise credit operations of the branches and report on their activities. Credit supervision of problem loans is handled by designated divisions at the main office and departments at the regional level. BRI's credit operations have received considerable expert inputs from external financing agencies. The impact of this support is reflected in the current evaluation procedures of BRI. In-house and overseas training have helped BRI improve its appraisal techniques. The BRI asset to liability ratio, as of December 1984, was 1.05:1.

6.247 The BRI serves as the principal channeling agency for the ADB, World Bank, and IFAD loans to the livestock sector. The Government of Indonesia is the borrower of these funds. The GOI, acting through the Ministry of Finance, then enters into agreements with BRI to channel bank loan funds to BRI for payment of a fee to BRI. BRI enters into credit agreements with eligible farmers.

6.248 In addition to these large, externally supported projects, DGLS has also been instrumental in developing credit programs for smallholder livestock development schemes. These include: (1) credit for capital investments (KMKP) for Mass Guidance (MASSAL) programs for village chickens and a smallholder cattle fattening scheme (Panca Usaha Ternak Potong or PUPT); (2) a small investments credits scheme (KIK) for Mass Guidance in cattle seed stock purchases and the dairy cattle development scheme (Panca Uasha Sapi Perah); and (3) a KMKP program covering all types of farmers and all types of livestock.

## 2. Non-institutional sources of credit

6.249 The most common source of non-institutional financing is advances and short-term lending from traders, village money lenders, and other intermediaries.

6.250 Trader financing is also dominant in the traditional processing industries, where the wholesaler often finances both backward and forward to secure his supply and market outlets. A World Bank study (World Bank, 1983) indicates that the cost of capital from non-institutional rural sources may be about 3% to 4% per month. This rate converts to an extremely high yearly interest rate, but such comparison is misleading, since the borrower most often only needs the funding for a short period, and the opportunity created by the loans yields high short-term profits. Defaults on these non-institutional borrowings are rare, and repayment agreements are generally adhered to.

6.251 During study team field visits, a marked preference was found among farmers to use the village money lender because procedures are simpler, transactions are kept secret as long as the borrower repays, and it is a traditional aspect of rural society in Indonesia and, thus, widely



290

accepted.

6.252 The village money lender (VML) is often called "orang jang kaya," or the wealthy one. He loans money at a higher rate of interest than does BRI, based upon his valuation of ability and willingness to pay. However, it becomes a social stigma on the family if they are not able to repay their loan to the VML. Therefore, every effort is made to do so, because they desire this credit source to remain open to them in case of need.

6.253 In several villages, the study team met enterprising individuals in who are putting their resources to work using the gadohan system of financing beef cattle, chicken, duck, and even crop production by landless people in the village.

6.254 Another credit source serving poultry producers was through the private owners of the "Poultry Nuclear Estate" poultry shops, particularly in some remote regions where the BRI scheme was not yet in operation.

3. Strengths and weaknesses

a. Strengths:

6.255 A fairly well-developed formal financial system is gaining increased capabilities to handle major project activities and the monitoring/evaluation efforts that are needed. A large measure of financial stability now exists in the bnanking system.

6.256 There is also an extensive network of informal lending mechanisms in place in rural areas, including those based on payment and receipt in kind (e.g., the "gadohan" systems described in Chapter 3) and in cash. Obviously, the informal system tends to channel resources to areas where they can earn the highest of rates of return. With the exception of some commercial poultry and swine operations, we expect that only minor amounts of funds from informal sources flow to smallholder livestock units.

b. Weaknesses:

6.257 The vast majority of financial resources are concentrated in Jakarta where high returns have traditionally been earned in areas such as real estate, construction, trade, industrial projects, hydrocarbon investments and transportation. The rural sector in general and the livestock sector in particular have not been attractive investments for the financial system. Consequently, much of the project and investment activities in livestock have come from public or quasi-public sources.

6.258 In programs where large amounts of credit have been chanelled to smallholders (BIMAS programs for rice), repayment has been poor and GOI has been forced to write-off much of the loan portfolio. Our initial observations on various livestock distribution schemes (Chapter VIII) indicate that a parallel situation is developing.

6.259 The lack of attractive lending opportunities for formal credit institutions ion rural areas and the high costs of supervision and administration inherent in making small loans to a scattered rural population have left the vast majority of smallholders without regular access to formal lines of credit.

6.260 The financial institutions have not shown that the flexibility needed to help set up rural-based savings and loan institutions with the necessary autonomy to funnel resources to smallholders.

## D. Institutional support: farmer evaluation

### 1. Survey results

6.261 This section describes the results of the ADB/DGLS survey relating to institutional parameters. Livestock farmers interviewed for the ADB/DGLS livestock sector survey ranked the level of institutional support they receive for the livestock production activities and identified areas in which additional support is required. Table VI.11 shows how households ranked the level of support they receive from various sources. Not surprisingly, support from family, neighbors and the community was ranked strong most frequently (43%). Support from extension agents (29%), veterinarians and production institutions (28%) were ranked strong next most frequently, followed by support from informal traders (18%). The strength of institutional support varies among areas (table VI 12).

6.262 As one would expect, the majority of farmers ranked access to electricity, piped water and telephone services as bad to non-existent (table VI.13). A greater proportion of farmers ranked access to farm-to-market roads as fair to good (64%).

6.263 Most households live near schools (76%). A greater percentage of households are located far or very far from agricultural services -- market town (67%), veterinary officer (60%), ag office (72%), and extension office (62%, table VI.14). Table VI.15 shows that access to agricultural services varies among areas.

6.264 Farmers were asked what types of assistance they needed to improve the household's welfare derived from livestock production. Tables VI.16 and VI.17 identify areas of perceived need. Households mentioned the need for more and better breeds of cattle more frequently than other livestock species, probably reflecting the relative importance of cattle in comparison to other livestock. Animal health was ranked very important more frequently than other types of assistance (50%). Better marketing (40%) and extension services (40%) were mentioned next most frequently, followed by higher prices (32%).

6.265 Appendix tables 6.10 through 6.28 list several crosstables showing farmers' questions about available institutional support services such as roads, electrical supply, piped water supply, telephone system, distance to school and other services, contacts with information sources such as extension, coops, veterinary institutions, etc. Chi-square tests were carried out (not reported here) that indicated significant regional differences in response.

6.266 Appendix table 6.30 through 6.41 list crosstables reflecting farmers' opinions about alternative measures to improve their livestock enterprises by province. In all cases, chi-square values are high. The chi-square tests again indicated significant regional differences.



192

Table VI.11: Percentage of farm families ranking access to institutional support for livestock production

| Institutional support from: | Strong | Moderate | Weak | None |
|---|---|---|---|---|
| Family, neighbors, community | 43 | 32 | 16 | 11 |
| Informal traders | 18 | 41 | 17 | 25 |
| Middlemen | 8 | 9 | 18 | 66 |
| Stock farmers | 7 | 9 | 8 | 75 |
| Ag research station, schools universities | 5 | 12 | 7 | 76 |
| Veterinarians & production institutions | 28 | 32 | 12 | 27 |
| Co-ops & marketing institutions | 15 | 19 | 23 | 44 |
| Extension agents | 29 | 38 | 16 | 17 |
| Banks & credit institutions | 12 | 15 | 14 | 59 |

Source: ADB/DGLS Livestock Sector Survey, 1985

2. Strengths and weaknesses

a. Strengths:

6.267 Survey results showed surprisingly high responses for farmers receiving institutional support for livestock production from GOI entities. As mentioned several places in the report, however, the survey procedures introduced bias regarding the expected frequency of contact between government officials (the enumerates) and the sampled farmers.

6.268 Nevertheless, farmer responses indicated that strengthened institutional support services for livestock (recommended as a major project activity in Chapter IX) would have a good chance of filtering down to farmers. Table VI.17 also indicated that farmers placed high priority by GOI services currently provided by GOI and provincial governments (animal health, training, credit, extension services and market information).

6.269 The significant growth of many infrastructure facilities in rural areas, particularly on Java amnd Sumatra, is reflected several places in Appendix Tables 6.10 - 6.19. Many of these insfrastructure investments would help support investments in livestock and in the support services noted in Chapter IX.

b. Weaknesses:

6.270 The survey was not able to help us prioritize the types of support services needed. Respondents were forced to choose a level of importance within a category (e.g., better training) but not to set absolute priorities between categories as far as the most imporant constraint represented by the existing services available to producers.

Table VI.12: Percentage of households ranking level of institutional support "strong", by area

| Institutional support from: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 a/ |
|---|---|---|---|---|---|---|---|---|---|---|
| Family/community | 50 | 31 | 5 | 63 | 77 | 31 | 37 | 45 | 100 | 62 |
| Informal traders | 21 | 15 | - | 36 | 33 | 2 | 23 | 14 | 74 | 40 |
| Middlemen | 65 | - | - | 23 | - | 16 | 38 | - | 4 | - |
| Stock farmers | - | - | - | 25 | 22 | 15 | - | 2 | - | 40 |
| Research station, schools, univ | - | - | - | - | 22 | 7 | - | 8 | 27 | 40 |
| Vets/production institutes | 16 | 22 | 40 | 39 | 44 | 31 | 29 | 20 | 70 | 63 |
| Co-op/marketing institutions | 10 | - | 15 | 39 | 33 | 15 | 8 | 6 | 12 | 62 |
| Extension agents | 40 | 17 | - | 46 | 66 | 40 | 8 | 24 | 100 | 61 |
| Credit institution | 13 | - | 1 | 56 | 22 | 8 | 5 | 6 | 40 | 42 |

Source: ADB/DGLS (1985)
b/ Numbers correspond to areas as follows:
1 = N. Sumatra, 2 = S.Sumatra, 3 = W. Java, 4 = C. Java, 5 = E. Java, 6 = Nusa Tenggara, 7 = Kalimantan, 8 = Sulawesia, 9 = the Moluccas 10 = Irian Jaya

Table VI.13: Percentage of households ranking quality of institutional services

| Service | Quality of Services: Good | Fair | Bad | None |
|---|---|---|---|---|
| Farm to market roads | 29 | 35 | 27 | 9 |
| Electric supply | 12 | 10 | 2 | 75 |
| Piped water | 3 | 9 | 4 | 84 |
| Telephone service | - | - | 3 | 95 |

Source: ADB/DGLS 1985



2.94

Table IV.14: <u>Percentage of households estimating distance from institutional services</u>

| Institution | Distance | | |
|---|---|---|---|
| | Very Far | Far | Near |
| Nearest market town | 21 | 46 | 32 |
| Nearest school | 1 | 23 | 76 |
| Nearest veterinary officer | 23 | 37 | 41 |
| Ag office | 35 | 37 | 28 |
| Extension office | 30 | 34 | 36 |
| Nearest hospital | 12 | 40 | 48 |

Source: ADB/DGLS (1985)

Table VI.15: <u>Percentage of households "very far" from selected institutional services by area</u>

| Area [a] | Market Town | Vet Officer | Ag Office | Extension Office |
|---|---|---|---|---|
| North Sumatra | 13 | - | 13 | 20 |
| South Sumatra | 36 | 42 | 50 | 30 |
| West Java | 6 | 11 | 44 | 80 |
| Central Java | 13 | 11 | 13 | 25 |
| East Java | - | 22 | 34 | 22 |
| Nusa Tenggara | 7 | 20 | 30 | 20 |
| Kalimantan | 48 | 31 | 50 | 35 |
| Sulawesi | 15 | 46 | 48 | 40 |
| Moluccu | 25 | 4 | 75 | 27 |
Irian Jaya | 4 | - | 4 | 5 |

Source: ADB/DGLS (1985)

[a] Table II.18 identifies provinces included in each area

Table VI.16: Percentage of livestock farmers listing assistance needed to improve household welfare by livestock species

| Type of assistance: | Cattle | Buffalo | Goats | Sheep | Pig | Poultry |
|---|---|---|---|---|---|---|
| More species | 59.5 | 20.1 | 6.4 | 3.3 | 2.1 | 8.9 |
| Better breeds | 62.5 | 21.8 | 5.1 | 1.2 | 2.2 | 7.1 |

Source: ADB/DGLS (1985)

Table VI.17: Percentage of households ranking importance of institutional needs

| | Importance | | | | |
|---|---|---|---|---|---|
| Needs | Very | Moderate | Marginal | Not | Don't Care |
| Higher prices | 32 | 44 | 15 | 5 | 5 |
| Better animal health | 50 | 29 | 18 | - | 3 |
| Better marketing | 40 | 35 | 23 | 1 | 1 |
| More training | 30 | 40 | 22 | 7 | 1 |
| Credit facilities | 30 | 33 | 25 | 7 | 5 |
| More extension services | 40 | 60 | - | - | - |
| More feed | 14 | 59 | 3 | 4 | 20 |
| Better quality feed | 3 | 77 | - | - | 20 |
| More market info | 20 | 60 | - | - | 20 |
| Better roads | 25 | 50 | - | - | 25 |

Source: ADB/DGLS (1985)

6.271 Given the lack of enforcement of payment for delinquent loans by farmers, GOI credit schemes have come to be regarded as giveaway programs by many farmers. Therefore, any question of dealing with rural credit will always elicit a high response regarding its importance and desireability.

6.272 The responses on importance of feed quality and availability (Appendix Tables 37 and 38) is not entirely consistent with our analysis of feed resources (Chapter IV).

6.273 In more remote, less developed provinces, formal GOI institutional support is much less, according to the farmers' responses. This is clearly shown in table VI.12 for provinces in Kalimantan, the Moluccas, and South Sumatra and in the tables relating distances to services (tables VI.14 and VI.15).



247

# PART IV. FARMING SYSTEMS ANALYSIS

## Chapter VII. Description and Analysis of Selected Indonesian Farming Systems

### A. Approach

7.1 A farming system consists of or more major or dominant crops and various minor crops along with the activities of animal and household components. In Indonesia the dominant crops largely determine the feed source and, hence, become a major factor in selection and use of animals in the system. Nutrient flow through the system is critical in limited-resource agriculture and thus crop/animal relationships are pertinent to the efficiency of the system.

7.2 Certain climatological and physical factors have influenced the evolvement and development of some systems. Available water from rainfall and irrigation still determine the type of rice/secondary crop-based system. Elevation, temperature, and soil type play roles in the location of estate crops, e.g., coconut in the lowlands and on well-drained soils, and tea at the higher elevations. Temperature affects the location of dairy-type cattle and their performance at higher elevations. Furthermore, forages grown under somewhat cooler temperatures tend to be of higher quality. The calcareous soils of West Timor favored the naturalization of leucaena and this led to development of a beef-fattening system based on the feeding of this forage.

7.3 In Java, Bali, Lombok, parts of Sulawesi and Sumatra (transmigration areas) the higher fertility soils are devoted to intensive arable cropping on small-size farms. Pasture and forage production is not a priority, yet livestock comprise an integral part of farming systems. Extensive grazing is found on land systems less suited to arable crop production, primarily in Sulawesi. Mixed crop/livestock farming systems prevail among a vast number of smallholders in Indonesia, yet the limited area of extensive livestock systems contribute disproportionately to the supply of animals available for GOI distribution to farmers, both settled and transmigrants.

7.4 Ruminant animals are important in many small-farmer cropping systems for draft and manure, and could play a greater role in the whole farm production system for provision of meat, milk, and animal by-products. These animals provide a means whereby crop by-products and residues, as well as native vegetation in non-cultivated areas, can be converted into animal products. In most cropping areas, however, there are periods in which severe forage deficits exist. In much of Indonesia, the most critical period occurs during the latter part of the dry season and during the growth of the main rice crop before stubbles are available for grazing.



198

7.5 Descriptions and analyses of crop/livestock production and management systems are carried out not only to understand them but also to identify possible means of improvement. To understand livestock production systems, it is necessary to recognize their purposes, identify components and determine their boundaries, quantify inputs and outputs, examine relationships with cropping systems, determine linkages and interactions with off-farm enterprises, and estimate efficiencies of the systems.

7.6 In recent years, much interest has been generated and activities have evolved in research and development of crop systems for small farmers in developing countries. In Indonesia, this activity was initiated in 1969 with associated cropping schemes which incorporated intercropping, relay, and rotational crop considerations, all within the Central Research Institute for Food Crops of the AARD. On a worldwide basis, and in Indonesia, very few of the so-called farming systems (actually cropping systems) research and development programs included detailed studies of the animal component, an important element on most of the world's small farms. A livestock farming systems research program (actually livestock production and management systems) was established in 1981 within the Indonesian Research Institute for Animal Production (Balai Penelitian Ternak—BPT, Bogor) of the AARD. To date, activities directed toward crop and livestock production and management systems have only occasionally been coordinated.

7.7 In the present review of the Indonesian livestock sector an attempt was made to describe, analyze, and quantify some of the major crop/livestock production and management systems. It must be recognized that farming systems are location-specific and whole farm enterprises vary from farm to farm. Sufficient common factors exist among classes of farms, however, to formulate farming system models directed toward crop/animal interactions. A methodology for this has been developed with livestock production and management in mind (McDowell and Hildebrand, 1980; Camoens, et al., 1985). A standard format permits the characterization and description of selected farming system types. Using this technique of modeling, analyses of crop/livestock systems are made simple, adding meaning and depth to the perception of household, crop, livestock, inputs, outputs, and their interactions. An appreciation of the interaction effects within a type of system gives a better understanding of the rationale of a whole farm system and serves to explain why a single phase of technology, such as a new crop variety, may be rejected by small farmers. Furthermore, such an analysis minimizes the risk of developing a new and productive technology that might not be acceptable because it does not fit into the farming system for which it was intended.

7.8 The use of simple modeling diagrams, as presented here, represents a "bottom-up" approach which focuses on the description, analysis, and resolution of problems at the farm level. This has become known as the Farming Systems Research and Extension (FSR/E) approach. It contrasts with "top-down" models for macro-planning which look at characteristics of agricultural systems on a regional and national basis. The FSR/E approach is useful as a tool for planners in the design of support programs which help farmers meet production goals.

## B. Major Farming Systems in Indonesia

7.9 After visiting most of Java, the major outer islands, reviewing



295

the provincial livestock sector with local staff, and interviewing farmers, the study team compiled information to formulate composite-type crop/livestock (farming) systems. These are listed in appendix table 7.1 along with major crops and animals, regional locations and feed sources. Three general categories were identified, namely 1) food crop-based, 2) estate crop-based, and 3) livestock-(animal) based. For the most part, food-crop based systems comprise the most important farming systems with animals providing a supportive and complementary role. In terms of farmer income, however, dairy-based and poultry-based (commercial) systems in Java and near some of the urban centers of Bali, Sulawesi, Sumatra, and Kalimantan, and beef fattening-based systems in Java, Sulawesi and NTT are becoming important.

1. Food Crop-Based Systems

7.10 In the irrigated lowlands and partially irrigated uplands rice predominates and is intensively cultivated. With a year-round water supply, five crops can be harvested in two years, i.e., rice after rice. With less water, two crops of rice are followed by secondary crops such as corn, peanut, soybean, mung bean, sweet potato, and in some areas vegetables and tobacco. In these systems, the swamp buffalo is the major draft animal where soils are heavy and deep, with cattle predominating on the lighter and shallower soils. Tradition, however, determines to some extent the preference for cattle or buffalo so that small areas exist where one or the other is more commonly used.

7.11 It will be noted that chickens, small ruminants and swine have been listed as components of the livestock production systems. Chickens are commonly found around households where they scavenge for feed and may receive household waste products. They contribute to the family well-being and livelihood by providing eggs and meat for food and market. Small ruminants are not kept by all farmers and goats are more prevalent than sheep. They, too, are scavengers and are as important, or in some cases more so, for ceremonial functions than a source of family food supply. Swine are primarily kept by non-Muslim families, particularly in Bali and parts of Sumatra, Sulawesi, NTT, NTB, and Irian Jaya. An important function of both small ruminants and swine is the accumulation of capital savings. Only rarely are both species found on the same farm.

7.12 Under rainfed conditions of the lowlands, rice remains the predominant crop. In some regions, two crops are grown with the first crop being dry seeded and the second transplanted. In the uplands, especially drought-prone regions, corn emerges as the major crop. In these areas it is mixed with a number of other crops especially cassava, along with peanut, mung bean, pigeon pea, cowpea, dry bean, lima bean, pumpkin, chili peppers, upland rice and others. It should be noted, however, that not all farmers grow this full array of crops. Cattle are kept by some farmers under rainfed conditions, being used for draft purposes in the lowlands but less so in the uplands where soils are drier, more shallow and often cultivated by hand for the single crop season.

7.13 In farming systems of both irrigated and rainfed regions, livestock feed is derived from five main sources, namely, 1) crop residues and by-products, 2) grazing after crop harvests, 3) grazing native vegetation in non-cultivated areas, communal and public lands, 4) cut-and-



310

carry native vegetation and improved grasses (e.g. elephant and setaria) and legumes (primarily leucaena and sesbania), and 5) limited purchases of feedstuffs, primarily rice bran and other agro-industrial by-products. These are discussed in more detail in Chapter IV (The Feed Resource Base).

2. Estate Crop-Based Systems

7.14 Among the estate crops, a coconut-based system is the most important as related to the livestock component of the whole farm since grazing under coconut palms is a common practice. Rubber and palm oil were separated because legumes such as calopo, kudzu and centro provide ground cover under the trees and a feed source. Generally, grazing is not practiced because of concerns that animals may knock down the latex collection cups of rubber trees and damage the oil-bearing fruits of the palms. These losses, however, have not yet been quantified and/or measured against the potential revenue generated from various livestock species. Plantation owners often permit small holders to tether large and small ruminants under the trees and to cut-and-carry the legume herbage. Some of the other estate crops, such as cloves and cashew provide a feed source from native grasses and other vegetation growing among the trees.

3. Livestock-Based Systems

7.15 The livestock-based farming systems have been given attention by the DGLS in recent years. These systems are found on farms where animal products comprise a major source of cash flow. Recently, poultry raising (broilers) and egg production emerged as commercial enterprises and will continue to expand with emphasis being placed on nucleus estate development of smaller flocks (up to 5,000 birds). These systems and others, with the exception of swamp buffalo fattening, have been diagrammed as composite-type farming systems and explained in more detail in the following section. Buffalo fattening represents a localized enterprise, an example being an operation along the Barito River in South Kalimantan. In view of declining buffalo numbers in Indonesia (Chapter III), their slow growth rate and relatively low reproductive rate, less emphasis will be given to buffalo fattening in the future.

7.16 In the livestock-based systems most farmers also produce crops and a mixed garden for the family food supply. In some instances, products from these farm enterprises are sold, but a large portion of the cash flow comes from the livestock component of the farming system. As the livestock industry continues to expand a higher percentage of the family income will be derived from animals and their products.

C. Characteristics of Selected Composite-Type Systems

7.17 Budgets are presented at the end of each description of major types of farming systems. The objective of the budgets is to describe and quantify the role of the livestock in each of the systems. In order to estimate the net revenues of the crop enterprise and the livestock enterprise, a number of assumptions are made. First, it is assumed that approximately one half of the revenues from the crop enterprise is used to pay for cash inputs. The most important costs are labor (about one third of total costs) and harvesting (about one half of total costs). Land costs are about 5 percent of total costs, or 2.5 percent of gross revenues.

Secondly, uniform farmgate prices, based on 1984 averages for East Java, are used for all Indonesia (Rp/kg):

| | |
|---|---|
| unmilled rice: | 140 |
| maize: | 125 |
| cassava: | 50 |
| sweet potato: | 60 |
| groundnut: | 750 |
| soy bean: | 410 |
| mung bean: | 575 |
| cattle (liveweight): | 1,100 |
| buffalo (liveweight): | 1,000 |
| sheep/goat (liveweight): | 1,000 |
| swine (liveweight): | 800 |
| poultry (liveweight): | 900 |
| eggs (per piece): | 75 |
| milk (per liter): | 220 |
| land preparation with buffalo or cattle (per day): | 2,000 |

Budgets can be modified by inserting alternative prices or using different assumptions.

7.18 A substantial part of the gross revenue of the crop production is used by the household for home consumption and not sold to the market. The net returns to the family should therefore not be interpreted as cash income to the household.

7.19 A summary of the technical assumptions can be found in table VII.1. Additional budgets of some selected farms having been visited by the teams are listed in the appendix to this chapter (appendix 7A). These descriptions provide an insight to the diversity and complexity of individual Indonesian farming systems.

7.20 With the exception of the livestock-based farming systems such as ranching systems and commercial duck farms, nutritional budgets are calculated for each type of system. Crop residue feed supply is estimated in metabolizable energy (ME) and total protein (TP). Assumptions underlying the livestock nutrition budget are discussed in the section dealing with each of the major types of farming systems.

7.21 In the standard diagram used for system modeling the box identified as "market" represents most off-farm activities and resources. It includes products sold off the farm as well as purchased inputs and items for the household. The "household" box constitutes the core of the farm unit. In preparing the models, labor use, sources of human food and animal feed, household income and the roles of animals were highlighted.

7.22 For most products there is a direct relationship to market, but frequently, the farmer cooperative (KUD) is involved. In some models a dotted line is used when sales contributed less than 20% of the household income or when an activity was weak. Fuel is extremely important on small farms. Gathering wood often constitutes a significant expenditure of labor and may represent a source of income (not depicted in these systems).

7.23 The 14 models presented are, by no means, all-inclusive. Hundreds of models would be needed to characterize all small-farm systems. Furthermore, the diagrams do not represent a single farm but rather depict a general-type system compiled from single farm studies of many regions. Also it is known that many farm households in Indonesia derive a substantial part of their income from off-farm employment (selling their labor to the market). In order to simplify the analyses, this aspect of the Indonesian farming systems is not further quantified. Additional selected farming system profiles are given in appendix 7A.

Table VII.1. Yield assumptions for farming systems budgets

| Type of farming system: | Lowland rice-based irrigated | Partly irrigated upland | Rainfed upland | Shifting (swidden) | Mixed estate and food crops | Mixed with fattening | Amerasi farm | Small semi-commerical livestock farm |
|---|---|---|---|---|---|---|---|---|
| Crop [a] | | | | | | | | |
| Rice | 5.0 | 4.0 | 2.0 | 0.8 | 5.0 | 5.0 | 2.0 | 4.0 |
| Maize | 1.5 | 1.0 | 0.5 | 0.8 | 1.0 | 1.0 | 1.0 | |
| Peanuts | 1.0 | 1.0 | 0.35 | 0.3 | 0.8 | 0.4 | | 0.6 |
| Soybeans | 1.0 | 1.0 | | 0.3 | 0.8 | 0.4 | | 0.67 |
| Mungbeans | 0.6 | | | | | | 0.4 | |
| Sweet potato | 3.5 | | | 0.7 | | | | |
| Cassava | 10.0 | 8.0 | 5.0 | 2.0 | | 5.0 | | |
| Coconut | | | | | | | | |
| (trees/ha) | | | | | 65 | | | |
| (nuts/tree) | | | | | 60 | | | |
| Leucaena | | | | | | | | 11.0 |
| Livestock species | | | | | | | | |
| Buffalo (kg/hd) | 75 | | | | | | | |
| Cattle (kg/hd) | | 60 | | | 60 | 300 | 120 | |
| Draft (days) | 30 | 42 | | | 42 | | | |
| Small ruminants (kg/female) | 14 | 17.5 | | | | | | |
| Pigs (kg/sow) | | | 30.0 | | | | | 405.0 |
| Chickens | | | | | | | | |
| (eggs/hen) | | 25 | 25 | 20 | 25 | 20 | 20 | |
| (kg/hen) | | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | |
| Ducks | | | | | | | | |
| (eggs/hen) | 100 | | | | | | | |

[a] All figures for crops are tons per ha per harvest unless otherwise stated

1. Lowland rice system (Figure VII.1)

7.24 This system is characteristic of traditional small-farm operations where irrigation is available. Rice is the main crop and is well fertilized to assure high grain yields. Secondary crops are planted to utilize residual moisture and to provide a source of family food. These include maize, peanut, soybean, mung bean, sweet potato, cassava, cowpea, and dry bean. In some instances crop products may be sold for an income supplement, especially fruit and vegetables from the mixed garden. Rice is milled in the villages, thus, rice bran is available. Furthermore, rice straw is a major source of cattle and buffalo feed along with other crop residues. The animal component is comprised of cattle or buffalo, ducks, chickens and small ruminants or swine, but not all are found on single farms. The cattle or buffalo are kept to utilize crop residues, to produce manure, and to provide power for tillage. Manure is primarily used for the home garden but some may be sold or bartered locally. The large animals are usually confined and stall fed, but may be tethered or tended in non-cultivated areas. They graze after crop harvest, usually in groups and move from field to field regardless of land ownership. Older animals are sold for meat. The ducks feed on grains lost during harvest and on insects and weeds in rice paddies and around irrigation canals. The eggs and meat from chickens and ducks are consumed within the household or sold on the local market.

7.25 The economic budget (table VII.2) shows the annual return to the family's labor. It is obvious that the same system without ducks and livestock would also constitute an important source of agricultural income, second after rice.

7.26 The intensity of land use is higher on small farms in the lowland rice system than any of the others described in this report. Still, a shortage of feed restricts animal output, even though water may be available for two or more crops of rice. This situation could be improved to some extent by sowing a forage legume after rice to increase the quantity and quality for available feed. It would not completely correct the deficit which occurs during growth of the first rice crop. Feed storage would alleviate the situation but in this system this practice might not be economically favorable.

7.27 The lowland, rice-based system involves the intensive cropping of rice, maize, cassava, peanuts, soybeans and sweet potatoes, all of which provide residues for the feeding of ruminants. An estimated 4.12 tons of DM provide 7,348 Mcal of ME and 247 kg of total protein, assuming the residue yields as shown in table VII.3.

7.28 Two head of mature female buffaloes, each weighing an average of 400 kg over the year, are maintained to provide draft to the cropping system. Assuming a calving interval of 24 months, the buffaloes have the following yearly work/production schedules (days per year) which determine their nutritional requirements for ME and TP:

20 days working 4 hours per day
10 days working 8 hours per day
45 days late gestation (BW increases to 450 kg)
50 days lactation at 4 kg of 7.0% milk per day
240 days maintenance only

The "late gestation" period (when the demand of the growing fetus creates additional nutritional requirements above maintenance) is 90 days, or an average of 45 days per year. The buffalo is assumed to produce an average daily milk yield of 7 kg for the nursing calf over a period of 100 days, or 50 days average per year of calving interval. The calf actually nurses longer but the low level of milk production necessary beyond the 100 days does not create a significant level of nutritional demand. The daily nutritional requirements for the buffalo are shown in table VII.4.

7.29 The feed resources available to feed the buffaloes include weeds and native grasses consumed during grazing of fallow paddy, paddy bunds and roadsides, rice straw, and other crop residues available on a seasonal basis. Rice bran produced is assumed to be left with the miller in payment for milling or is used to feed the small flock of 30 ducks and is therefore not available as feed for the buffaloes. Rice straw is available in greater quantities than the buffalo can consume and is therefore considered to be an "unlimited" resource. The buffaloes graze for an average 2 hours per day and are able to consume dry matter in the form of weeds and native grasses at the rate of 1.0% of their bodyweight, or 4 kg. They are stall-fed at night on rice straw and other crop residues (dry matter consumed equal to 1.0% of bodyweight, or 4 kg).

7.30 The amount of ME and TP provided by crop residues is shown in table (lowland, rice-based). A total of 4,129 kg of DM are produced from cropping activities. Rice straw represents 81.7% of the total available residue DM and is considered in the feed budget as an "unlimited" resource as more is produced than the buffaloes are capable of consuming. "Non-rice crop" residues total 357.4 kg of DM annually, or an average of only 0.98 kg per day available to the two buffaloes. The 0.98 kg of non-rice crop residues are assumed to contain 2.19 Mcal ME and 0.11 kg of TP. The nutritional requirements for one 400 kg buffalo cow at different physiological states and her intake of DM, ME and TP from weeds and native grass, rice straw and non-rice crop residues is presented in table VII.4. Dry matter grazed is assumed to have a ME and TP content of 1.50 Mcal per kg and 9.0%, respectively. Intake of weeds and native grasses from grazing and rice straw from stall feeding are each assumed to be 1.0% of bodyweight, or 4 kg per day (4.5 kg during late pregnancy when bodyweight rises to 450 kg). Each buffalo is assumed to consume 50% of available non-rice crop residue DM, or 0.47 kg daily. Crop residues, including rice straw, account for an average 42.6% of DM intake, 45.9% of ME, and 25.2% of TP with DM consumed from grazing accounting for the remainder of nutrient intake.

7.31 Average daily intake of ME and TP, outside of the late gestation period, is estimated at 16.62 Mcal and 775 g, respectively. Intake of ME and TP are estimated to be deficient only during the 10 days of heavy work (8 hours per day) and during 50 days of lactation. Because of seasonal differences in availability and nutrient content of forage and crop residue DM the actual daily nutritional balance for the buffalo will fluctuate widely across the year unless some method of forage preservation, such as ensiling, is practiced. Some adjustment is made by the buffalo by increasing or decreasing the intake of DM from rice straw and grazing. Such adjustments are probably not sufficient to prevent loss of weight when ME and TP availability from weeds and native grass and non-rice crop residues is below nutritional requirements. Some bodyweight is recovered during the periods when availability of ME and TP exceeds nutritional requirements, especially during the estimated 240 days when the buffalo is not working hard or lactating. Adjustments in the production cycle of the buffalo, such as controlled breeding to have calving occur at the time of the year when available DM from crop residues is abundant, would reduce the fluctations in the nutritional balance. The seasonal loss and recovery of weight is a contributing factor to the long calving intervals of buffaloes (and cattle) on Indonesian smallholdings.

7.32 The cropping system provides the major proportion of the diet for the duck flock as well as for the buffaloes. As mentioned above, the rice bran produced from the milling process may be used for the duck flock, especially if young ducklings are purchased instead of mature replacement hens. Foraging on paddy post-harvest and during fallow periods provides weeds, snails and insects for the duck flock. Some feed such as sago palm pith, small fish and rice bran may be purchased off-farm. The duck flock is usually managed by the wife and younger children of the smallholder.

Figure VII.1. Lowlands, rice-based farming system

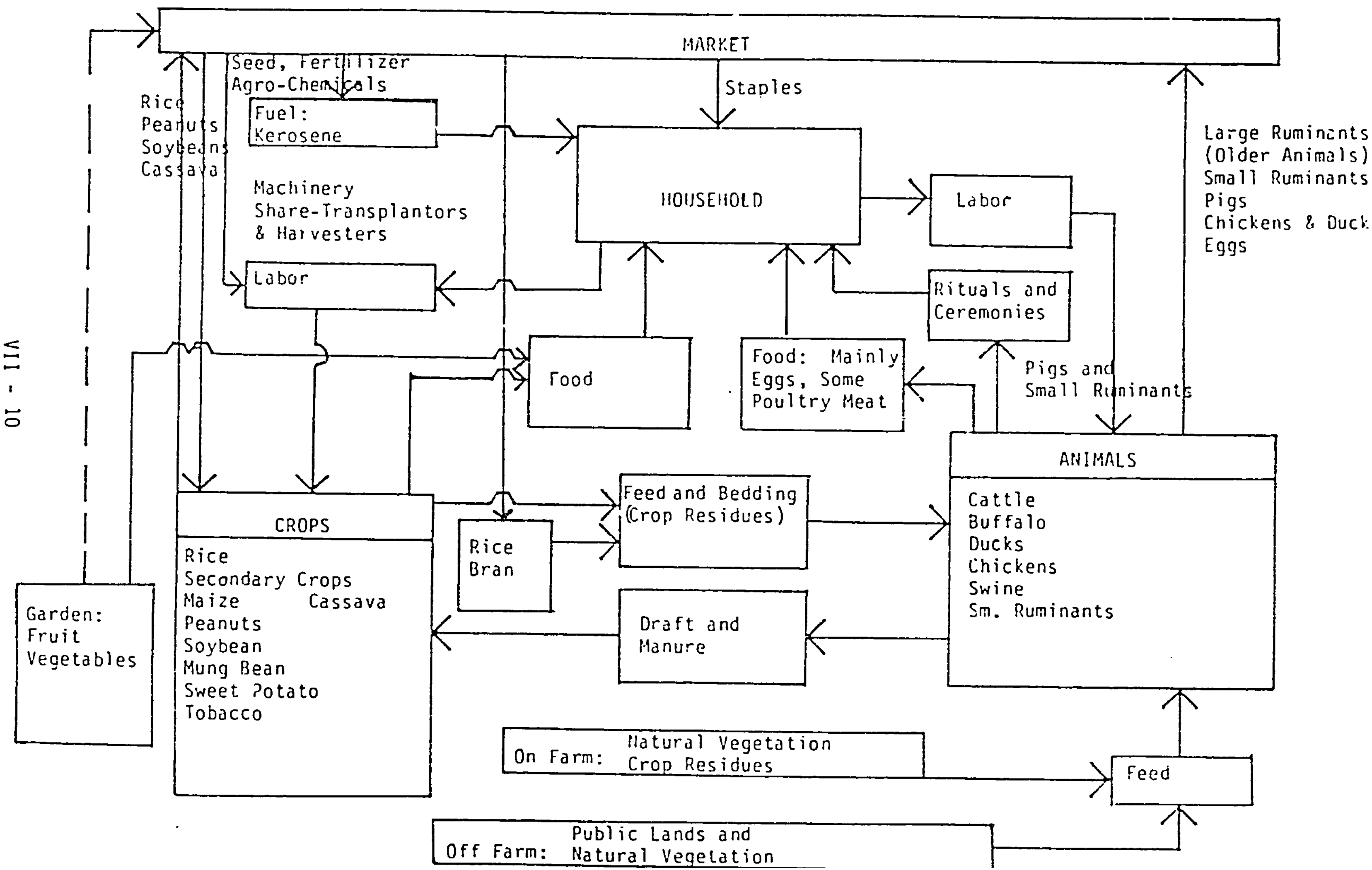


Table VII.2. Annual budget for lowland rice-based farming system

Farm size: 0.4 ha irrigated land
0.1 ha mixed garden
2 head of buffalo (females)
30 ducks

Cropping pattern: Rice-rice-palawija (secondary crops)

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 4,000 | 560,000 |
| maize | 240 | 30,000 |
| cassava | 600 | 30,000 |
| peanuts | 60 | 45,000 |
| soybeans | 60 | 24,600 |
| mungbeans | 24 | 13,800 |
| sweet potato | 70 | 4,200 |
| mixed garden | | 100,000 |
| subtotal, crops | | 807,600 |
| Livestock: | | |
| meat | 150 | 150,000 |
| draft 30 days | | 60,000 |
| eggs 3,000 | | 225,000 |
| subtotal, livestock | | 435,000 |

Annual expenses

| | | |
|---|---|---|
| Crops: | 403,800 | |
| Livestock inputs: | 0 | |
| Annual net return to family labor from crops: | | 403,800 ( 48%) |
| Annual net return to family laobr from livestock: | | 435,000 ( 52%) |
| Annual total return to family labor from agriculture: | | 838,800 |

Table VII.3. Metabolizable energy (ME) and total protein (TP) provided by crop residues for lowland, rice-based farming system

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 4000 | Rice straw | 84.30 | 3,372.00 | 1.63 | 45 | 5,496.36 | 151.74 |
| | | Rice bran | 10.00 | 400.00 | 2.63 | 135 | 1,052.00 | 54.00 |
| Maize | 240 | Stover | 59.60 | 143.04 | 1.77 | 57 | 253.18 | 8.15 |
| | | Husks | 10.00 | 24.00 | 2.62 | 81 | 62.88 | 1.94 |
| Cassava | 600 | Tops | 2.50 | 15.00 | 2.20 | 249 | 33.00 | 3.74 |
| Peanuts | 60 | Vines | 94.80 | 56.88 | 2.42 | 150 | 137.65 | 8.53 |
| Soybeans | 60 | Vines | 185.50 | 111.30 | 2.65 | 159 | 294.95 | 17.70 |
| Sweet potato | 70 | Vines | 10.20 | 7.14 | 2.48 | 157 | 17.71 | 1.12 |
| | Total | | | 4,129.36 | | | 7,347.72 | 246.92 |
| | Total, non-rice residues | | | 357.36 | | | 799.36 | 41.18 |
| | Total, non-rice residues per day | | | .98 | | | 2.19 | .11 |

[a] Percentage of residues as per appendix table 4.5 from DBPP/FPUGM (1983)

Table VII.4. Nutritional requirements and intake from grazing and crop residues for 400 kg buffalo cow in a lowland cropping system

| Physiological status | Daily requirements b/ | | Intake of DM a/: Weeds and native grasses from grazing | | | Rice straw | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as a % of total | | | Surplus (deficit) over (from) requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | -------- (%) | -------- | | (Mcal) | (g) |
| 20 days maintenance plus 4 hrs daily work | 15.50 | 577 | 6.0 | 9.00 | 540 | 4.0 | 6.52 | 180 | .00 | .00 | .00 | 0.47 | 1.10 | 55 | 10.47 | 16.62 | 775 | 42.7 | 45.8 | 25.2 | 1.12 | 198 |
| 10 days maintenance plus 8 hrs daily work | 18.90 | 715 | 6.0 | 9.00 | 540 | 4.0 | 6.52 | 180 | .00 | .00 | .00 | 0.47 | 1.10 | 55 | 10.47 | 16.62 | 775 | 42.7 | 45.8 | 25.2 | (2.28) | 60 |
| 45 days maintenance plus late gestation (450 kg bodyweight) | 16.20 | 720 | 6.75 | 10.13 | 603 | 4.5 | 7.34 | 202 | .00 | .00 | .00 | 0.47 | 1.10 | 5 | 11.72 | 18.56 | 865 | 42.4 | 45.4 | 25.1 | 2.36 | 145 |
| 50 days maintenance plus lactation at 4 kg 7.0% milk | 18.00 | 906 | 6.0 | 9.00 | 540 | 4.0 | 6.52 | 180 | .00 | .00 | .00 | 0.47 | 1.10 | 55 | 10.47 | 16.62 | 775 | 42.7 | 45.8 | 25.2 | (1.38) | (133) |
| 240 days maintenance only (includes early gestation) | 11.20 | 469 | 6.0 | 9.00 | 540 | 4.0 | 6.52 | 180 | .00 | .00 | .00 | 0.47 | 1.10 | 55 | 10.47 | 15.62 | 775 | 42.69 | 45.8 | 25.2 | 5.42 | 306 |

a/ Assumptions:

- Intake from grazing of roadsides, fallow paddy and in communal areas assumed at 1.0% of bodyweight (400 kg) per day. Nutrient content of the consumed dry matter: ME = 1.50 Mcal per kg DM, TP = 9% of DM
- Intake of rice straw assumed to be 1.0% of bodyweight. Nutrient content of rice straw as per appendix tables 4A.1 and 4A.2.
- Available ME and TP per head (2 head adult cows) from non-rice crop residues as per table VII.3.

b/ Source: Appendix table 4A.7.

## 2. Partially Irrigated Upland (Figure VII.2)

7.33 This is a mixed rice-secondary crops system in which rice is the main crop. Two crops of rice may be grown, the first being dry-seeded and the second transplanted. It is likely that maize will be intercropped with other food crops, especially cassava. Off-farm sale from the mixed garden generally is replaced by products from secondary food crops. Cattle rather than buffalo provide the source of draft and manure. Not all farmers own cattle and depend on neighbors for draft service, either on a cash basis or by exchange labor agreement. Providing the animal feed supply is more difficult than in the lowland because of less available water and less fertile soils. Thus, the farmer is dependent on cut-and-carry from a further distance which requires more of his and the family time. In addition, the family is usually dependent on off-farm collection of wood for fuel rather than purchase of kerosene.

7.34 Although not modeled, one other crop/livestock system holds importance in the irrigated areas, namely, intensified vegetable growing. Farmers may not keep cattle but will purchase or barter for manure to provide plant nutrients for the vegetable crop.

7.35 In the upland rice-based system both cattle and goats are maintained. Two mature cows are used both for draft and the production of calves for sale. Four female and one male goat are confinement-fed on cut-and-carry grass and weeds, crop residues and rice straw. They produce kids for sale after weaning.

7.36 Table VII.5 indicates that the partly irrigated system, if sufficiently large in size, is a well-balanced system with various income sources. In such a system, risk of crop failure is spread over various enterprises.

7.37 The cropping system is estimated to produce an average of 2.48 kg of DM, 6.23 Mcal of ME and 0.32 kg of TP daily of non-rice crop residues (table VII.6). As with the irrigated lowland system, rice straw is assumed to be available in unlimited quantities relative to the capacity of the cattle and goats to consume it.

7.38 It is assumed that the cattle each work 42 days per year and 4 hours per day. Their forage source is grazing (4 hours per day) of fallow paddy and communal areas, crop residues and rice straw. Of available crop residue dry matter, the cattle consume 75% while the goats are fed the remaining 25%. The cattle are fed all of the available rice bran. Grazing provides an intake of dry matter equivalent to 1.0% of their 400 kg bodyweight, or 4 kg of DM per day. The ME and TP content of the DM consumed from grazing is the same as for the irrigated lowland system, i.e., 1.50 Mcal and 9%, respectively. Rice straw is consumed by the cattle at the rate of 0.25% of bodyweight, or 1.0 kg DM per head per day.

7.39 A calving interval of 24 months is assumed. On a yearly basis, each cow's days are divided as follows:

42 days of working 4 hours per day
45 days of late pregnancy which increase nutritional requirements above those for maintenance

75 days of lactation with an average production of 3 kg of 3.0% fat milk.

203 days of maintenance only (including 90 days of early pregnancy which does not create additional nutrient demands) with no work

Each year, one calf is marketed with a liveweight of 120 kg at 7 months of age.

7.40 The goats are fed in confinement on cut-and-carry weeds and native grass, rice straw and non-rice crop by-products. Cut-and-carry forage and rice straw are consumed at the rate of 2.0 and 1.0%, respectively. The goats receive 25% of the non-rice crop by-products.

7.41 Crop residues, including rice straw and rice bran, account for only 44.2% of the DM intake of the cows in the upland rice-based farming system, but 61.0% and 53.0% of the ME and TP intake, respectively. These are higher levels than were estimated for the buffaloes in the lowland, irrigated cropping system. Aside from the assumed use of rice bran for the feeding of the cows, the upland cropping system provides more residues of a higher quality compared to the irrigated lowland system due to the inclusion of more corn and cassava in the crop mix.

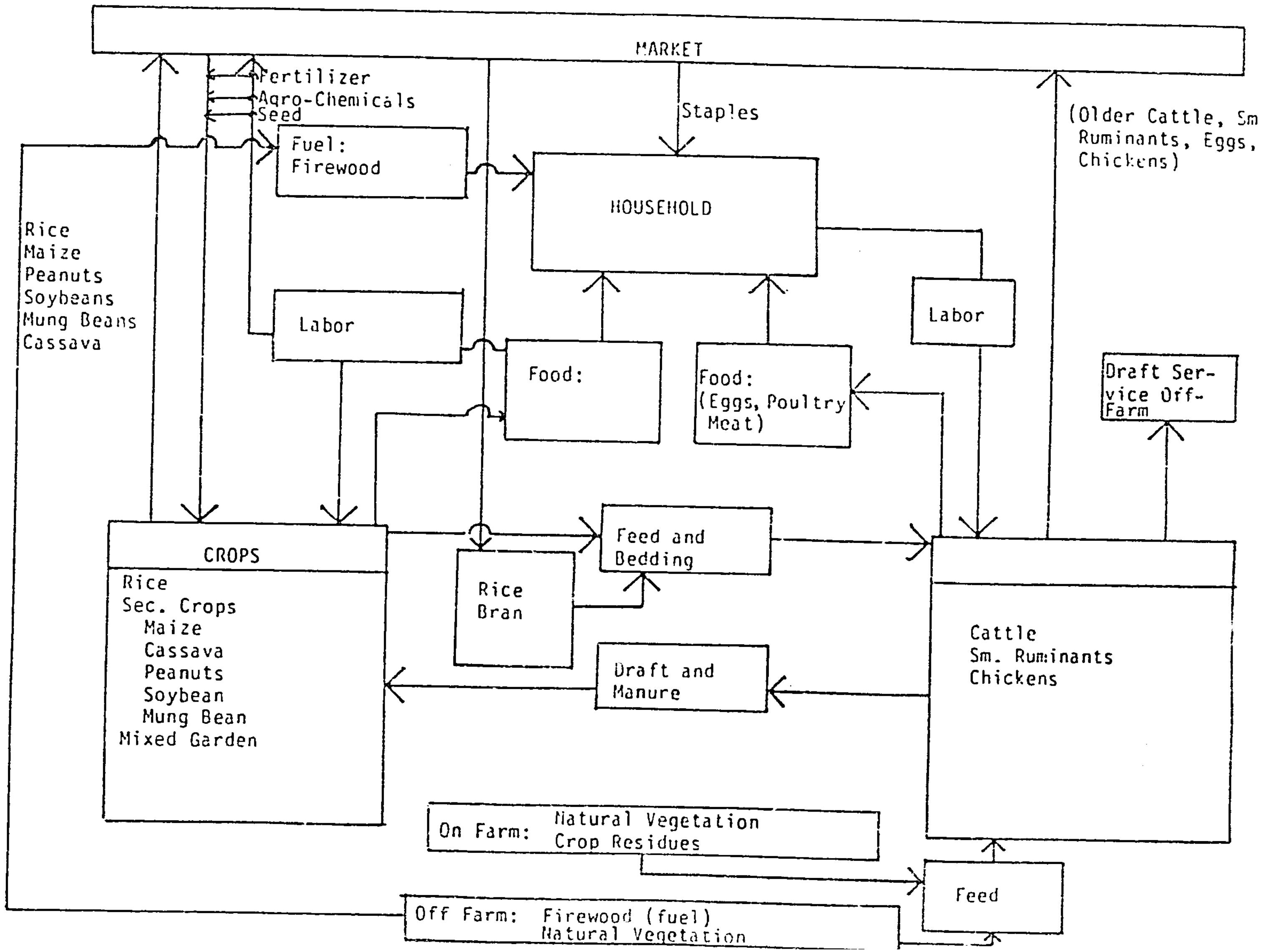
7.42 With the supplemental feeding of available rice bran, the cows are in nutritional balance for the majority of the year (table VII.7). Only during late gestation and the lactation period of 90 days are they in deficit for ME and probably lose weight. Any weight loss would be more than compensated for during the 203 days they are not working or lactating, when an estimated 3.47 Mcal of ME and 391 g of TP are in surplus each day.

7.43 Crop residues account for a greater proportion of the intake of DM by the goats (47.8 to 50.0%), but a smaller proportion of their intake of ME and TP compared to the cows. This is due to the assumption that the goats do not receive any rice bran and only 25% of the non-rice crop by-products. The goats must depend on consumption of cut-and-carry forage for the majority of their TP. This indicates that selection of cut-and-carry forage is an important factor in productivity for confinement-fed goats. The nutritional balance sheet in table VII.7 indicates that if the assumptions on intake and forage quality are correct, the does would be deficit in ME and TP for 150 days out of the year. The surplus of ME and TP available for the remaining 215 days probably would not be enough to allow the goats to recover bodyweight lost during late gestation and lactation. Most likely, while the cut-and-carry forage presented to the goats is of an <u>average</u> content of 1.50 Mcal ME and 9.0% TP, their ability to select higher quality plants and plant parts from among the forage mass allows them to consume a higher level of nutrients than is assumed. For this reason, estimating the contribution of different forage sources to the diet of goat requires careful consideration of what is actually consumed by the animal.



312

Figure VII.2. Partially irrigated, upland farming system






313

Table VII.5. Annual budget for partially irrigated, upland rice-based farming system

Farm size: 0.25 ha irrigated paddy
0.60 ha upland (dry) paddy
0.15 ha mixed garden
2 head cattle (females)
10 chickens (hens plus 2 roosters)
4 goats (females plus 1 male)

Cropping pattern: Rice-rice-palawija (irrigated)
Palawija (upland)

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| **Crops:** | | |
| rice | 2,000 | 280,000 |
| maize | 360 | 45,000 |
| cassava | 960 | 48,000 |
| peanuts | 221 | 156,750 |
| soybean | 125 | 51,250 |
| mixed garden | | 150,000 |
| subtotal, crops | | 740,000 |
| **Livestock:** | | |
| meat (cattle) | 120 | 132,000 |
| meat (chickens) | 30 | 27,000 |
| meat (goats) | 57 | 57,000 |
| draft | 42 days | 84,000 |
| eggs | 200 | 15,000 |
| subtotal, livestock | | 315,000 |

Annual expenses:

| | | |
|---|---|---|
| Crops: | 370,000 | |
| Livestock: | 0 | |
| Annual net returns to family labor from crops: | | 370,000 ( 54%) |
| Annual net returns to family labor from livestock: | | 315,000 ( 46%) |
| Annual total returns to family labor from agriculture: | | 685,000 |

Table VII.6. Annual crop residue budget for partially irrigated, upland rice-based farming system

| Crop | Yield | Residue | Residue as % of yield a/ | Residue available | Degree of utilization by swine | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | | Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 2000 | Rice straw | 148.80 | 2,976.00 | Neglible | 1.63 | 450 | 4,850.88 | 133.92 |
| | | Rice bran | 10.00 | 200.00 | High | 2.63 | 1351 | 526.00 | 27.00 |
| Maize | 360 | Stover | 32.90 | 118.44 | Neglible | 1.77 | 573 | 209.64 | 6.75 |
| | | Husks | 10.00 | 36.00 | Low | 2.62 | 814 | 94.32 | 2.92 |
| Cassava | 960 | Tops | 6.80 | 65.28 | Medium | 2.20 | 2496 | 143.62 | 16.25 |
| | | Peelings | 13.20 | 126.72 | High | 3.36 | 497 | 425.78 | 6.21 |
| Peanuts | 221 | Vines | 147.20 | 325.31 | Medium | 2.42 | 1509 | 787.26 | 48.80 |
| Soybeans | 125 | Vines | 185.50 | 231.88 | Low | 2.65 | 1591 | 614.47 | 36.87 |
| Sweet potato | 0 | Vines | 5.30 | .00 | Medium | 2.48 | 1574 | .00 | .00 |
| Mung beans | 0 | Vines | 25.00 | .00 | Medium | 2.34 | 1207 | .00 | .00 |
| | | Total | | 4,079.63 | | | | 7,651.96 | 278.72 |
| | | Total, non-rice residue | | 903.63 | | | | 2,275.08 | 117.80 |
| | | Total, non-rice residue per day | | 2.48 | | | | 6.23 | .32 |

a/ Source: Appendix table 4.5



35

Table VII.7. Nutritional requirements and intake from available forage and crop residues for Zebu x native cows and native goats confinement-fed in an upland rice-based farming system

| Physiological status | Daily requirements[a/] | | Intake of DM from: Weeds and native native grasses | | | Rice straw | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as a % of total | | | Surplus (deficit) over (from) requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | ------ (%) --------- | | | (Mcal) | (g) |
| 400 kg Zebu x native cows: [b/] | | | | | | | | | | | | | | | | | | | | | | |
| 42 days maintenance plus 4 hrs daily work | 14.40 | 573 | 4.0 | 6.00 | 360 | 2.0 | 3.26 | 90 | 0.55 | 1.44 | 74 | 0.62 | 4.67 | 240 | 7.17 | 15.37 | 764 | 44.2 | 61.0 | 52.9 | 0.97 | 191 |
| 30 days maintenance plus late gestation (450 kg bodyweight) | 16.90 | 763 | 4.5 | 6.75 | 360 | 2.25 | 3.26 | 101 | 0.27 | .72 | 37 | 0.62 | 4.67 | 240 | 7.92 | 16.52 | 820 | 43.2 | 59.2 | 50.6 | (0.38) | 57 |
| 90 days maintenance plus lactation at 5 kg 3.5% milk | 17.70 | 783 | 4.0 | 6.00 | 360 | 2.0 | 3.26 | 90 | 0.27 | .72 | 37 | 0.62 | 4.67 | 240 | 7.17 | 15.37 | 764 | 44.2 | 61.0 | 52.9 | (2.33) | (19) |
| 203 days maintenance only | 11.90 | 373 | 4.0 | 6.00 | 360 | 2.0 | 3.26 | 90 | 0.27 | .72 | 37 | 0.62 | 4.67 | 240 | 7.17 | 15.37 | 764 | 44.2 | 61.0 | 52.9 | 3.47 | 390 |
| Goats (4 does, 1 buck):[c/] | | | | | | | | | | | | | | | | | | | | | | |
| 60 days maintenance plus late gestation (30 kg bodyweight) | 2.05 | 144 | 0.6 | .90 | 54 | 0.30 | 0.49 | 14 | 0.0 | 0.0 | 0 | 0.25 | 0.31 | 16 | 1.15 | 1.70 | 84 | 47.8 | 47.0 | 35.3 | (0.38) | (60) |
| 90 days maintenance plus lactation at 1.5 kg 4.0% milk | 3.50 | 170 | 0.5 | .75 | 45 | 0.25 | 0.41 | 11 | 0.0 | 0.0 | 0 | 0.25 | 0.31 | 16 | 1.00 | 1.47 | 72 | 50.0 | 49.0 | 37.7 | (2.03) | (97) |
| 215 days maintenance only | 1.41 | 54 | 0.5 | .75 | 45 | 0.25 | 0.41 | 11 | 0.0 | 0.0 | 0 | 0.25 | 0.31 | 16 | 1.00 | 1.47 | 72 | 50.0 | 49.0 | 37.7 | .06 | 18 |

a/ Source: Appendix tables 4A.5 and 4A.10

b/ Assumptions (cows):
- Calving interval of 13 months assumed for cows
- Intake from grazing under coconut trees and in communal areas assumed at 1.0% of bodyweight (4 kg) per day. Nutrient content of the consumed dry matter: ME = 1.50 Mcal per kg DM, TP = 9% of DM
- nutrient content of rice straw as per appendix tables 4A.1 and 4A.2
- Intake of rice straw assumed to be 1.0% of bodyweight.
- Cows receive 75% of available crop residue DM and all of the rice bran, goats the remaining 25%
- Available ME and TP per head (2 head adult cows) from non-rice crop residues as per table VII.5.

c/ Assumptions (goats):
- Kidding interval of 12 months. Litter size of 1.2 weaned and sold at 7 months weighing 12 kg
- Daily intake of DM from cut-and-carry forage at 2.0% of bodyweight
- Intake of rice straw at 1.0% of bodyweight



316

### 3. Rainfed uplands (Figure VII.3)

7.44 The system presented describes a mixed cropping pattern in which maize is the main crop. Water is often a limiting factor in crop and feed production so that maize will be intercropped with other food crops, including dry-seeded rice and vegetables. Residues of most crops are used for feed. In some regions, the lower leaves of maize will be stripped before maturity and fed to cattle. Little commercial fertilizer is used by the farmer so that manure becomes an important source of nutrient supply for crops. In this system, spices, particularly cloves, and fruit trees (e.g. citrus), often provide a supplemental source of income. Even though not depicted, a number of farmers keep cattle as well as small ruminants. The lack of animal feed, however, is more severe than in the partially irrigated upland so that farmers must spend considerable time in search of cut-and-carry feedstuff, up to 6 hours or more in the dry season. There may be an area(s) for communal grazing, but with unrestricted animal numbers little herbage is available because of overgrazing the low producing grasses and vegetation. Generally, the communal ownership associated with free access for all village livestock prevents any strategy for improvement of these pastures.

7.45 The term upland should be broadly interpreted to include drylands at the lower elevations under rainfed conditions. Here, relatively abundant moisture is available because of a slow build up of water supply, either as underground or storage water. This allows rice cultivation to be feasible. Cattle are also more prevalent than in the higher, more drought prone areas. The increased production of crops and their residues alleviates to some extent the feed supply deficit during the dry season but the farmer is still highly dependent on cut-and-carry from public lands as well as grazing in non-cultivated areas.

7.46 It should be noted that a number of the more progressive farmers in mixed cropping systems have planted improved grasses (such as elephant and setaria), as well as legumes (mostly leucaena and sesbania), along paths and roadways, field boundaries and terraces. Although not fertilized, they persist and provide supplementary feed, often during stress periods. Two other species, gliricidia and calliandra, provide forage during the dry season. In addition, a number of other fodder trees such as acacia and mimosa, especially in the drier parts of the outer islands, are valuable sources of feed supply.

7.47 The profitability of rainfed upland systems (table VII.8) depends to a large degree on the establishment of tree crops (mixed garden) by the farmer. These can be fruit trees or a combination of fruit trees and plantation crops such as coffee, tea, cloves or coconut.

7.48 In the upland, rice-based farming system, the smallholder raises a small flock of sheep in confinement. Five ewes and 1 ram are fed on cut-and-carry forage (weeds, grasses, tree leaves, etc.), rice straw and available crop residues. Adult ewe bodyweight is assumed to be 25 kg (30 kg in late gestation). Reproduction rate (lambing rate, or lambs born per ewe per year) is assumed at 1.50 and weaning rate 1.35. Only one parturition per year per ewe is assumed. Total lamb marketed per year from the sheep component is 88 kg resulting from the sale of an average 6.75 lambs weighing 13 kg at marketing (table VII.8).

7.49 For the purposes of determining nutritional requirements, the year is divided into 4 separate periods:

- 193 days maintenance (including 90 days early gestation)
- 60 days late gestation (30 kg bodyweight to reflect increased weight of fetus and placenta)
- 56 days early lactation
- 56 days late lactation

7.50 The ewes (and ram) consume forage dry matter from cut-and-carry at the rate of 3.0% of bodyweight per day (0.75 kg). The nutritional content of the forage is assumed to be 1.75 Mcal ME per kg DM and 10% TP, slightly higher in quality than for the previous two farming systems due to inclusion of more tree leaves and native legumes.

7.51 Rice straw dry matter is consumed by the ewes at the rate of 0.50% of bodyweight. Nutritional content of rice straw is assumed at 1.63 Mcal ME per kg DM and 4.5% TP as per appendix tables 4A.1 and 4A.2.

7.52 Relative to the lowland system, the upland cropping system provides little forage in the form of non-rice crop residues (table VII.9). Total protein available from crop residues, on a per head per day basis, is neglible. Metabolizeble energy is only 0.24 Mcal per day. All crop residues combined, including rice straw and bran, account for only 24.3% of estimated total ME intake and 8.4% of estimated TP intake (table VII.10).

7.53 Given the assumptions on intake of DM from the various forage sources, the sheep are estimated to be in serious energy and protein deficiency for a majority of the year. If this situation is real, the sheep would be losing bodyweight to support gestation and lactation for 172 days out of the year. Some bodyweight loss is expected in early lactation as intake lags behind nutritional requirements. However, bodyweight loss in late gestation would probably lead to pregnancy ketosis, death or abortion. More likely, the nutritional requirements for the Javanese sheep are somewhat lower than those stated in table VII.10 as the estimates are based on a compilation of .eports of research on sheep nutrition under widely varying conditions (appendix table 4A.9). It is also likely that the actual intake of ME and TP from cut-and-carry forage and crop residues is higher than what is estimated in table VII.10.

Figure VII.3. Upland, rainfed, mixed cropping farming system

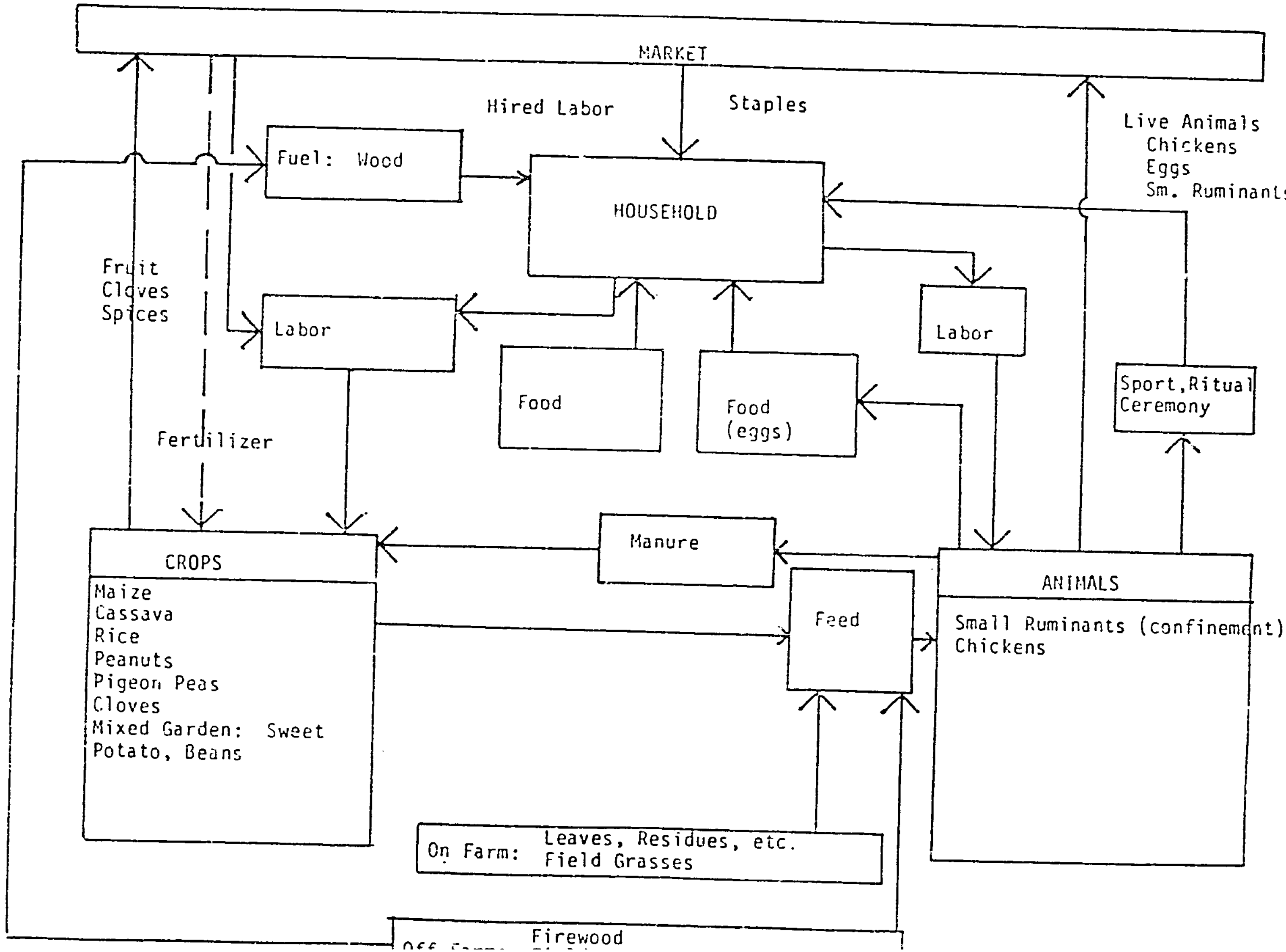


Table VII.8. Annual budget for rainfed, upland rice-based farming system

Farm size: 1.0 ha upland (dry)
0.5 ha mixed garden
5 ewes (plus 1 ram)
5 hens (plus 1 rooster)

Cropping pattern: Mixed

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 200 | 28,000 |
| maize | 300 | 37,500 |
| cassava | 1,000 | 50,000 |
| peanuts | 35 | 26,250 |
| mixe'l garden | | 500,000 |
| subtotal, crops | | 641,750 |
| Livestock: | | |
| meat (sheep) | 88 | 88,000 |
| meat (poultry) | 15 | 13,500 |
| eggs | 100 | 7,500 |
| subtotal, livestock | | 109,000 |

Annual expenses:

| | |
|---|---|
| Crops: | 320,875 |
| Livestock: | 0 |

| | |
|---|---|
| Annual net return to family labor from crops: | 320,875 ( 75%) |
| Annual net return to family labor from livestock: | 109,000 ( 25%) |
| Annual total return to family labor from agriculture: | 429,875 |

Table VII.9. Annual crop residue budget for rainfed, upland rice-based farming system

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of DM: ME | Content of DM: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 200 | Rice straw | 148.30 | 296.60 | 1.63 | 45 | 483.46 | 13.35 |
| | | Rice bran | 10.00 | 20.00 | 2.63 | 135 | 52.60 | 2.70 |
| Maize | 300 | Stover | 32.90 | 98.70 | 1.77 | 57 | 174.70 | 5.63 |
| | | Husks | 10.00 | 30.00 | 2.62 | 81 | 78.60 | 2.43 |
| Cassava | 1000 | Tops | 6.80 | 68.00 | 2.20 | 249 | 149.60 | 16.93 |
| Peanuts | 35 | Vines | 147.20 | 51.52 | 2.42 | 150 | 124.68 | 7.73 |
| Soybeans | 0 | Vines | 185.50 | .00 | 2.65 | 159 | .00 | .00 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| | Total | | | 564.82 | | | 1,063.64 | 48.76 |
| | Total, non-rice residues | | | 248.22 | | | 527.58 | 32.72 |
| | Total, non-rice residues per day | | | .68 | | | 1.45 | .09 |

a/ Source: Table 4.5



321

Table VII.10. Nutritional requirements and intake from forage and crop residues for native sheep confinement-fed in a rainfed, upland rice-based farming system

| Physiological status | Daily requirements b/ | | Intake of DM from a/: Cut and carry weeds and native grass | | | Rice straw | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as as % of total | | | Surplus (deficit) over (from) requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (g) | (Mcal) | (g) | (g) | (Mcal) | (g) | (g) | (Mcal) | (g) | (g) | (Mcal) | (g) | (g) | (Mcal) | (g) | --------- (%) | ------- | | (Mcal) | (g) |
| 193 days maintenance (including 90 days early gestation) | 1.04 | 53 | 750 | 1.31 | 75 | 125 | .20 | 5.63 | 9.00 | .02 | 1.22 | .11 | .24 | .02 | 884.1 | 1.78 | 81.9 | 15.17 | 26.29 | 8.38 | .74 | 28.9 |
| 60 days late gestation (30 kg bodyweight) | 3.42 | 148 | 900 | 1.58 | 90 | 150 | .24 | 6.75 | 9.00 | .02 | 1.22 | .11 | .24 | .02 | 1059.1 | 2.08 | 98.0 | 15.02 | 24.34 | 8.15 | (1.34) | (50.0) |
| 56 days early lactation | 2.67 | 129 | 750 | 1.31 | 75 | 125 | .20 | 5.63 | 9.00 | .02 | 1.22 | .11 | .24 | .02 | 884.1 | 1.77 | 81.9 | 15.17 | 26.14 | 8.38 | (0.90) | (47.2) |
| 56 days late lactation | 2.86 | 126 | 750 | 1.31 | 75 | 125 | .20 | 5.63 | 9.00 | .02 | 1.22 | .11 | .24 | .02 | 884.1 | 1.77 | 81.9 | 15.17 | 26.14 | 8.38 | (1.09) | (44.1) |

a/ Assumptions:

- Intake of weeds, grass and other plant materials from cut and carry assumed at 3.0% of bodyweight. Nutrient content of cut-and-carry forage: ME: 1.75 Mcal/kg DM, TP:10% of DM
- Intake of rice straw assumed to be 0.5% of BW. Nutrient content of rice straw as per appendix tables 4A.1 and 4A.2.
- Available rice bran per head as per table VII.8. Nutrient content of rice bran: ME : 2.63 Mcal/kg DM, TP : 13.5% of DM
- Available ME and TP per head from non-rice crop residues as per table VII.3.

b/ Daily nutritional requirements as per appendix table 4A.9.

4. Shifting agriculture (Figure VII.4)

7.54 As a crop/livestock system, shifting agriculture contributes very little to the national economy. The GOI has attempted to stabilize this farming system. Nevertheless, it still persists in the sparsely settled outer islands and has been responsible for clearing of lands, many of which have been invaded with imperata. Forage of this grass is of very low quality (see discussion in Chapter IV, Forage Resource Base). Furthermore, under shifting agriculture the crop-animal interaction is minimal with no benefit being derived from nutrient cycling.

7.55 Only free-ranging native pigs and chickens are raised in the shifting agriculture system. While a considerable quantity of crop residues are produced, the majority of the nutrients consumed by pigs are obtained from household vegetable wastes, and from rooting in fallow fields and forested areas. More advanced production systems involve the confinement of the pig near the household and the feeding of cooked tubers and vegetable wastes.

7.56 The net returns for the shifting agriculture system (table VII.11), although low, are likely to be inflated because of the use of East Java prices. When farmers are located far from a market center, attaching a value to agricultural production becomes a problem. Because of high transport costs, differences between products purchased and the same products sold (acquisition cost and selling price) are often large. Consequently most of the crop products are consumed within the household and/or village.

7.57 Cropping activities in the shifting agriculture system generate approximately 1,250 kg of DM in the form of residues (table VII.12). Very little of the residues generated have high feeding value in the production of swine. Leaves and vines of peanuts, mung beans, sweet potatoes and the leaves of cassava, when chopped and cooked, can provide a small amount of needed nutrients, primarily protein, to support gestating and lactating sows. Cassava peelings are high in energy but must be boiled or dried to reduce the level of cyanogenic glucosides which are toxic to swine. Given the low level of availability of highly digestible, high protein crop residues and by-products, there is little opportunity for intensive swine production as a component of shifting agriculture farming systems.

7.58 A greater opportunity exists for the utilization of crop residues in the production of sheep or goats within the shifting agriculture system. The small amounts of energy and protein from stover, vines and leaves could be efficiently utilized as a supplement to cut-and-carry native grasses and weeds harvested from open forest land and fallow fields.

Figure VII.4. Shifting agriculture farming system

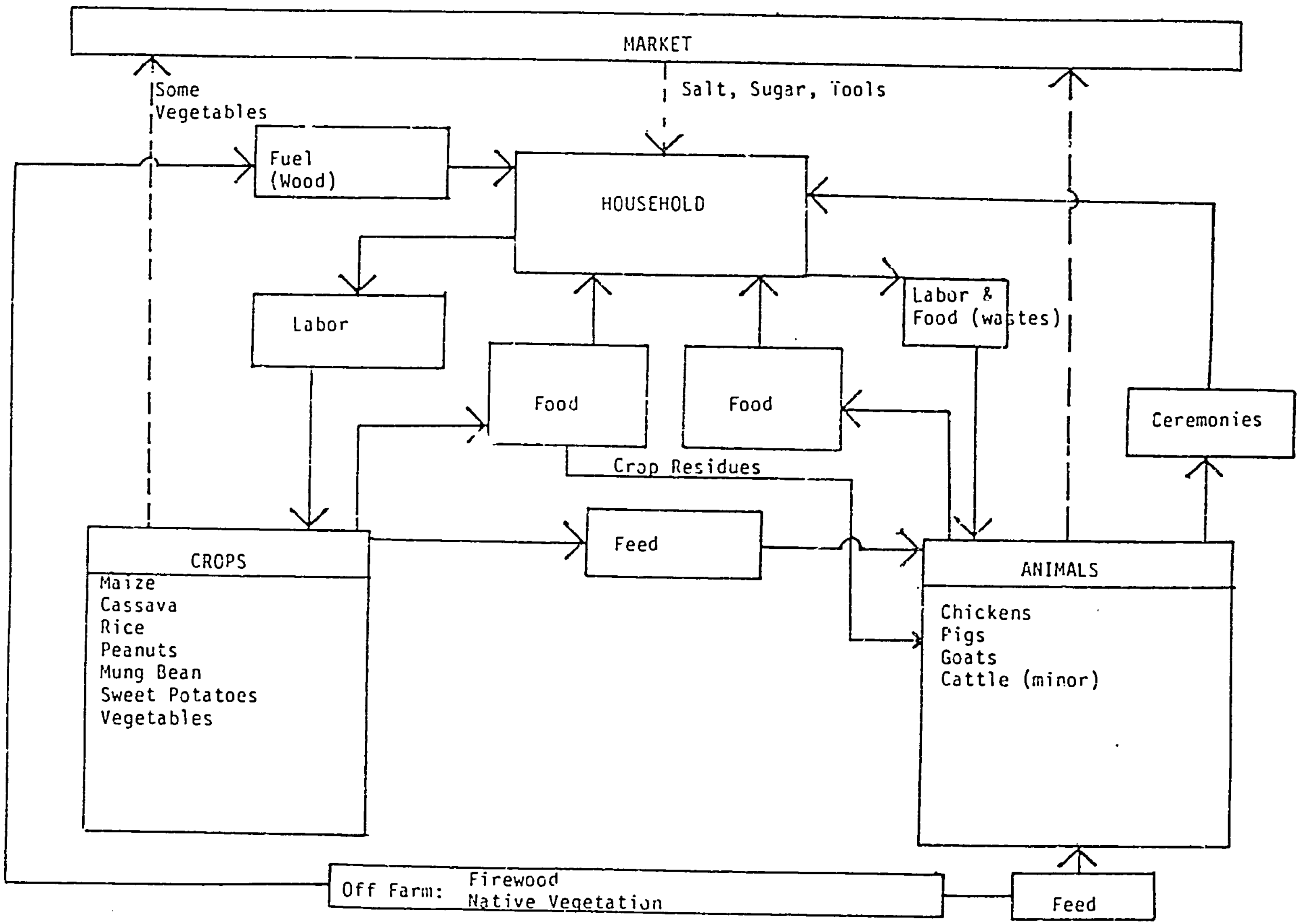


Table VII.11. Annual budget for shifting agriculture farming system

| | |
|---|---|
| Farm size: | 9 ha of which 3 ha are cultivated<br>2 sows (plus 1 boar)<br>4 hens (plus 1 rooster) |
| Cropping pattern: | 3 years cropping, 6 years fallow<br>(year 1 rice, year 2 mixed, year 3 cassava) |

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| **Crops:** | | |
| rice | 400 | 56,000 |
| maize | 400 | 50,000 |
| peanuts | 150 | 112,500 |
| beans | 150 | 61,500 |
| sweet potato | 350 | 21,000 |
| cassava | 1,000 | 50,000 |
| subtotal, crops | | 351,000 |
| **Livestock:** | | |
| meat (swine) | 60 | 48,000 |
| meat (poultry) | 12 | 10,800 |
| eggs 80 | | 6,000 |
| subtotal, livestock | | 64,800 |

Annual expenses:

| | |
|---|---|
| Crops: | 0 * |
| Livestock: | 0 |

| | | |
|---|---|---|
| Annual net return to family labor from crops: | 351,000 | ( 78%) |
| Annual net return to family labor from livestock: | 64,800 | ( 22%) |
| Total return to family labor from agriculture: | 415,800 | |

* Barter and communal labor play a major role in reducing costs

Table VII.12. Annual crop residue budget for shifting agriculture system

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Degree of utilization by swine | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 400 | Rice straw | 148.80 | 595.20 | Neglible | 1.63 | 45 | 970.18 | 26.78 |
| | | Rice bran | 10.00 | 40.00 | High | 2.63 | 135 | 105.20 | 5.40 |
| Maize | 400 | Stover | 32.90 | 131.60 | Neglible | 1.77 | 57 | 232.93 | 7.50 |
| | | Husks | 10.00 | 40.00 | Low | 2.62 | 81 | 104.80 | 3.24 |
| Cassava | 1000 | Tops | 6.80 | 68.00 | Medium | 2.20 | 249 | 149.60 | 16.93 |
| | | Peelings | 13.20 | 132.00 | High | 3.36 | 49 | 443.52 | 6.47 |
| Peanuts | 150 | Vines | 147.20 | 220.80 | Medium | 2.42 | 150 | 534.34 | 33.12 |
| Soybeans | 0 | Vines | 185.50 | .00 | Low | 2.65 | 159 | .00 | .00 |
| Sweet potato | 350 | Vines | 5.30 | 18.55 | Medium | 2.48 | 157 | 46.00 | 2.91 |
| Mung beans | 150 | Vines | 25.00 | 37.50 | Medium | 2.34 | 120 | 87.75 | 4.50 |
| | Total | | | 1,246.15 | | | | 2,586.57 | 102.36 |
| | Total, non-rice residues | | | 610.95 | | | | 1,511.19 | 70.17 |
| | Total, non-rice residues per day | | | 1.67 | | | | 4.14 | 0.19 |

[a] Source: Table IV.5

5. Coconut-mixed farming (Figure VII.5)

7.59 Coconut production in Indonesia is largely a small farmer operation with trees being planted around the home site and on land contiguous with those of neighbors, in effect forming a plantation. The wide spacing of trees, 6 to 8 meters, permits sufficient transmission of light for growth of native grasses and other vegetation which provides forage for grazing of ruminants. The level of interaction between the crop (coconut) and livestock components of this system is low to moderate because little of the coconut by-products are suitable or available for feed at the farm level. Furthermore, the amount of herbage on offer for grazing is usually low because of infertile soils, non-productive grasses, overgrazing and invasion of unpalatable weeds. Most farmers maintain an associated crop enterprise of rice and various secondary crops which provide residues for animal feed.

7.60 The forage quantity and quality could be measurably increased by establishing improved grasses and legumes under the coconuts. The market for livestock products and returns on inputs must be sufficient, however, to persuade the farmer that such a venture will be worthwhile. At present, he simply collects coconuts with no inputs.

7.61 As in the case of upland farming systems with mixed gardens, coconut-mixed farming systems (table VII.13) derive a substantial income from tree crops. A description of present coconut-mixed farming follows.

7.62 Two head of Zebu X native cows, each weighing an average of 400 kg, are maintained in the coconut-crops farming system primarily to provide draft and calves. Cows are assumed to work a total of 42 days per year, at an average 4 hours per day. Because of the low quality of the available forage, a calving interval of 2 years is estimated.

7.63 The cropping system utilizing 0.25 ha of irrigated land and producing rice, maize and peanuts, provides relatively little of the total nutrients required for the cattle. Less than 0.50 kg of DM is available from non-rice crop residues but, as in previous rice-based systems, rice straw is assumed to be available in unlimited quantities (Table VII.14). The small amount of rice bran available from the 2.5 ton rice crop is assumed to be fed to the cattle as a needed supplement. Consumption of forage by grazing of coconut stands, fallow paddy and roadsides is the primary source of nutrients providing almost 70% of required ME and 78% of TP (table VII.15).

7.64 Assuming intake and quality of DM as shown in table VII.15, the 400 kg cows are in positive nutritional balance for the majority of the year. Only during the lactation period when an estimated 5 kg of milk are produced daily is the cow deficient in ME and TP. During this period, the cow would either draw on body reserves for sufficient energy or decrease milk production to a lower level. High calf mortalities characteristic of Indonesian smallholder farming systems may be a result of low levels of intake of ME and TP by lactating cows. Bodyweight lost during the lactation period would be rapidly recovered post-weaning. As can be appreciated from table VII.15, utilizing lactating cows or cows in late gestation for draft creates severe nutritional demands which may not be met by available feed resources.

Figure VII.5. Coconut-mixed crops farming system

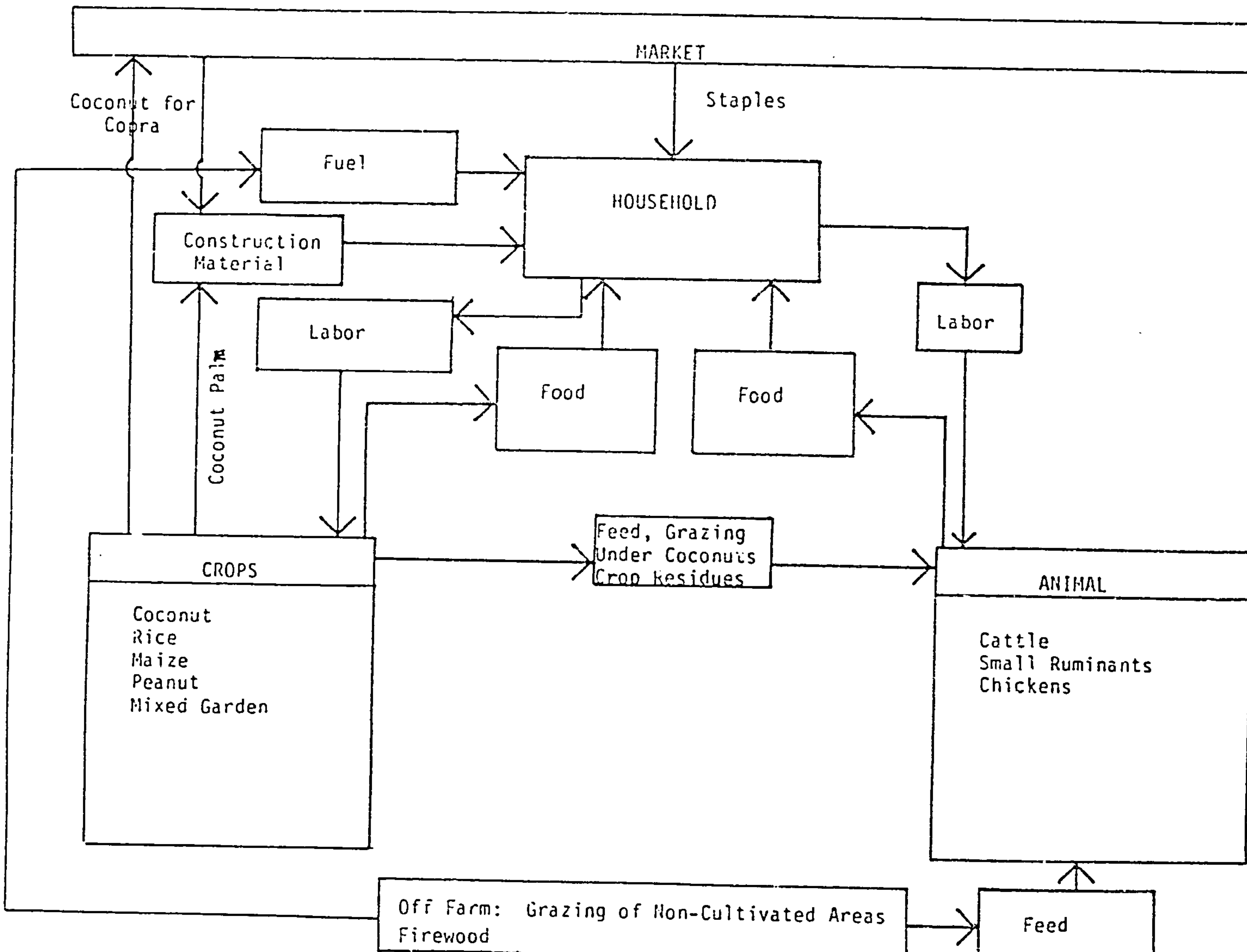


Table VII.13. Annual budget for coconut-crop-livestock farming system

Farm size: 0.25 ha irrigated
0.50 ha coconuts
2 head cattle
15 hens (plus 3 roosters)

Cropping pattern: rice-rice-palawija

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 2,500 | 350,000 |
| maize | 150 | 18,750 |
| peanuts | 80 | 60,000 |
| subtotal, crops: | | 428,750 |
| coconuts 3,900 | | 390,000 |
| Livestock: | | |
| meat (cattle) | 120 | 132,000 |
| meat (chicken) | 45 | 40,500 |
| draft 42 days | | 84,000 |
| eggs 300 | | 22,500 |
| subtotal, livestock: | | 279,000 |

Annual expenses:

| | |
|---|---|
| Crops: | 409,375 |
| Coconuts: | 0 |
| Livestock: | 0 |

| | | |
|---|---|---|
| Annual net return to family labor from crops: | 214,375 | ( 24%) |
| Annual net return to family labor from coconuts: | 390,000 | ( 44%) |
| Annual net return to family labor from livestock: | 279,000 | ( 32%) |
| Total annual returns to family labor from agriculture: | 883,375 | |

Table VII.14. Annual crop residue budget for coconut-crop-livestock farming system

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 2500 | Rice straw | 80.10 | 2,002.50 | 1.63 | 45 | 3,264.08 | 90.11 |
| | | Rice bran | 10.00 | 250.00 | 2.63 | 135 | 657.50 | 33.75 |
| Maize | 150 | Stover | 59.60 | 89.40 | 1.77 | 57 | 158.24 | 5.10 |
| | | Husks | 10.00 | 15.00 | 2.62 | 81 | 39.30 | 1.22 |
| Cassava | 0 | Tops | 1.10 | .00 | 2.20 | 249 | .00 | .00 |
| Peanuts | 80 | Vines | 94.80 | 75.84 | 2.42 | 150 | 183.53 | 11.38 |
| Soybeans | 0 | Vines | 165.50 | .00 | 2.65 | 159 | .00 | .00 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| | Total | | | 2,432.74 | | | 4,302.65 | 141.55 |
| | Total, non-rice residues | | | 180.24 | | | 381.07 | 17.69 |
| | Total, non-rice residues per day | | | .49 | | | 1.04 | .05 |

[a] Source: Table 4.5

Table VII.15. Nutritional requirements and intake from available forage and crop residues for Zebu X native cow in a coconut-rice-based farming system [a]

| Physiological Status | Daily requirements [b] | | Intake of DM from: Weeds and native grasses | | | Rice straw | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as a % of total | | | Surplus (deficit) over (from) requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (g) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (%) | (%) | (%) | (Mcal) | (g) |
| 42 days maintenance plus 4 hrs daily work | 14.4 | 573 | 6.0 | 10.50 | 600 | 2.0 | 3.26 | 90 | .340 | 0.89 | 45.9 | 247 | 0.61 | 30 | 8.59 | 15.26 | 766 | 30.1 | 31.2 | 21.7 | 0.86 | 193 |
| 30 days maintenance plus late gestation (450 kg bodyweight) | 16.9 | 763 | 6.75 | 11.81 | 675 | 2.25 | 3.67 | 101 | .340 | 0.89 | 45.9 | 247 | 0.61 | 30 | 9.59 | 16.98 | 852 | 29.6 | 30.4 | 20.8 | 0.08 | 89 |
| 50 days maintenance plus lactation at 5 kg 3.5% milk | 17.7 | 783 | 6.0 | 10.50 | 600 | 2.0 | 3.26 | 90 | .340 | 0.89 | 45.9 | 247 | 0.61 | 30 | 8.59 | 15.30 | 766 | 30.1 | 31.2 | 21.7 | (2.44) | (17.1) |
| 243 days maintenance plus early gestation | 11.9 | 373 | 6.0 | 10.50 | 600 | 2.0 | 3.26 | 90 | .340 | 0.39 | 45.9 | 247 | 0.61 | 30 | 8.59 | 15.30 | 766 | 30.1 | 31.2 | 21.7 | 3.36 | 393 |

[a] Assumptions:
Calving interval of 24 months assumed
Intake of DM from grazing under coconut trees and in communal areas assumed at 1.5% of bodyweight (400 kg) per day. Nutrient content of the consumed dry matter: ME = 1.59 Mcal per kg DM, TP = 9% of DM
Intake of rice straw assumed to be 0.5% of bodyweight. Nutrient content of rice straw as per appendix tables A.1 and A.2.
Available ME and TP per head (7 head adult cows) from non-rice crop residues as per table VII.12.

[b] Source: Appendix table A.5

6. Rubber-estate livestock system (Figure VII.6)

7.65 Rubber in Indonesia is mainly produced on large estates. Research at BPT and Malaysia has shown the benefits of integration between livestock, especially small ruminants, and rubber farming. This type of interaction occurs spontaneously, but is generally discouraged by plantation managers who are only concerned with the rubber revenues. Smallholder rubber plantations, however, do not suffer from the handicap of split livestock-rubber trees ownership, and offer an excellent opportunity for tree crop-livestock integration, comparable to the coconut-livestock system.

7.66 It is assumed that the smallholder rubber producer has a small flock of 10 ewes and 1 ram which are grazed beneath the rubber trees. Goats are precluded by their tendency to knock the latex collecting cups off the trees. Because of the similarity in land resources and labor availability, the rubber-sheep farming system is assumed to have the same crop component as the coconut-cattle system. The annual budget for the rubber-sheep system (table VII.16) differs from that of the coconut-cattle system only in the increased revenue from rubber ( Rp 759,000) compared to coconuts (Rp 390,000). The amount of dry matter, metabolizable energy and total protein from crop residues available to support the small flock of sheep will be similar to that reported in table VII.14. The grazing of weeds and improved legumes such as calopogonium and centrosema grown under the rubber trees for erosion control provides sufficient forage to cover from 50 to 75% of daily nutritional requirements. Crop residues should cover the remainder of nutritional requirements to allow the sheep to produce at the level of 1.35 lamb weaned per ewe annually (see table VII.10 for native sheep confinement fed in an upland, rice-based farming system).

Figure VII.6. Estate Crops: Rubber-Mixed Farming - Java, Sumatra, Kalimantan

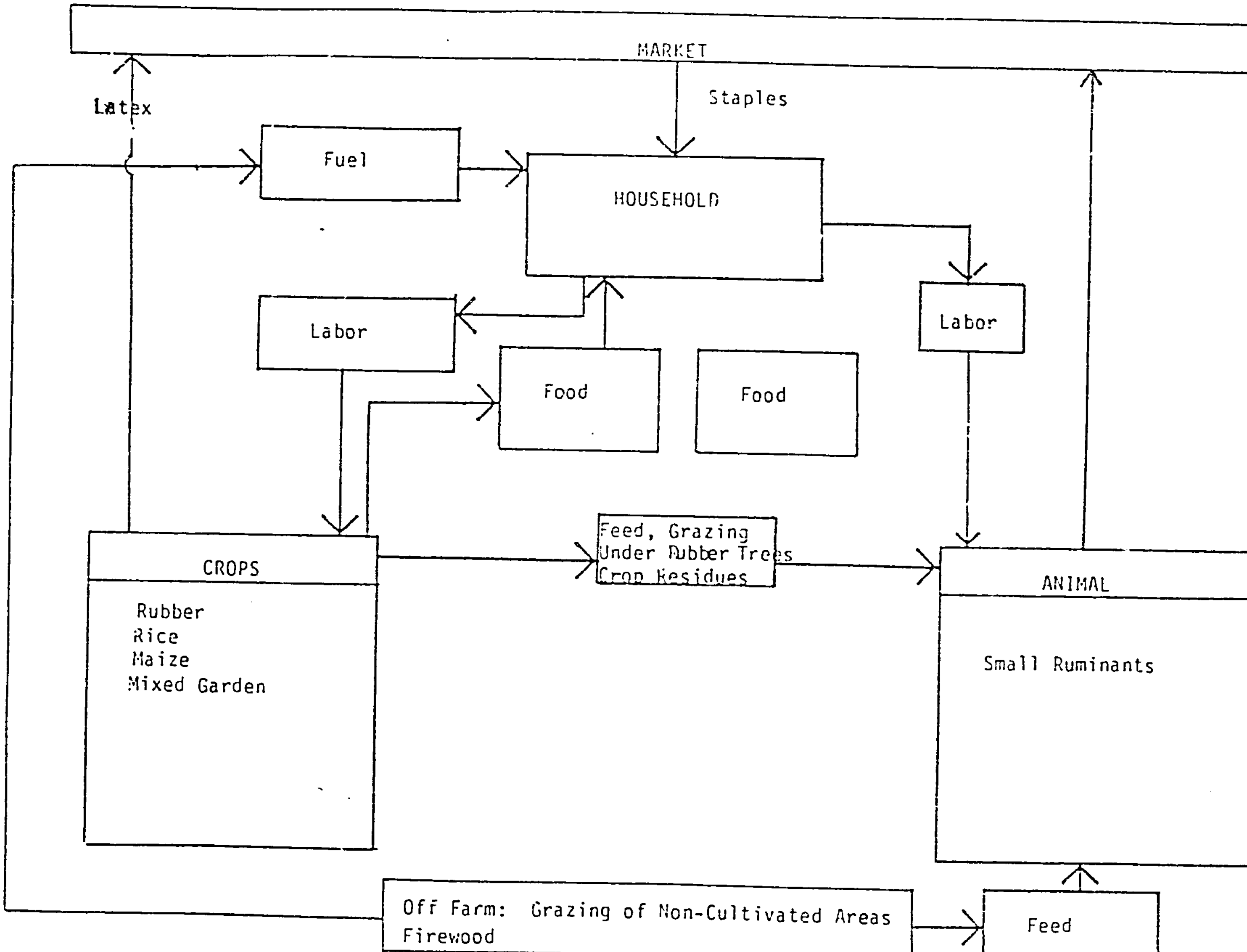


Table VII.16. Annual budget for rubber-crop-livestock farming system

Farm size: 0.25 ha irrigated
1.00 ha rubber
10 ewes, 1 male

Cropping pattern: rice-rice-palawija

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 2,500 | 350,000 |
| maize | 150 | 18,750 |
| peanuts | 80 | 60,000 |
| subtotal, crops: | | 428,750 |
| rubber | 1,130 | 759,000 |
| Livestock: | | |
| meat (sheep) | 176 | 176,000 |
| Total | | 1,363,750 |

Annual expenses:

| | |
|---|---|
| Crops: | 214,375 |
| Rubber: | 319,000 |
| Livestock: | 0 |
| Total | 533,375 |

| | |
|---|---|
| Annual net return to family labor from crops: | 214,375 ( 26%) |
| Annual net return to family labor from rubber: | 440,000 ( 53%) |
| Annual net return to family labor from livestock: | 176,000 ( 21%) |
| Total annual returns to family labor from agriculture: | 830,375 |

## 7. Beef-fattening

7.67 Two systems have been modeled, namely, village-level fattening of Holstein and Ongole bull calves on Java, and the "Amarasi" beef-fattening in southeast Timor. Although not modeled, commercial fattening operations are encountered and are increasing in Java and some of the outer islands. They represent an intensive management scheme with animals confined in a feed lot, being fed a concentrate ration along with improved grasses and legumes. The operation varies in size from 15 to over 100 animals. For the most part, feeder stock of about 150 to 200 kg are purchased and fattened for about one year with average daily gains of 0.7 kg/head. They are sold with no consideration of carcass quality. Animals used include Brahman crosses, Bali cattle and buffalo.

### a. Smallholder beef fattening (Figure VII.7)

7.68 This system of feeding Holstein calves and/or Orgole crosses has developed on Java during recent years, prompted in part by the increased GOI interest in dairying which has made Holstein-Friesian bull calves available, but even more important, by the rising demand for red meat in the cities and the favorable prices which have resulted. The entrepreneurs are, for the most part mixed crop farmers who still grow crops for home consumption. They keep from two to six animals in confinement. Usually, weaned Holstein-Friesian bull calves are purchased from neighbors who are dairy farmers, or Ongole-crossed calves from draft-type females are used. In addition to ownership, several forms of share-fattening arrangements exist. The feed ration is based on rice bran, supplemented with purchased concentrate, crop residues, cut-and-carry native vegetation, and improved grasses and legumes as the calves grow older. This is a commercial, small-scale operation with fattened stock sold to an itinerant buyer who primarily supplies the urban market. In some cases, an added farm income comes from sale of manure, but it may also be used on farm in home gardens.

7.69 Fattening of Holstein-friesian bull calves is done by smallholders on Java on an ownership or shareholder basis. Calves are purchased at weaning from dairy farmers and are raised in confinement to a bodyweight of 300 to 400 kg before being sold for beef. They are sold to middlemen who collect and transport truck-load lots to the Jakarta market. Usually two head are maintained, one near to sale weight, the other younger, in order that income from sales of fattened bulls will not all be at once.

7.70 The budget in table VII.17 shows that even under sharing arrangements, a sharecropper can derive a major part of his income from his livestock enterprise, provided that he can acheive good growth rates. The management of such a fattening system requires a basic understanding of feed resources and feeding management.

7.71 Feedstuffs used in the fattening process consist of limited amounts of crop residues available on-farm or purchased from neighbors, plus cut-and-carry forage and purchased rice bran (table VII.19 ). The smallholder usually will have a small amount of irrigated land which provides rice and secondary crop grains for family consumption. Less than 200 kg of DM from non-rice crop residues is estimated to be available from cropping activities (table VII.18). Rice straw is available in quantities which exceed the limitations of voluntary intake and is used at 0.25% of BW or less due to its low nutritional value.

7.72 To estimate nutritional requirements and nutrient balances, two bulls are assumed to be fed. A 30-month-old bull weighs 400 kg, is at an assumed stage of being nearly ready for market, and is growing at a rate of 250 g per day. A younger 12-month-old bull weighs 200 kg and is growing at 350 g per day. The younger bull consumes 100% of the 0.54 kg of crop residue DM available daily, 2.0% of its bodyweight as DM from cut-and-carry forage and 0.25% as DM from rice straw. The older bull consumes 1.75% of its bodyweight as DM from cut-and-carry forage, and, as for the younger bull, 0.25% of bodyweight as rice straw DM.

7.73 Consumed ME and TP and nutritional requirements are assumed to be in near balance for the older bull but is deficient for the younger animal. Actual growth rate by the younger bull would be somewhat less than the 350 g per day assumed in table VII.19 unless content of TP in the consumed diet was higher. Actual availability and nutritional quality of available forage varies widely across the year and daily or even weekly nutritional balance will not be constant unless some form of forage management (e.g. preservation as silage) is practiced.

7.74 For both bulls, crop residues, including rice straw, account for less than 20% of total ME and TP intake which is indicative of a low interaction between the cropping system and beef fattening. Efforts to improve the efficiency of the beef fattening enterprise should focus on improved sources of forage off-farm or intensive use of available land to produce high-yielding forage or food-forage crops on-farm.

Figure VII.7. Smallholder beef fattening system

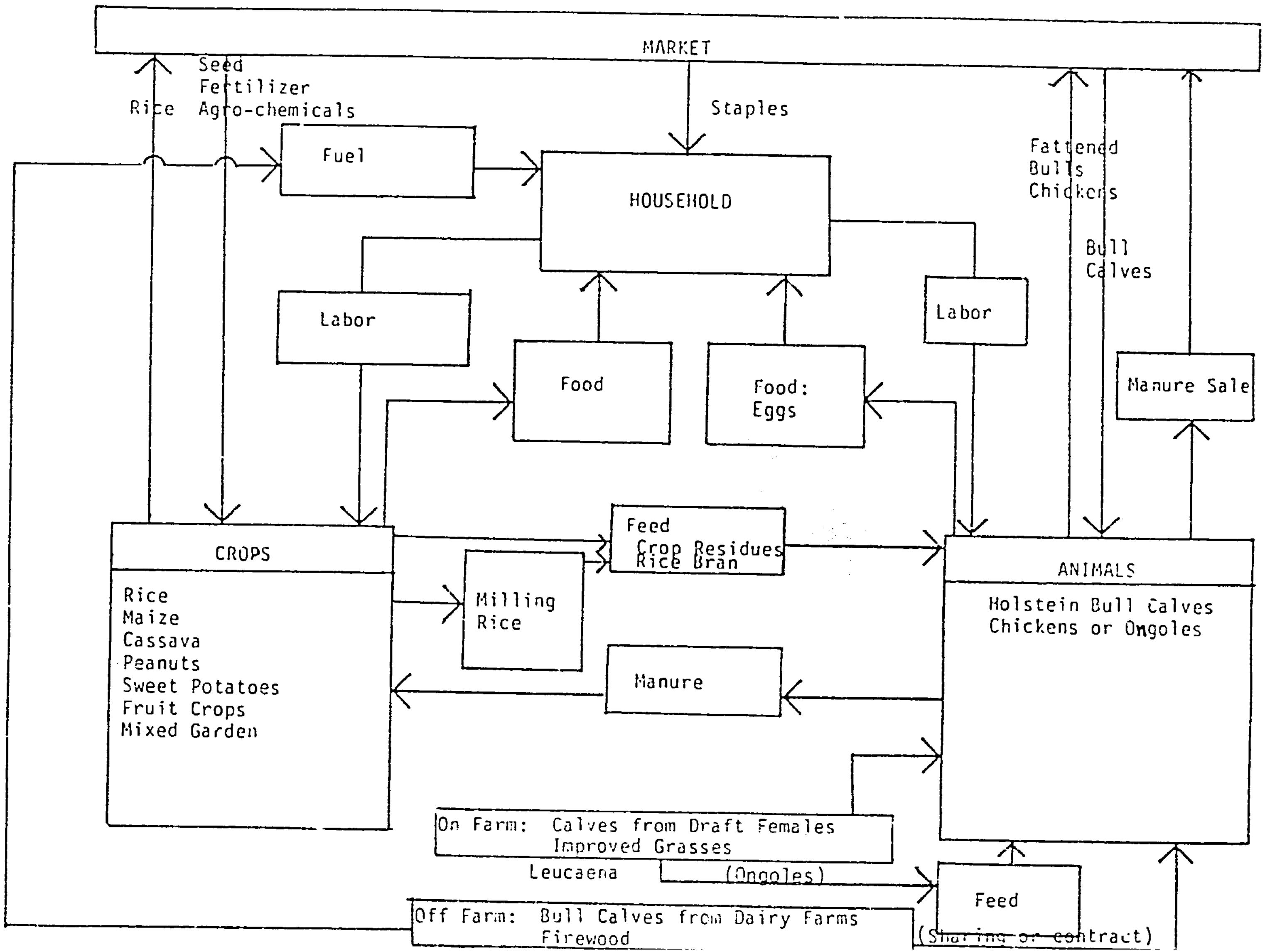


Table VII.17. Annual budget for fattening of Holstein bull calves by shareholders

Farm size:
- 0.1 ha improved grasses
- 0.1 ha mixed garden
- 0.1 ha irrigated
- 0.1 ha upland
- 2 Holstein bull calves (one 30 months, one less than one year)
- 10 chickens

Cropping pattern:
- rice-rice-rice on irrigated paddy
- rice-secondary crops on upland

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 1,000 | 140,000 |
| soybeans | 20 | 8,200 |
| maize | 100 | 12,500 |
| cassava | 250 | 12,250 |
| mixed garden | | 100,000 |
| subtotal, crops: | | 273,200 |
| Livestock: | | |
| meat (cattle) | 600 | 660,000 |
| meat (poultry) | 30 | 27,500 |
| eggs | 200 | 15,000 |
| subtotal, livestock | | 702,500 |

Annual expenses

| | | |
|---|---|---|
| Crops: | | 136,600 |
| Livestock: | Owner's share | 330,000 |
| | Feed | 58,000 |
| Total, livestock expenses | | 388,000 |

| | |
|---|---|
| Annual net returns to family labor from crops: | 136,600 ( 30%) |
| Annual net returns to family labor from livestock: | 314,500 ( 70%) |
| Total annual returns to family labor from agriculture: | 451,100 |



338

Table VII.18. Annual crop residue budget for Holstein bull fattening by shareholders

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 1000 | Rice straw | 84.30 | 843.00 | 1.63 | 45 | 1,374.09 | 37.94 |
| | | Rice bran | 10.00 | 100.00 | 2.63 | 135 | 263.00 | 13.50 |
| Maize | 100 | Stover | 59.60 | 59.60 | 1.77 | 57 | 105.49 | 3.40 |
| | | Husks | 10.00 | 10.00 | 2.62 | 81 | 26.20 | 0.81 |
| Cassava | 250 | Tops | 2.50 | 6.25 | 2.20 | 249 | 13.75 | 1.56 |
| Peanuts | 0 | Vines | 94.80 | .00 | 2.42 | 150 | .00 | .00 |
| Soybeans | 20 | Vines | 185.50 | 37.10 | 2.65 | 159 | 98.32 | 5.90 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| | Total | | | 1,055.95 | | | 1,880.85 | 63.11 |
| | Total, non-rice residues | | | 112.95 | | | 243.76 | 11.67 |
| | Total, non-rice residues per day | | | 0.31 | | | 0.67 | .03 |

[a] Source: Table IV.5

Table VII.19. Nutritional requirements and intake from forage and crop residues for Holstein-Friesian bulls confinement-fed in a village fattening scheme

| Physiological status | Daily requirements a/ | | Intake of DM from: Weeds native grass | | | Rice straw | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as a % of total | | | Surplus (deficit) over (from) requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (%) | | | (Mcal) | (g) |
| 30-month old bull (400 kg BW) | | | | | | | | | | | | | | | | | | | | | | |
| Growth rate of 250 g per day | 12.27 | 598 | 6.00 | 10.50 | 540 | 1.00 | 1.62 | 45.00 | 0.21 | 0.54 | 27.68 | .00 | .00 | .00 | 7.21 | 12.66 | 612.68 | 16.72 | 17.06 | 11.86 | .39 | 14.68 |
| 12-month-old bull (200 kg BW) | | | | | | | | | | | | | | | | | | | | | | |
| Growth rate of 350 g per day | 8.82 | 504 | 4.00 | 7.00 | 360 | 0.50 | 0.81 | 22.50 | 0.07 | 0.18 | 9.45 | 1.01 | 0.67 | 30.09 | 5.58 | 8.66 | 421.95 | 28.32 | 19.21 | 14.68 | (.16 ) | (82.05) |

a/ Source: Appendix table 4A.6
b/ Intake of DM from weeds, grass and other plant materials from cut and carry assumed at 2.0% of bodyweight for younger bull, 1.75% for older bull. Nutrient content of DM from cut-and-carry forage: ME = 1.75 Mcal/kg, TP = 9% of DM
c/ Intake of rice straw assumed to be 0.25% of BW for both bulls. Nutrient content of rice straw as per appendix tables 4A.1 and 4A.2.
d/ Available rice bran per head as per table VII.16. Nutrient content of rice bran: ME = 2.63 Mcal/kg DM, TP = 13.5% of DM
e/ Available ME and TP per head from non-rice crop residues as per table VII.18. Younger bull consumes all available crop residues.

b. Smallholder beef fattening: Amarasi Model (Figure VII.8)

7.75 This system originated and is largely confined to the Amarasi area near Kupang, Timor, but is spreading to other parts of NTT and NTB. It arose because of the calcareous soil condition which favored the naturalization and year-round production of leucaena. Farmers soon recognized the value of this forage legume for cattle, goats, and swine (in limited amount). From this evolved a small holder beef fattening operation in which Bali feeder stock (120-150 kg) were purchased on the local market and fed an almost 100% leucaena diet. The animals receive some crop residues, salt, and banana stems as a water supplement. They are fattened for about one year and sold at about 300 kg/head. In addition to purchased feeder-stock, farmers are now raising their own calves.

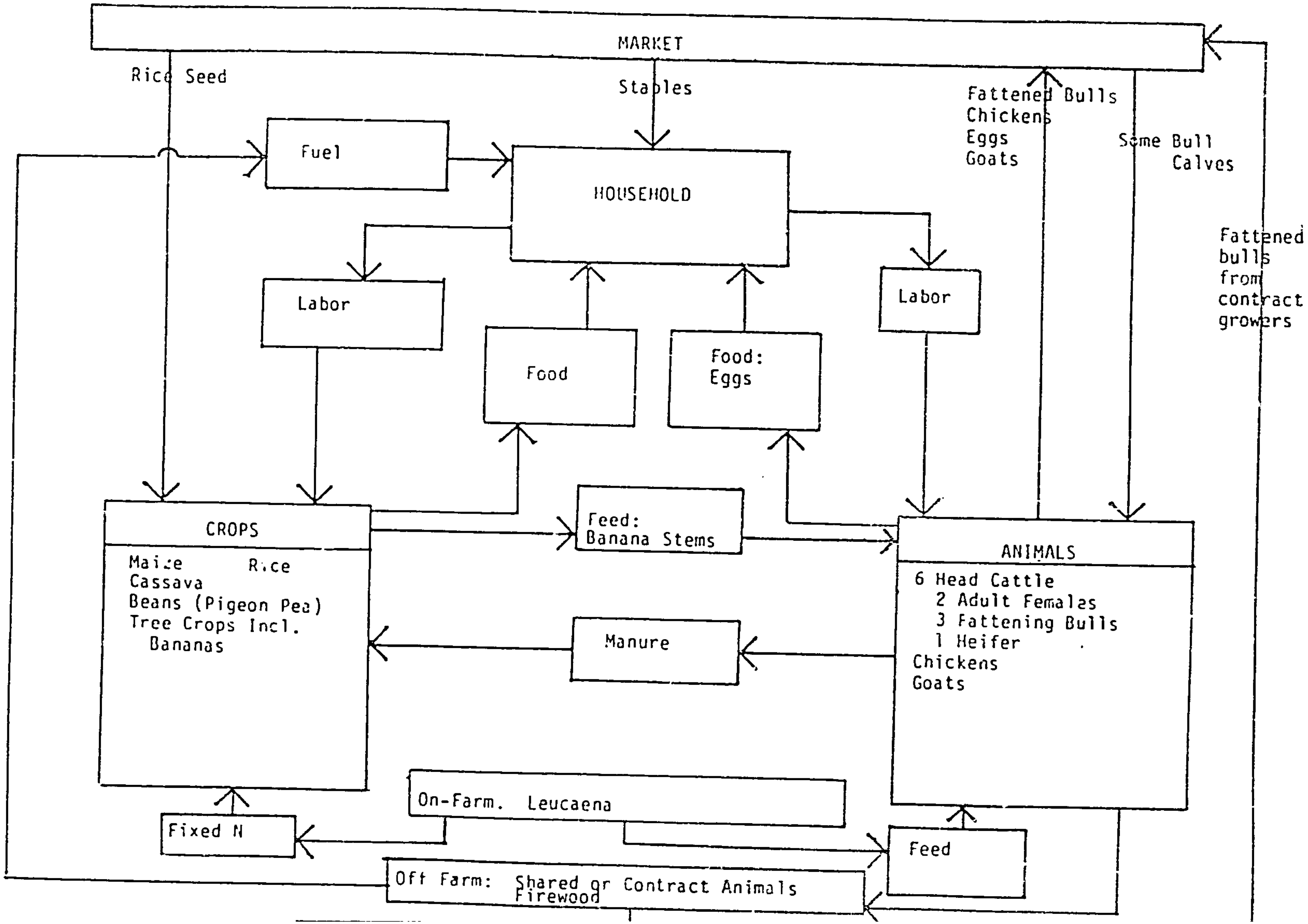
7.76 The Amarasi budget (VII.20) is significant as it shows a fattening scheme without cash outlays. Note that the crop-leucaena rotation implies a relatively large size of farm. This aspect virtually excludes the application of this system in densely populated areas such as Java, Madura and Bali.

7.77 As very little crop residue DM is available from the limited planting of rice, maize and mung beans (table VII.21), leucaena (lamtoro) provides the majority of the energy and protein needed to support the growth of three Bali bulls (table VII.22).

7.78 Daily growth rates for 300 kg, 250 kg and 150 kg bulls is assumed at 100, 250 and 350 g, respectively. The amount of lamtoro DM consumed by the three bulls is assumed to be that required to provide the ME not consumed in the form of rice bran and crop residues. Therefore, total ME consumed is exactly equal to ME required for the given bodyweight and growth rate. The resulting estimates of DM intake on a % of bodyweight basis for the three bulls (300 kg, 250 kg and 150 kg) are 1.04, 1.32, and 1.57, respectively, which are slightly lower than the expected level of intake for stall-fed fattening bulls of 1.75 to 2.00% of bodyweight. Due to the high nutrient density of the lamtoro DM, energy consumption may place an upper limit on DM intake before rumen fill. Most of the TP consumed which is surplus to daily requirements would be utilized by the bulls as energy with the resulting surplus nitrogen excreted in the urine.

7.79 If the DM content of the lamtoro harvest was approximately 10%, the 2.25 to 3.20 kg of lamtoro DM fed to the bulls would represent 22.5 to 32.0 kg of fresh material. This is in the range of 30 kg per head per day reported as the amount of fresh material fed to the stall-fed bulls in the Amarasi system (Jones, 1983).

Figure VII.8. Leucaena-based beef fattening, Amarasi, NTT




VII - 45

Table VII.20. Annual budget for beef fattening, Amarasi (NTT) model

Farm size: 1.50 ha leucaena
0.25 ha rice (dryland)
0.25 ha secondary crops
0.25 ha mixed garden
2 bulls
5 chickens (plus 1 rooster)

Cropping pattern: 1 year cultivation, 3 years leucaena

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 500 | 70,000 |
| maize | 150 | 182,750 |
| mungbeans | 40 | 23,000 |
| mixed garden | | 250,000 |
| subtotal, crops | | 361,750 |
| Livestock: | | |
| meat (cattle) | 240 | 240,000 |
| meat (poultry) | 15 | 13,500 |
| eggs | 100 | 7,500 |
| subtotal, livestock | | 260,000 |

Annual expenses

| | |
|---|---|
| Crops: 25% of output (no fertilizer needed) | 90,440 |
| Livestock: | 0 |

| | |
|---|---|
| Annual net return to family labor from crops: | 271,310 ( 51%) |
| Annual net return to family labor from livestock: | 260,000 ( 49%) |
| Total annual returns to family labor from agriculture: | 531,310 |

Table VII.21. Annual crop residue budget for Amarasi beef fattening, leucaena-rice-based farming system

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 500 | Rice straw | 148.30 | 741.50 | 1.63 | 45 | 1,208.65 | 33.37 |
| | | Rice bran | 10.00 | 50.00 | 2.63 | 135 | 131.50 | 6.75 |
| Maize | 150 | Stover | 32.90 | 49.35 | 1.77 | 57 | 87.35 | 2.81 |
| | | Husks | 10.00 | 15.00 | 2.62 | 81 | 39.30 | 1.22 |
| Cassava | 0 | Tops | 6.80 | .00 | 2.20 | 249 | .00 | .00 |
| Peanuts | 0 | Vines | 147.20 | .00 | 2.42 | 150 | .00 | .00 |
| Soybeans | 0 | Vines | 165.50 | .00 | 2.65 | 159 | .00 | .00 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| Mungbeans | 40 | Vines | 165.50 | 74.20 | 2.65 | 159 | 196.63 | 11.80 |
| | Total | | | 930.05 | | | 1,663.42 | 55.94 |
| | Total, non-rice residues | | | 64.35 | | | 323.28 | 15.83 |
| | Total, non-rice residues per day | | | .18 | | | .89 | .04 |

[a] Source: Table IV.5

Table VII.22. Nutritional requirements and intake from available forage and crop residues for Bali beef bulls in leucaena-based intensive fattening system, Amarasi, NTT

| Physiological status | Daily requirements b/ | | Intake of DM from: a/ Lamtoro | | | Rice bran | | | Non-rice crop residues | | | Total | | | Crop residues as a % of total | | | Surplus (deficit) over (from) nutritional requirements | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | DM | ME | TP | ME | TP |
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | ------ | (%) | ------ | (Mcal) | (g) |
| Bulls (3 head): | | | | | | | | | | | | | | | | | | | |
| 300 kg adult, growth rate of 100 g per day | 9.46 | 466 | 3.04 | 8.99 | 869 | .046 | 0.17 | 6 | .06 | 0.30 | 0.0 | 3.14 | 9.46 | 875 | 3.3 | 5.0 | 0.7 | 0.0 | 409 |
| 250 kg adult, growth rate of 250 g per day | 9.94 | 552 | 3.20 | 9.47 | 915 | .046 | 0.17 | 6 | .06 | 0.30 | 0.0 | 3.30 | 9.94 | 921 | 3.2 | 4.7 | 0.6 | 0.0 | 369 |
| 150 kg young bull, growth rate of 350 g per day | 7.14 | 430 | 2.25 | 6.67 | 644 | .046 | 0.17 | 6 | .06 | 0.30 | 0.0 | 2.36 | 7.14 | 650 | 4.5 | 6.6 | 0.9 | 0.0 | 220 |

a/ Assumptions:
- Bali breed cattle used for fattening
- Nutritional content of lamtoro (as per table 4A.1 and 4A.2: ME = 2.96 Mcal/kg DM, TP = 286 g/kg DM
- Available ME and TP per head from non-rice crop residues as per table VII.19.

b/ Source: Table 4A.6.

## 10. Dairy production system (Figure VII.9)

7.80 A smallholder milk production system has existed in Java for more than 30 years but has recently expanded because of GOI interest in promoting the domestic production of milk, a market influenced by favorable GOI policies, and DGLS assistance programs for KUDs and producers. In general, the smallholder dairy farmers are located in the uplands and maintain two milking cows along with limited mixed crops (usually maize, cassava, and mixed garden). The primary source of cash flow comes from sales of milk, some manure and bull calves. Milk production per cow seldom exceeds 10 liters per day with a lactation period of 250 days or less. Thus, the genetic potential of the Holstein-Friesian is not being realized due largely to lack of proper management and inadequate feed quality. Despite the availability of concentrates, cows are not usually fed in relation to requirements as determined by bodyweight, gestation, growth rate and milk production. The farmer depends on cut-and-carry native grass and vegetation along with elephant and setaria grasses. Generally, the forage diet does not include a legume. Thus, low herbage quality restricts animal intake and digestibility. These feed aspects can be notably improved by establishment of tree legumes such as leucaena and sesbania, a regular fertilizer program for the grasses, conservation of forage as silage, and concentrate feeding based on milk production.

7.81 An important aspect of the smallholder dairy production system (table VII.23) is that the income derived from the dairy cows is spread over most of the year, thereby contributing to the subsistence expenses of the family (e.g. purchase of rice).

7.82 The smallholder in the assumed dairy production model plants maize and cassava on 2 ha of upland soils plus maintains 0.10 ha of elephant grass ("rumput gadjah", Pennesiteum purpureum) for cut-and-carry forage to sustain the dairy herd. The 2.0 tons of maize and 3.5 tons of cassava harvested yield residue DM of 794 kg and an estimated 4.36 Mcal of ME (table VII.24).

7.83 Two adult milking cows are maintained, one growing heifer (12 months old, 250 kg bodyweight), and one heifer calf. Bull calves are sold soon after birth. Cows are of Holstein-Friesian breeding and produce an average 10 l per day of 3.5% fat milk. A calving interval of 14 months is assumed reducing the 270-day lactation to 217 days per year ((250 days/420 days of calving interval)*365) and the 60-day late gestation period to 52. During the remainder of the year nutritional requirements are for maintenance only.

7.84 Intake of rumput gadjah for both the adult lactating cows and the heifer is assumed at 2.0% of bodyweight. Properly managed, fertilized with manure and cut at 30- to 42-day intervals, rumput gadjah should have a nutrient content on a DM basis of better than 1.75 Mcal ME and 10% TP. However, management of cut-and-carry forage on Javanese smallholder dairies is less than optimum. Therefore, the assumed nutrient content in table VII.25 is 1.50 Mcal ME and 8.8% TP.

7.85 Concentrate (2.25 Mcal ME/kg DM and 14% TP) is fed to the adult cows during lactation at the rate of 1 kg per 3 kg of milk produced. Actual use of concentrates in Javanese smallholder dairies is not closely tied to production. The adult cows receive 1.8 kg of concentrate during late gestation and the heifer 1.0 kg up to the time of first calving. No concentrate is fed during the 96-day dry period.

7.86 The two adult cows consume 90% of the small amount of crop residues available, with the remaining 10% fed to the heifer. Crop residues account for less than 9.0% of the total DM intake of the adult cows, and only 3.5% of the total intake of the heifer.

7.87 The adult cows are deficit in ME during lactation at the rate of approximately 4.0% of requirements. Total protein intake is not markedly deficient. During the dry period and late lactation, sufficient ME and TP are consumed to increase body stores of energy, which will alleviate the effects of the deficiency of consumed energy well into the first trimester of lactation. The negative energy balance of lactating dairy cows is probably one of the principal causes of the low levels of production and long calving intervals of the Holstein-Friesians milked on Javanese smallholder dairies. If available DM from crop residues could be preserved for feeding during the lactation period, especially during the first 90 days of lactation, instead of being fed during the dry period and late gestation, total lactation yield could probably be increased and calving interval reduced.

Figure VII.9. Smallholder dairy production system

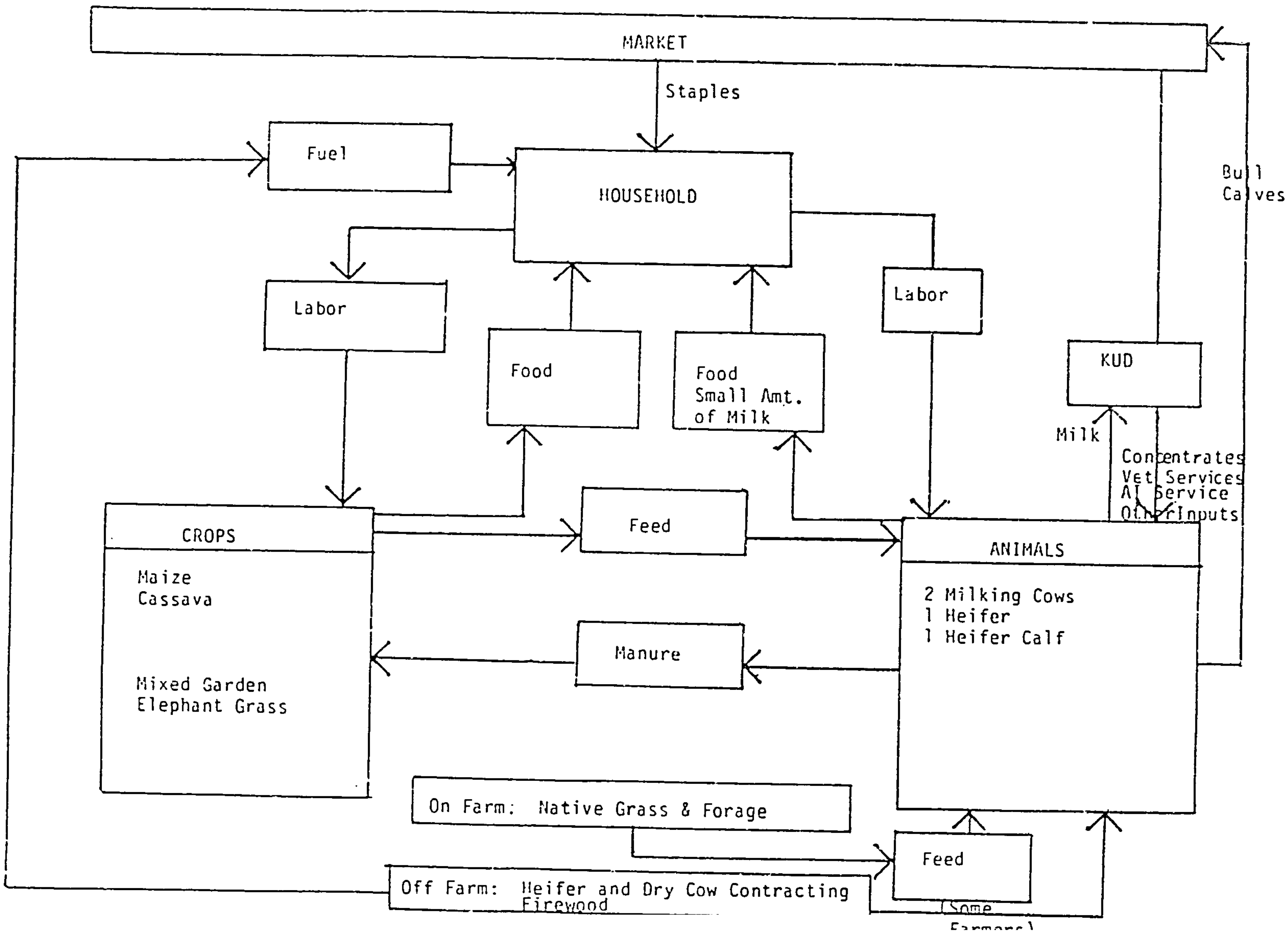


Table VII.23. Annual budget for smallholder dairy production

Farm size: 2.0 ha maize, maize-cassava
0.1 ha rumput gadjah
0.2 ha mixed garden

Cropping pattern: maize, maize-cassava

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| maize | 2,000 | 250,000 |
| cassava | 3,500 | 175,000 |
| mixed garden | | 100,000 |
| subtotal, crops | | 525,000 |
| Livestock: | | |
| meat (cattle) | (0.75 hd) | 37,500 |
| milk | 4,340 | 998,200 |
| subtotal, livestock | | 1,035,700 |

Annual expenses

| | | |
|---|---|---|
| Crops: | | 262,500 |
| Livestock: | (2,500 kg feed) | 337,500 |

| | |
|---|---|
| Annual net return to family labor from crops: | 262,500 ( 27%) |
| Annual net return to family labor from livestock: | 698,200 ( 73%) |
| Total annual returns to family labor from agriculture: | 960,700 |

Table VII.24. Annual crop residue budget for smallholder dairy

| Crop | Yield | Residue | Residue as % of yield [a] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 0 | Rice straw | 84.30 | .00 | 1.63 | 45 | .00 | .00 |
| | | Rice bran | 10.00 | .00 | 2.63 | 135 | .00 | .00 |
| Maize | 2000 | Stover | 27.80 | 556.00 | 1.77 | 57 | 984.12 | 31.69 |
| | | Husks | 10.00 | 200.00 | 2.62 | 81 | 524.00 | 16.20 |
| Cassava | 3500 | Tops | 1.10 | 38.50 | 2.20 | 249 | 84.70 | 9.59 |
| Peanuts | 0 | Vines | 94.60 | .00 | 2.42 | 150 | .00 | .00 |
| Soybeans | 0 | Vines | 185.50 | .00 | 2.65 | 159 | .00 | .00 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| | Total | | | 794.50 | | | 1,592.82 | 57.48 |
| | Total, non-rice residues | | | 794.50 | | | 1,592.82 | 57.48 |
| | Total, non-rice residues per day | | | 2.18 | | | 4.36 | .16 |

[a] Source: Table IV.5

Table VII.25. Nutritional requirements and intake from forage crop residues and concentrate for 500 kg Holstein Friesian dairy cow and 12-month-old heifer in smallholder system

| Physiological status | Daily requirements b/ ME | Daily requirements b/ TP | Intake of DM from a/: Rumput gadjah DM | Rumput gadjah ME | Rumput gadjah TP | Concentrate DM | Concentrate ME | Concentrate TP | Crop residues DM | Crop residues ME | Crop residues TP | Total DM | Total ME | Total TP | Crop residues as a % of total DM | Crop residues as a % of total ME | Crop residues as a % of total TP | Surplus (deficit) over (from) requirements ME | Surplus (deficit) over (from) requirements TP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (g) | (kg) | (Mcal) | (kg) | | | | (Mcal) | (kg) |
| 500 kg adult cow: | | | | | | | | | | | | | | | | | | | |
| [illegible] days maintenance [illegible] | 14.06 | 432 | 10.00 | 15.00 | 860 | .00 | .00 | 0.0 | .98 | 2.21 | 71 | 10.98 | 17.21 | 0.95 | 8.7 | 12.8 | 7.5 | 3.15 | 519 |
| 52 days maintenance plus late lactation (550 kg) | 19.65 | 877 | 11.00 | 16.50 | 968 | 1.80 | 4.05 | 252 | .98 | 2.21 | 71 | 13.78 | 22.66 | 1.29 | 7.1 | 9.7 | 5.5 | 3.11 | 414 |
| 217 days maintenance plus lactation 10 lt 3.5% fat | 25.66 | 1,252 | 10.00 | 15.00 | 860 | 3.30 | 7.43 | 462 | .98 | 2.21 | 71 | 14.28 | 24.64 | 1.20 | 6.9 | 9.0 | 5.9 | (1.03) | (0.49) |
| 250 kg 12-month-old heifer: | | | | | | | | | | | | | | | | | | | |
| Growing at 250 gms per day | 9.81 | 486 | 5.00 | 7.50 | 440 | 1.00 | 2.25 | 140 | .22 | .49 | 16 | 6.22 | 10.24 | 0.59 | 3.5 | 4.8 | 2.7 | 0.43 | 110 |

a/ Assumptions:
- Smallholder herd consists of 2 adult cow, 1 12-month old heifer and one heifer calf
- Calving interval of 14 months (420 days)
- Lactation of 250 days (217 days per year). Yield of 10 kg per day, 3.5% milk
- Adult cows receive 90% of crop residues DM, yearling heifer 10%, calf none
- Intake of DM from rumput gadjah by adult cows at 2.0% of BW. Nutrient content of DM: ME = 1.50 Mcal/kg DM, TP = 8.6% of DM
- Concentrate DM fed to adult lactating cows at 1 kg per 3 liters of milk produced. Nutrient content of the concentrate: ME = 2.25 Mcal/kg DM, TP = 14% of DM
- Heifer consumes DM from rumput gadjah at 2.0% of BW and receives 1 kg of concentrate DM daily

b/ Daily requirements as per appendix table 44.5

11. Smallholder swine systems (Figures VII.10 and VII.11)

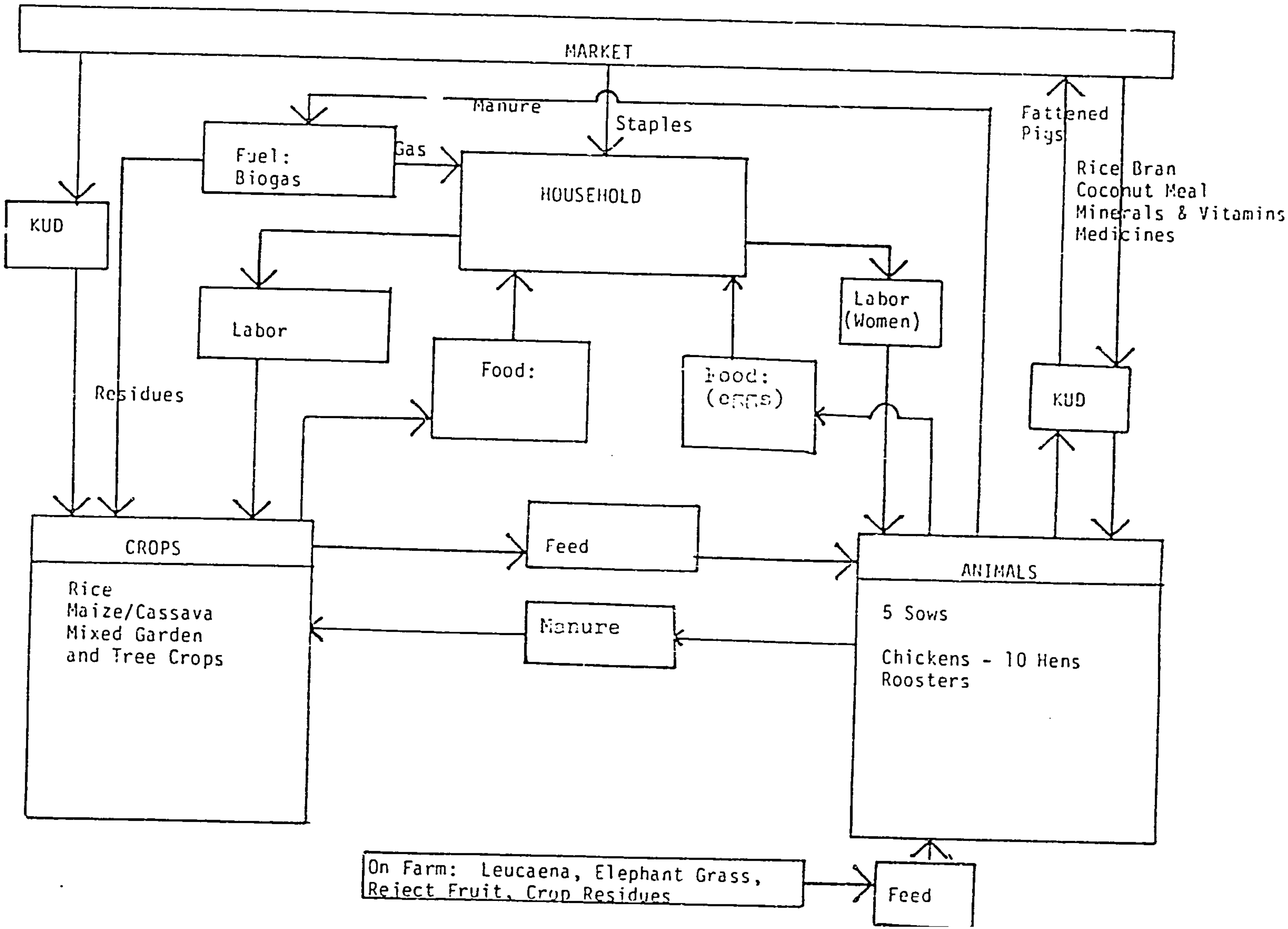
7.88 Two swine production systems have been modeled, one in Bali and the other in Irian Jaya. These are specialized operations, intended primarily to supply a local market. Other systems exist, particularly in Sulawesi, which supply the local and inter-island markets. These are crop/livestock systems in which a major portion of the cash flow is derived from off-farm sale of swine. On most farms, women are primarily responsible for care and management of the animals.

7.89 Because of the high quality management (feed purchases and crossbred animals), the income of the swine component equals the income of the crop component (table VII.26). If the swine component was expanded to a larger size, it would have to classified as a "commercial livestock system".

7.90 The smallholder system in Bali (figure VII.10) consists of two native X saddleback sows which provide young animals (about 10 kg) for a special market product known as "babi guling" as well as older animals (about 80 kg) for the general market. The feed supply from crop residues is fairly high with an estimated average of 3.03 Mcal of ME available daily from rice bran and non-rice crop residues(table VII.27). Much of the non-rice crop residue produced from cropping activities is not suitable for swine but could be utilized by small ruminants, cattle or buffalo. In table VII.28, a potential ration utilizing coconut meal to balance the deficiency of ME and TP from available crop residues is presented for the small 2 sow operation.

7.91 The small holder scheme shown in Figure VII.11 depicts a typical and traditional system in Irian Jaya in which pigs and boars are fattened. Very few pigs are sold in the market. Instead, these animals are closely tied to the social, religious and cultural activities of the large family group, i.e. the clan. Pigs are slaughtered to be eaten by the total clan on important occasions (visits by important people, wedding feasts, etc.). Pigs are also used to pay the bride price, one pig for the bride and one for each member of her immediate family. The feed supply comes from on-farm products, especially sweet potatoes and residues, as well as grazing of native pastures. The home garden is an important component of this system and on some farms provides a higher percentage of cash flow than swine production.

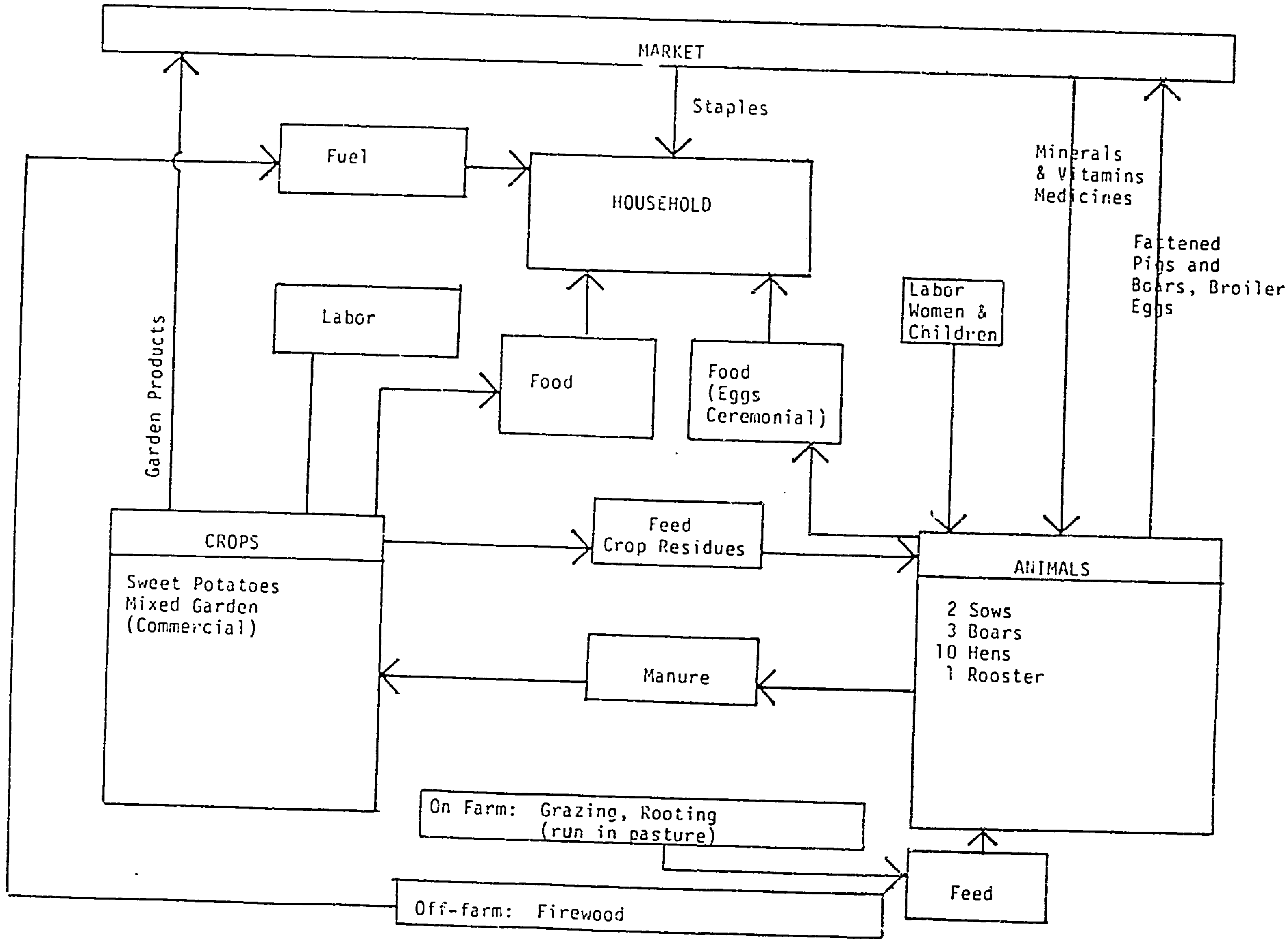
Figure VII.10. Smallholder swine production, Bali






353

Figure VII.11. Smallholder swine production system, Wamena, Irian Jaya






354

Table VII.26. Annual budget for smallholder swine production (Bali)

Farm size: 0.25 ha irrigated
0.25 ha mixed garden
2 sows (saddleback crosses)

Cropping pattern: rice-rice-palawija

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 2,000 | 280,000 |
| peanuts | 60 | 45,000 |
| soybean | 100 | 41,000 |
| mixed garden | | 250,000 |
| subtotal, crops | | 616,000 |
| Livestock: | | |
| meat (swine) | 824 | 824,000 |
| subtotal, livestock | | 2,060,000 |

Annual expenses:

| | |
|---|---|
| Crops: | 308,000 |
| Livestock: | 600,000 |

| | |
|---|---|
| Annual net return to family labor from crops: | 308,000 (49%) |
| Annual net return to family labor from livestock: | 320,000 (51%) |
| Total annual return to family labor from agriculture: | 628,000 |

Table VII.27. Metabolizable energy (ME) and total protein (TP) provided by crop residues for lowland, rice-based farming system [a]

| Crop | Yield | Residue | Residue as % of yield [b] | Residue available | Content of: ME | Content of: TP | Estimated yield of: ME | Estimated yield of: TP |
|---|---|---|---|---|---|---|---|---|
| | (kg) | | | (kg DM) | (Mcal/kg DM) | (g/kg DM) | (Mcal) | (kg) |
| Rice | 2000 | Rice straw | 84.30 | 1,686.00 | .00 | 0 | .00 | .00 |
| | | Rice bran | 10.00 | 200.00 | 2.29 | 135 | 458.00 | 27.00 |
| | | Broken rice | 5.00 | 100.00 | | | | |
| Maize | 00 | Stover | 59.60 | .00 | .00 | 0 | .00 | .00 |
| | | Husks | 10.00 | .00 | .00 | 0 | .00 | .00 |
| Cassava | 1000 | Tops | 2.50 | 25.00 | 1.75 | 150 | 43.75 | 3.75 |
| | | Peelings | 10.00 | 100.00 | 2.75 | 40 | 275.00 | 4.00 |
| Peanuts | 60 | Vines | 94.80 | 56.88 | 1.75 | 10 | 99.54 | .57 |
| Soybeans | 100 | Vines | 185.50 | 185.50 | 1.25 | 12 | 231.88 | 2.23 |
| Sweet potato | 0 | Vines | 10.20 | .00 | 2.48 | 157 | .00 | .00 |
| | Total | | | 2,353.38 | | | 1,108.17 | 37.54 |
| | Total, non-rice residues | | | 367.38 | | | 650.17 | 10.54 |
| | Total, non-rice residues per day | | | 1.01 | | | 1.78 | .03 |

[a] Values for ME and TP are as reported by Devendra and Fuller (1979) and/or estimated for pigs

Table VII.28. Potential diet for Bali smallholder pig operation utilizing on- and off-farm feed resources.

| Feedstuff | Amount available per day [a] | Daily herd requirments and amount supplied from feed: Metabolizable energy | Total protein |
|---|---|---|---|
| | (kg) | (Mcal) | (kg) |
| | | 12.68 | .560 |
| Rice bran | .548 | 1.25 | .074 |
| Broken rice | .274 | .82 | .022 |
| Cassava peelings | .274 | .75 | .011 |
| Cassava tops | .068 | .19 | .010 |
| Peanut vines | .156 | .27 | -0- |
| Cull fruit [b] | 1.000 | 2.90 | .055 |
| Subtotal, on-farm feedstuffs | 2.320 | 6.18 | .172 |
| Deficiency from requirements | | 6.50 | .388 |
| Amount of copra meal necessary to cover deficiency (kg) [c] | | 2.17 | 1.940 |

a/ Nutritional requirements as per appendix table A.8
b/ Cull fruit DM assumed to contain 2.90 Mcal ME/kg and 5.5% TP
c/ Copra meal DM assumed to contain 2.99 Mcal ME/kg and 20% TP

## 12. Smallholder commercial broiler/layer (Figure VII.12)

7.92 This is a typical system encountered in West Java and representative of operations in other parts of Java, Sumatra, Sulawesi, and Kalimantan. The layer/broiler component provides a major portion of the cash income, but rice and fruit from the mixed garden also contribute to off-farm sales. The layers begin producing eggs at 5 months of age and continue for one year at an 80% laying rate. Broilers are produced on a 6-week cycle. In both components, the supply of chicks and feed, as well as marketing of eggs and broilers, are handled on a contractual arrangement. The chickens not only provide a steady source of income but also produce valuable manure for the rice crop and mixed garden. In the crop/animal interaction, the rice straw is used for bedding and compost.

7.93 Even though modeled in a combined system, the broiler and layer components frequently comprise separate systems, especially in the development of nucleus estate management schemes. In some instances, the farm operation is restricted to the poultry component with no crop interaction.

7.94 The budget (table VII.29) shows the importance of the income from the livestock component. Figures for poultry costs and returns are borrowed from the Poultry Nucleus Estate (PIR) budget in appendix 7A which follows this chapter.

Figure VII.12. Smallholder crop-poultry (layers and broilers) production system

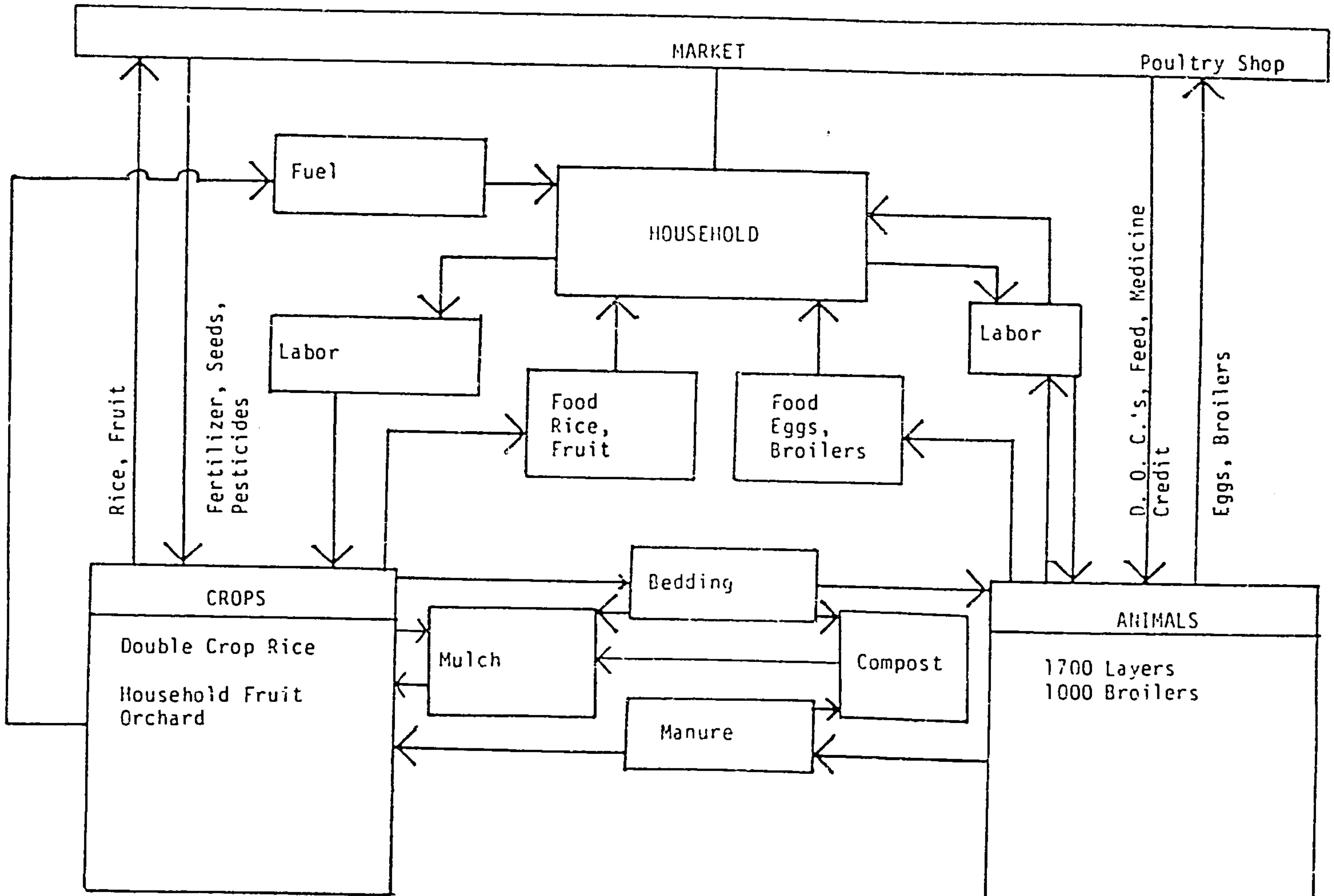


Table VII.29. Annual budget for smallholder commercial broiler/layer operation

Farm size: 0.25 ha irrigated
0.50 ha mixed garden
1,700 layers
1,000 broilers

Cropping pattern: rice-rice-palawija

Annual revenues:

| | Kg produced | Value (Rp) |
|---|---|---|
| Crops: | | |
| rice | 2,000 | 280,000 |
| peanuts | 60 | 45,000 |
| soybean | 100 | 41,000 |
| mixed garden | | 500,000 |
| subtotal, crops: | | 866,000 |
| Livestock: | | |
| eggs (see PIR budget) | | 1,500,000 (net) |
| meat (see PIR budget) | | 1,000,000 (net) |
| manure | 4,000 | 40,000 |
| subtotal, livestock: | | 2,540,000 |

Annual expenses

| | |
|---|---|
| Crops: | 433,000 |
| Livestock | (see PIR budget, appendix 7A) |

| | | |
|---|---|---|
| Annual net returns to family labor from crops: | 433,000 | (15%) |
| Annual net returns to family labor from livestock: | 2,540,000 | (85%) |
| Total annual returns to family labor from agriculture: | 2,973,000 | |

13. Smallholder commercial duck egg production (Figure VII.13)

7.95 Ducks are found on small farms where lowland-irrigated or partially-irrigated rice is produced. Intensive duck egg production is characteristic of several provinces on Java, Sumatra and Kalimantan. A more complete discussion of commercial duck egg production is found in Chapter III, "The Animal Resource Base".

7.96 The model below considers an egg production system characteristic of the Tegal region of Central Java. The principal feed source for producing hens is grazing of fallow and recently-harvested rice paddies, supplemented with aquatic weeds, snails, small fish and sago palm pith. Ducks may be herded as much as 400 km per year as the herder follows regional harvest patterns. Eggs are marketed through village traders or direct to the local village marketplace by the herder/owner's wife. Most producers buy their replacement ducklings either at 3 days of age or 5 months, ready to produce. Cull ducks are sold for meat.

7.97 The budget (table VII.30) is self-explanatory.

Figure VII.13. Smallholder market duck egg production system

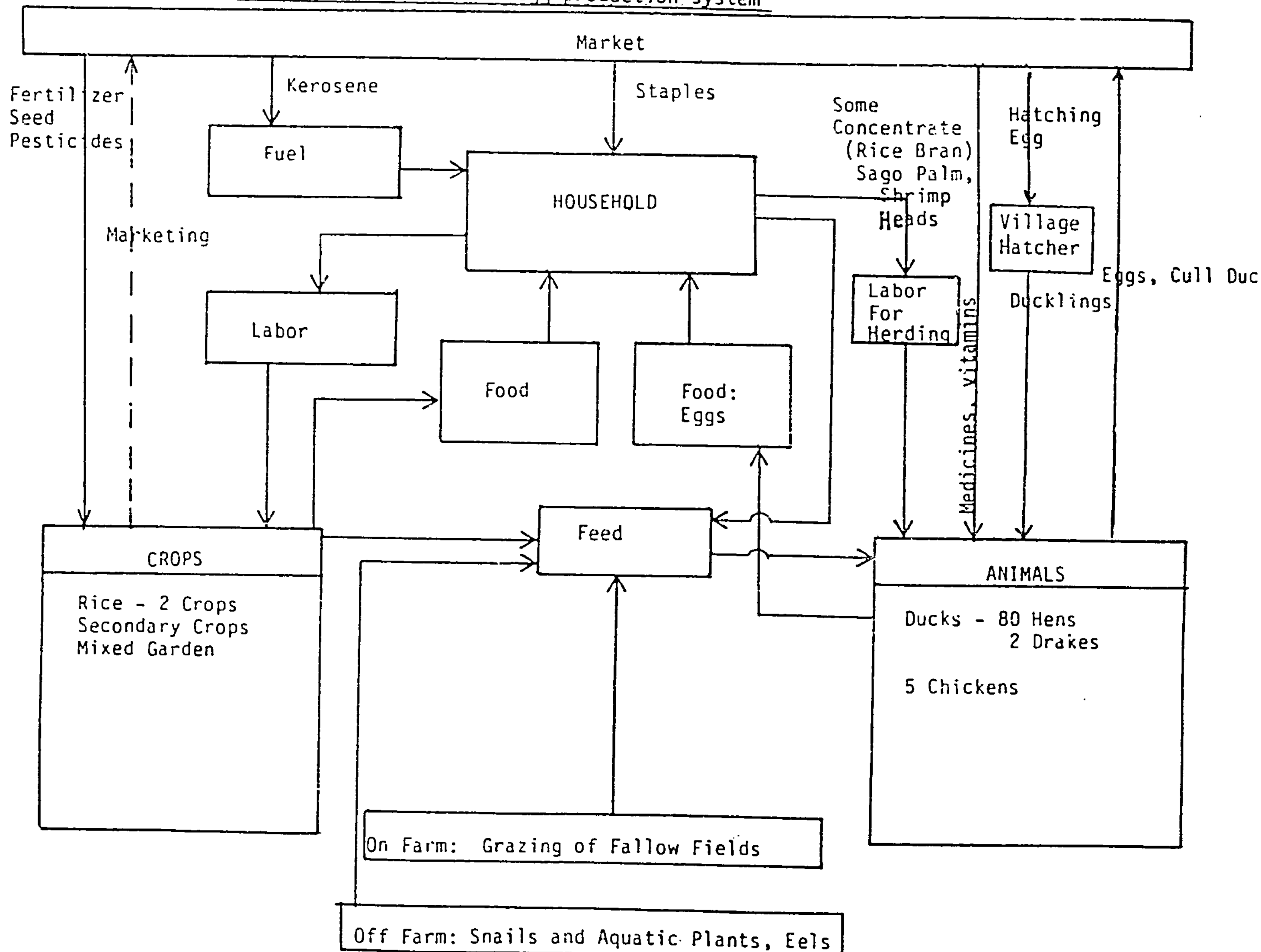


Table VII.30. Smallholder commercial duck egg production (Tegal)

Farm size: 0.4 ha irrigated
0.1 ha mixed garden
80 hens (plus 2 drakes)

Cropping pattern: rice-rice-secondary crops

| | | Units produced | Value (Rp) |
|---|---|---|---|
| Annual revenues | | | |
| Crops: | | (See budget for lowland rice-based farming systems) | |
| Livestock: | | | |
| | eggs | 12,960 eggs (premium) | 1,116,400 |
| | meat | 41 ducks | 51,250 |
| | total | | 1,217,650 |

Annual expenses

Crops: (See budget for lowland rice-based farming systems)

| Livestock: | Units | Rp/unit | Total cost (Rp) |
|---|---|---|---|
| feed: | | | |
| basic | 365 days | 1,000 | 365,000 |
| prod'n | 365 days | 550 | 148,500 |
| ducklings | (35 head/2yr) | | 106,250 |
| medicines and vits | 12 mos | 1,500 | 18,000 |
| total | | | 637,750 |

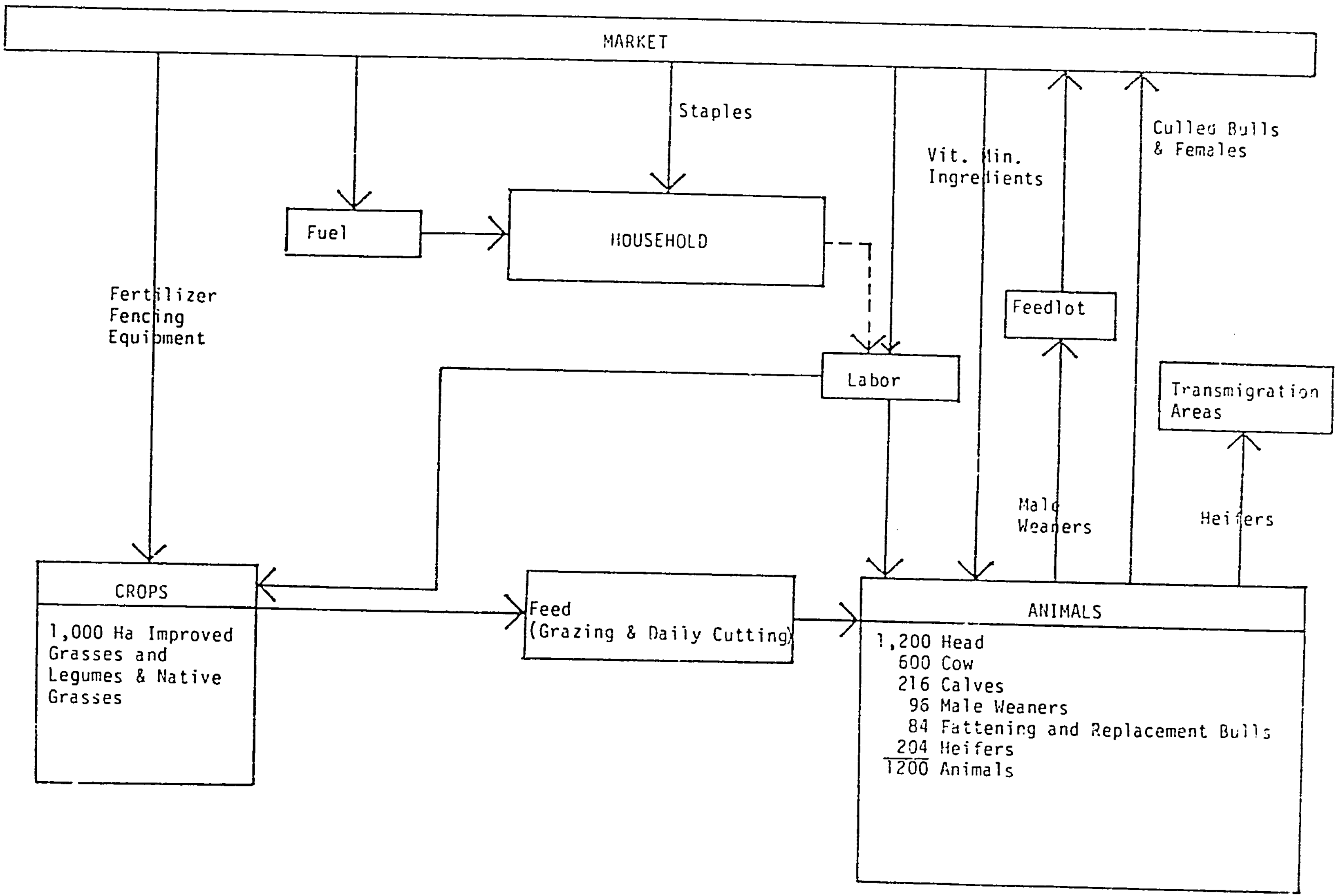
| | |
|---|---|
| Annual net return to family labor from crops | 403,800 (39%) |
| Annual net return to family labor from ducks | 637,750 (61%) |
| Total annual return to family labor from agriculture: | 1,041,550 |

14. Ranching (Figure VII.14)

7.98 The modeled system shows a general ranching operation. In general, the larger ranches with 3,000 or more animals are subsidized by the GOI. These farms should supply animals for farmer distribution through transmigration schemes, but so far have concentrated on herd building and bull calf fattening. The large and small private operations have not attracted widespread attention nor attained a high degree of success. The feed supply for the breeding herd comes from improved (fertilized grasses and legumes), and native pastures. Most large ranches engage in a feed lot fattening operation using excess bulls that are fed a rice bran concentrate ration along with green-chop forage from grasses such as elephant, brachiaria and setaria. These animals are sold to traders for the inter-island market.

7.99 Budgeting (table VII.31) for a ranching system is a difficult exercise in view of the large capital outlays, the long term of the planning process and the high variability of production levels because of variations in management and environmental factors. A more detailed economic analysis, including capital development costs, is given in Kristanto (1982) for South Sulawesi smallholder ranching schemes.

Figure VII.14. Commercial ranching with Ongoles and Brahma X Ongoles, Sulawesi






365

Table VII.31. Annual budget for beef production on large-scale ranches (Sulawesi)

Farm size: 1,000 ha native and improve pasture
1,000 head cattle (incl. youngstock and calves)
breeds: Ongole (50%) and Ongole crosses (50%)

Annual revenues

| | head | Kg | Revenue (Rp) |
|---|---|---|---|
| fattening bulls and weaners | 130 | 23,400 | 28,080,000 |
| heifers | 40 | 8,000 | 10,000,000 |
| old cows | 100 | 35,000 | 35,000,000 |
| old bulls | 15 | 7,500 | 7,500,000 |
| total | 285 | 73,900 | 80,580,000 |

Annual expenses

| | units | Rp/unit | total cost (Rp) |
|---|---|---|---|
| fertilizer | 150,000 kg | 100 | 15,000,000 |
| seeds | | | 10,000,000 |
| equipment | 250 hours | 20,000 | 5,000,000 |
| fencing | (100 million for 10 yrs) | | 10,000,000 |
| labor | 10 persons | 1,000,000 | 10,000,000 |
| interest (10%) | | | 20,000,000 |
| subtotal | | | 70,000,000 |
| miscellaneous (10% of costs) | | | 7,000,000 |
| total costs | | | 77,000,000 |
| Annual net returns to management and land | | | 3,500,000 |



366

D. Strengths and weaknesses

7.100 Table VII.32 provides an overview of the linkages between the livestock and the crop components of the major Indonesian farming systems. Linkages are weak in the shifting agriculture system where all animals are scavengers, in the Amarasi model where most of the feed comes from the planted fallow crop "lamtoro" (leucaena) and for the semi-commercial livestock farmers (dairy and poultry). For those systems with strong linkages between the livestock and crop components, such as the partially irrigated upland farming system, changes in cropping patterns and crop yields would be expected to have a significant impact on livestock productivity and on income derived from the livestock component.

Table VII.32. Linkages between livestock and crop components by type of farming system

| Criterion: | % of income from livestock | % of ME [a/] requirements from crops | Livestock-crop linkage |
|---|---|---|---|
| Type of farming system: | | | |
| Lowland irrigated | 52 | 45 | strong |
| Partially irrigated upland | 46 | 50-60 | strong |
| Rainfed upland | 25 | 25 | medium |
| Shifting agriculture | 27 | - | weak |
| Mixed estate/food crops | 32 | 30 | strong |
| Mixed food crops with fattening | 70 | 20 | medium |
| Amarasi model | 49 | 5 | weak |
| Dairy smallholder | 73 | 5-13 | weak |
| Swine smallholder | 65 | 48 | strong |

a/ ME = metabolizable energy

7.101 The diversity of farming systems in Indonesia evolved and developed in response to population densities, available soil moisture, soil fertility and topography and has been influenced by culture and tradition. Common attributes among systems, however, permitted the identification of three general categories, namely 1) food crop-based, 2) estate crop-based and 3) livestock-based farming systems. By use of simple diagrams which highlight the household, labor use, the role of crops and animals, sources of food and feed and off-farm linkages, composite-type systems were described and characterized so as to appreciate and understand the interactions and relationships of physical, environmental and social elements of the whole farm operation. These analyses identify strengths and weaknesses of the crop-livestock systems, permit comparisons across environments, allow for structuring of research and development strategies and provide guidelines for agencies and individuals at the farm level to study the whole farm enterprise in more detail. Essentially, this comprises the Farming Systems Research/Extension approach. Information from this approach assists planners at the macrolevel to develop more appropriate regional and national policies for the well-being of small farmers.

7.102 A strong interaction and interdependence exists among components of the food crop-based systems in which animals provide draft power and off-farm sales. In turn, they utilize the crop residues and by-products and facilitate the recycling of nutrients through manure and compost. In the livestock-based systems farmers are still highly dependent on crop and mixed garden residues and by-products as a source of feedstuff, except for some of the beef fattening and poultry operations. Some farmers whose cash income is largely derived from livestock have established improved grasses and legumes on their farm sites. This increases the nutrient input into the system which, of course, benefits the crop component. There is less animal-crop interaction in the estate-based systems, but this could be increased by more effective utilization of legume ground cover under rubber trees and oil palms, as well as establishment of improved grasses and legumes under coconut palms.

7.103 Even though farmer-animal holders have effectively taken advantage of the spontaneously occuring grasses and native vegetation and crop residues, a basic need for improvement and development of the livestock sector is an increased amount of higher quality forage, especially during the dry season. The amount of native grass and vegetation available for cut-and-carry and grazing does not exceed 3 to 5 tons/ha of dry matter on an annual basis and in some localities will be less. The improved grasses and legumes which have moved onto farms are usually managed the same as native species, i.e., not fertilized and cut when needed regardless of growth stage. Thus, forage yield and quality are far below their genetic potential.

7.104 The cropping systems program of AARD has developed and promulgated modified cropping patterns over the past 15 years. Since the cropping systems are more intensified with the inclusion of additional secondary legume crops, additional feed supplies will be available. In 1982, a livestock systems program was established in AARD to study farmer profiles in regard to feed supply and animal management practices. Unfortunately, the two entities with a common interest in components of farming systems have only cooperated on occasion.

7.105 A well-organized forage research program is established in the Research Institute Animal Production (BPT) of AARD. Basically, the promising and potentially important grasses and legumes have been sorted out, and many are established in nurseries of nine DGLS UPT forage stations (see Chapter VI, appendix 6A), several provincial stations, demonstration farms, and introduction gardens of various universities.

7.106 Sufficient research data and observations already obtained warrant immediate on-farm trials and demonstrations, e.g., elephant grass, setaria, brachiaria, improved guinea grass and leucaena for cut-and-carry, several trailing legumes for overseeding grasslands in the humid areas, drought tolerant stylos (verano and seca) for the drier areas, leucaena planted on the contour of steep slopes, and various grasses and legumes under coconuts. This will require a supporting policy by the GOI and the



368

Ministry of Agriculture, additional trained staff (both research and extension, especially subject matter specialists), a well-organized and orchestrated training program, and on-farm follow-up visits. Additional research is needed in regard to overseeding rice peddies with rapid-growing, short-season legumes, treatment of rice straw to improve its nutritive value, testing of diverse genetic materials of the promising grass and legume species (especially hybrids of *Penniseteum purpureum*, elephant grass, and *P. americanum*, pearl or bulrush millet). There is a need for a country-wide survey of fodder trees and shrubs, their present utilization and potential. For an effective farming systems approach, the CRIFC cropping systems and BPT livestock system programs must collaborate and integrate their respective programs.



361

# Part V. SECTOR ANALYSIS

## CHAPTER VIII. LIVESTOCK SECTOR PROJECT ACTIVITIES, DEVELOPMENT STRATEGIES AND POLICY OPTIONS

### A. Current Projects and Programs

8.1 The review which follows highlights some of the main projects and programs dealing with livestock development. The emphasis is on central government efforts, but it should be remembered that most of these schemes are joint central government - provincial government programs, or are sponsored entirely by provincial government funds. There were simply too many provncial government programs to attempt a listing in this report. In addition, programs sponsored primarily by the private sector are also mentioned

8.2 In addition to the listing of projects which follow, the results of many other project activities have been mentioned in the preceding chapters (e.g., Bali Cattle Development program, foot and mouth disease eradication program). The section which follows merely attempts to provide a brief listing of major activities in the livestock sector to serve as a background for discussion of development strategy. Given the current emphasis placed on animal distribution schemes and dairy development relatively more emphasis is placed on these areas.

1. Intensification of Draft Animal Scheme (INTEK for "Intensifikasi Ternak Kerja")

8.3 This project started in 1985. BRI provides credit for cows and fodder plantings. The participating farmers are organized into groups of 25 farmers. Each farmer receives two animals. Repayment is made through income generated by hire services.

2. APBN Livestock Distribution Projects

8.4 These are implemented by Provincial Dinas Peternakan staff using national budget funds. Animals (primarily Bali, Madura and Ongole cattle, with smaller numbers of water buffalo and goats) are procured in Indonesia and distributed to cattle- and buffalo-deficit areas (primarily transmigration sites) under Sumba contract systems. Distribution projects are discussed in more detail later in the chapter.

3. Village Chicken Intensification Scheme (INTAB or "Intensifikasi Ternak Ayam Buras")

8.5 The focus is on providing vaccination services and extension services to selected producers. Only very limited development has taken place and data is not available to provide a basis for discussion on progress or problems.

4. BPSD - Bimbingan Peternak Sapi Daging:

8.6 This is one of the Provincial livestock distribution program. The standard Sumba contract is used requiring the repayment of 2 offspring, each 2 1/2 years old over 5 years. These are redistributed immediately with females going to other producers under the same contract and males distributed for fattening to smallholders who receive 60% of the value of body weight gain when the animal is sold. The Directorat General for Transmigration operates under similar terms and conditions.

5. Beef Cattle Development Scheme (Panca Usaha Ternak Potong - PUTP)

8.7 Smallholder credit for cattle purchases supervised by provincial DGLS staff, with farmers actually selecting animals.

6. Nucleus Estate Scheme for Poultry (PIR or "Perusahaan Inti Rakyat")

8.8 Various types of nucleus estate schemes are being promoted by DGLS and provincial Livestock Services in an effort to help implement Kepres 50, the Presidential Decree limiting individual ownership of chicken units maximum size levels to 5000 layers or 750 broilers per week. The program focus is to use existing poultry shops as the "inti" or nucleus with smallholder poultry producers as the "plasma". Implementation was to be through cooperatives and farmer groups (Kelompok). The cooperatives were to act as agents, buying inputs such as day-old chicks ("d.o.c.s"), feed and pharmaceuticals from feed mills or poultry shops and distributing these to farmer groups. The objective is to improve the farmers bargaining position and reduce input marketing margins. In practice, the operating costs of the cooperatives have wiped out the bulk purchase discounts (usually 15% for cash payment) that they received. Also, farmer repayment problems to both the cooperatives and poultry shops were mentioned as the major problem during field visits.

8.9 A number of poultry shops have set up contract systems with growers which help the shops maintain a regular market for their products and, in some contracts, also allow the poultry shops to market eggs or broilers. Since each shop has discretion over how they etablish contracts with participating producers, there is no single model thatr represents these schemes. Several variations are described in appendix 7.A.

7. Program Kesejahteraan Keluarga (PKK)

8.10 This is the Family Development Program, one activity of which is a marobati system (see Chapter II) for goat sharing. The does are owned by the village as part of the PKK program, the animals are loaned out to farmers, sales of offspring are divided 50:50 between farmer and PKK and the doe is returned to PKK when it is due to be sold as a cull. PKK uses proceeds to replace breeding stock.

8. Central Projects under DGLS with external support

a. Projects under Technical Assistance Grants

- Yogyakarta Animal Disease Investigation Center+ Project (ATA 321), Canada.

- Regional Diagnostic Veterinary Laboratory Project for the provinces of West Sumatera, Riau, and Jambi (ATA 231), West Germany.

- Veterinary Drug Control project, Gunung Sindur, Bogor, (ATA 297), Japan.

- NTT Livestock Development Project, (ATA 138), Australia. Also providing technical assistance components (as a grant) to Nusa Tenggara Development Project (section "b" below).

- Baturaden Dairy Development Project, Central Java, (ATA 174), EEC.

- International Course on Diagnosis of Animal Diseases and their Control programme, BPPH Medan, Japan.

- Assistance for Poultry Marketing for Small Producer (TCP/INS/4407), FAO, Completed in 1985.

- Livestock Sector Review, (ATA 345), ADB. (This report prepared under this grant)

- Eastern Island Veterinary Service Project, (ATA 132), Australia.

b. Project Under Loans or Grant/Loan Mix

- Smallholder Livestock Development Project, Phase I and II, IFAD. (Phase II also includes World Bank Funds). More discussion on this in section 9 below.

- South Kalimantan and Sumatera Livestock Development Project (ADB I).

- Second Kalimantan Livestock Development Project (ADB II).

- South East Sulawesi Transmigration Area Development Project (SESTADP), ADB and Canada.

- Transmigration Area Development Project II (IBRD) (DGLS not lead agency).

- National Agriculture Extension Project (NAEP II) (DGLS not lead agency).

- Nusa Tenggara Development Project, World Bank (DGLS not lead agency).

- Transmigration area development projects (World Bank), various provinces (see discussion, section 9, below).

c. Project Proposals Submitted for 1985/86

- Strengthening of Artificial Insemination Centre, Singosari, East Java (ATA 233), Japan assiatance requested.

- Smallholder Milk Handling, (ATA 318), Belgian Assistance requested.

- Proposal for Livestock Slaughter house and Marketing Project - Loan No. 725 - INO (ADB), proposal to ADB (DGLS not lead agency).

- Livestock Development in Transmigration Areas

- Feasibility study and the establishment of Animal Disease Investigation Centre in South Kalimantan - (ATA 231) Australia/Canada assistance requested.

- Pilot Project of Embryo Transfer, (ATA 388), British assistance requested.

- Feasibility study for Development of Mini Ranch in South Sulawesi (ATA 372).

- Feasibility Study for Duck development in Selected Areas (ATA 373).

9. Animal distribution and repayment schemes

8.11 This section provides additional detail on some of the projects mentioned briefly above, as well as some additional projects not yet listed. Given the major allocation of resources within the livestock sector for these activities, a more detailed look at these programs seems warranted. Chapter II provided background on the mechanics of Sumba contracts and variations thereof. Most of the major formal livestock distribution or "dropping" programs have been implemented since the mid-1970s and have been heavily oriented towards cattle, although virtually every domestic livestock species has been provided to producers at some stage.

a. Status

8.12 The distribution of animals has been the predominant development strategy for the livestock sector. Distribution programs have been carried out by a large number of Indonesian agencies under many different sources of funding. The major efforts have been by the Provincial Livestock Services with funds provided by Central Government and Provincial Government. Examples include the Presidential Decree progr m (INPRES) which was immediately followed by the Sapi (Cattle) Crash Program. These coincided with the start of the South Kalimantan and Sumatra Livestock Development projects under an ADB loan. Continuing programs are in place through the Department of Transmigration which collaborates with Provincial Livestock Services to distribute animals in transmigration areas. The programs in Aceh Province during Repelita III are illustrative (table VIII.1)

8.13 A number of provinces provided the study team with what appeared to be reasonably complete inventories of current animal numbers resulting from these dropping programs, and data on births, deaths, and redistributed animals from each of these programs. Field visits by the study team confirmed that these figures, even if accurate, concealed tremendous variation in both animal performance (particularly reproduction and mortality rates) as well as patterns of animal utilization relative to their intended uses. Many of the underlying problems causing poorer than expected animal performance are now generally known. Therefore, the study team did not attempt to go through the time consuming effort that would have been required to attempt a summary of these distribution programs. A summary of production figures for the ADB I Project in South Kalimantan, as of March, 1985, is presented in tables VIII.2 and VIII.3. The conclusions and recommendations dealing with animal distribution programs in the context of development strategies and policy options (Section "B" below) relies on consultant reviews of these figures backed up by study team field visits and extensive discussions with personnel involved in these efforts as well as with recipients.

b. Selected examples from field visits

8.14 To gain insights into actual operation of animal distribution progams in the field, the study team visited a wide range of distribution activities and was impressed by the ability to tailor the schemes to local needs. The distribution schemes are characterized by having many different types of repayment plans, and different types of "packages" tied to the distribution of animals. A broad range of examples is cited below. A more detailed discussion of the major animal distribution schemes sponsored by IFAD in Jambi and Lampung and by ADB in South Kalimantan is presented in section "B" which deals with sector development strategy

8.15 1) Desa Kolam Kiri (Transmigration), South Kalimantan: They use the usual Sumba plan, i.e., return two calves for each cow received within 5 years; the young stock is 18-24 months of age when returned. This is part of the ADB project area.

8.16 2) Village Farm, Wamena, Irian Jaya: This project involves sheep. The GOI gives 3 sheep to a farmers, one ram and two ewes. The farmer must pay back three lambs within 2 years. After that, the ewes and rams belong to the farmer. There were no problems with repayment.

8.17 Distribution of cattle was being carried out in the same village. A farmer received one bull and one cow. The bull was for joint use with other farmers. The pay back plan was two young animals within 5 years. These were Bali cattle and there were no problems as the cows gave one calf each year.

Table VIII.1: Summary of animal distribution programs during Repelita II, Aceh Province

| Breed | Sponsoring agency | No. distributed by year 1979 | 1980 | 1981 | 1982 | Purchase from |
|---|---|---|---|---|---|---|
| Brahman | Presidential Program | 0 | 462 | 0 | 0 | Australia |
| Brahman crossbred | Crash Program | 0 | 0 | 2332 | 0 | Australia |
| Ongole | Transmigration National Budget | 0 | 0 | 50 | 0 | South Sulawesi |
| Bali cattle | Transmigration National Budget | 0 | 0 | 266 | 0 | South Sulawesi |
| Murrah Buffalo | Provincial budget | 0 | 0 | 0 | 20 | Medan, N. Sumatra |
| Ettawah goats | Provincial Dev. Program | 0 | 0 | 20 | 75 | N. Sumatra/Java |
| Hybrid layer chickens | Provincial budget | 0 | 0 | 500 | 0 | Jakarta |
| Day old local duckings | Provincial Dev. program | 10,000 | 10,000 | 0 | 0 | Medan |

Source: Rancangan Repelita IV Daerah Sub Sektor Peternakan, Aceh, 1984.

Table VIII.2: Survival of originally distributed livestock in ADB I Project, South Kalimantan as of March, 1985

| Kind of livestock and breed | Year of distribution | Number distributed | | | Deaths | | | Current stock | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| Cattle: | | | | | | | | | | |
| Bali | 1982 | 1800 | 180 | 1980 | 185 | 27 | 212 | 1615 | 153 | 1768 |
| | 1983 | 1797 | 178 | 1975 | 145 | 12 | 157 | 1652 | 166 | 1818 |
| Sumba Ongole | 1982 | 0 | 172 | 172 | 0 | 10 | 10 | 0 | 162 | 162 |
| | 1983 | 600 | 60 | 660 | 44 | 4 | 48 | 556 | 56 | 612 |
| Brahman Cross | 1982 | 2216 | 33 | 2249 | 290 | 6 | 296 | 1926 | 27 | 1953 |
| | 1983 | 535 | 32 | 567 | 55 | 5 | 60 | 480 | 27 | 507 |
| Goats: | | | | | | | | | | |
| Ettawa | 1982 | 1665 | 333 | 1998 | 1407 | 286 | 1693 | 258 | 47 | 305 |
| Kacang | 1984 | 1754 | 118 | 1872 | 107 | 16 | 123 | 1647 | 102 | 1749 |

Source: ADB (1985). Based on Project Implementation Body data and Asian Development Bank (1985), "Livestock Development in South Kalimantan: a Project Benefit, Monitoring and Evaluation Study", in cooperation with Lambung Mangkurat University, Banjar Baru, South Kalimantan.

Table VIII.3: Total animals born and young animal mortality rates in ADB I Project, South Kalimantan as of March, 1984

| Kind of livestock and breed | | Year of distribution | Total offspring | | | Dead offspring | | | Surviving offspring | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| Cattle: | | | | | | | | | | | |
| | Bali | 1982 | 749 | 835 | 1584 | 65 | 152 | 277 | 486 | 465 | 951 |
| | | 1983 | 140 | 141 | 281 | 24 | 37 | 61 | 111 | 104 | 215 |
| | Sumba Ongole | 1983 | - | - | - | - | - | - | - | - | - |
| | | 1984 | 18 | 22 | 40 | 10 | 8 | 18 | 8 | 14 | 22 |
| | Brahman Cross | 1983 | 235 | 220 | 455 | 46 | 65 | 111 | 187 | 154 | 341 |
| | | 1984 | 85 | 87 | 172 | 34 | 27 | 61 | 51 | 60 | 111 |
| Goats: | | | | | | | | | | | |
| | Ettawah | 1982 | 495 | 481 | 976 | 242 | 245 | 487 | 253 | 236 | 489 |
| | Kacang | 1984 | 59 | 34 | 93 | 8 | 4 | 12 | 51 | 30 | 81 |

Source: ADB (1985). Based on Project Implementation Body data and Asian Development Bank (1985), "Livestock Development in South Kalimantan: a Project Benefit, Monitoring and Evaluation Study", in cooperation with Lambung Mangkurat University, Banjar Baru, South Kalimantan.



377

8.18 3) Catholic Church, Wamena, Irian Jaya: They select a group of three people and then sell three cows and one bull (Bali cattle) to each group. The package is valued as follows:

| | | |
|---|---|---|
| 3 Cows | - | Rp. 600,000 |
| 1 Bull | - | Rp. 200,000 |
| Total | | Rp. 800,000 |

The group has to pay back the principal at 1%/month at the end of three years, at 36% interest:

| | |
|---|---|
| Investment | Rp. 800,000 |
| Interest | Rp. 288,000 |
| Total | Rp. 1,088,000 |

Farmers expressed pleasure with this program and anticipated no problems in repayment due, in part, to high beef prices in this province (Chapter VI).

8.19 4) Irian Jaya Development Foundation, Jayapura: The IJDF has distributed 2,500 Bali cattle to the indigenous people who are not transmigrants. The procedure followed is to select a group of people, sell five cows and one bull to that group which pays back two young stock (2 years old) for each cow within six years. The schedule of payback is as follows:

| | |
|---|---|
| Years 1 & 2 | none |
| 3 | 2 |
| 4 | 2 |
| 5 | 2 |
| 6 | 4 |
| 6 | 10 |

This foundation is growing and now has two full-time people working in the program. They will expand.

8.20 5) Desa Sorong, transmigration village: The contact farmer (kontak tani) leads 20 households. Brahman crosses were distributed. Farmers receive one cow and will pay back two offspring (two-year old calves) within five years. He reports the same problem as explained earlier. The reproduction rates in Brahman crosses are low.

8.21 6) Waimital, the Moluccas (near Ambon): One group received five Bali cows and one Bali bull, and they have paid back 10 young stock within 5 years.

## B. Development Strategies and Options for the Livestock Sector

8.22 In this section, information from Chapter I through VII and part A of Chapter VIII is synthesized into a series of development strategies which the study team recommends should form the basis for further discussion within GOI as well as between GOI and donor agencies. Where possible, we also attempt to spell out some policy options that are available and the probable consequences of those policies. In addition, individual chapters contain summary sections dealing with strengths and weaknesses and/or future prospects in a specific area.

1. Livestock distribution schemes as a foundation for a livestock sector development strategy

8.23 In addition to the field visits mentioned in section "A" above, extensive visits were made to the IFAD cattle distribution sites in Lampung and Jambi provinces and to the ADB South Kalimantan Livestock Development Project sites. These projects highlighted both the strengths and weaknesses of the distribution programs as well as the critical factors leading to success or failure.

a. IFAD Cattle Distribution Scheme in Lampung Province

8.24 The study team felt that this project was meeting the stated goals and that there are some lessons to be learned that could be applied to livestock sector development strategies and policies. The basic reasons that this project appears to be working fairly well are as follows:

- Most recipients are in reasonably well developed agricultural areas whwere there is now some cash cropping and marketing/transportation infrastructure in place.

- The density of recipients per km$^2$ is high enough that animal sharing for draft power teams is possible and project extension/supervision efforts are more timely and efficient.

- The PMU's are located in the centers of the recipient areas, thus facilitating farmer access to technical assistance.

- There is a good transportation system for animal distribution and for the provision of planting material and other extension services.

- The infrastructure for draft power services is already in place including wide availability of plows, cart frames, blacksmiths and farmers skilled in building and using these items.

- The forage introduction program was straightforward with well-adapted, productive species available and few problem soils to deal with.

- The project focused on older transmigration areas where farm sizes of the remaining transmigrants were now large enough to make good use of the draft animals and devote a specific area to forage crops.

- There are large areas of cash crops, primarily tree crops, pepper, etc. that provide a good outlet for manure.

- Farmers have enough capital to buy a plow and cart to effectively utilize the introduced cattle.

- Adapted cattle (Bali breed) were distributed that were small enough to survive on the local feed resource base.

- The project management structure was set up based on prior experience with both internally and externally funded animal distribution projects. Task forces were a key element.

8.25 The relatively good performance of the IFAD project can also be seen by comparing it with results of the INPRES program in the same province over the period June 1981 - December 1984. These animals were primarily "Brahman cross" from Australia. A total of 714 animals were dropped. Over a 3 1/2 years period, 452 calves were born of which 59 died. An additional 121 of the original cows and bulls died. Adult mortality rate was 17% over the three years while the calf mortality rate was 13%. Assuming the females were bred before shipment, calving percentage averaged 38% per annum after accounting for cow mortalities. The target for repayment was 1,363 calves over 5 years. After 3 1/2 years, only 270 calves were repaid to the project. Results for both the INPRES and "Sapi Crash Program" showed similar performance coefficients for most of the provinces visited where these project were active. Obviously, lessons learned from these earlier programs have been applied to the IFAD scheme.

b. IFAD Cattle Distribution Scheme in Jambi Province:

8.26 In this IFAD-supported scheme, 2,018 Bali cattle were distributed in May, October and November 1984. The August, 1985 inventory was 1,984 adults for losses of 172 animals (8.5%) over a period of about a year. A total of 81 calves were born as of August, 1985. Out of 389 households surveyed in one "block", only 4 were using the animals for draft power, mainly because the land was full of stumps, too hilly, the animals too wild or the recipients couldn't afford to buy a plow. Losses were said to be due to Malignant catharral fever because the site was too near to existing concentrations of sheep.

8.27 Despite these problems, the project seemed to be faring better than the IBRD II Transmigration Project in the same general areas of Jambi Province. This is probably because of the use of "Brahman cross" cattle from Australia in the latter project while the IFAD project uses cattle procured within Indonesia. The figures below summarize population changes to date:

IBRD Project, Brahman cross from Australia:

| Dropped in October, 1983 | | | Inventory, August, 1985 | | | |
|---|---|---|---|---|---|---|
| Bulls | Cows | Total | Bulls | Cows | Total | Calves |
| 91 | 1593 | 1684 | 171 | 1084 | 1255 | 251 |

8.28 A total of about 329 adult cattle had died or been otherwise disposed of in about 2 years, a loss of about 20%. About 20% of the surviving cows had calved in 2 years. The transmigration block with the highest losses, Singkut, had only 615 adults left from the 1,045 dropped, a 41.5% loss and only 47 calves born from the surviving cows, a calving rate of 10% or less. Losses were diagnosed as mainly due to mineral deficiencies and parasites. Most of the reasons for lower than anticipated result in Jambi parallel the reasons for good success in Lampung:

- The Jambi sites are generally undeveloped agriculturally. Less than 1/2 the farm sites are cultivated and much of the area is still under slash and burn agriculture. Cash crops such as coffee, cloves and rubber are not yet producing income, and crop yields have declined markedly after the first one or two crops. Far: rs have neither the money to buy a plow or the incentive to use it since over 1/2 the farm is still in jungle.

- Population density of both people and cattle is still low.

- PMU's have more dispersed areas to cover, in general, since transmigration sites in Jambi are scattered.

- Transportation is not as well developed and roads in the transmigrations areas are impassable during the wet season.

- Draft power equipment and repair infrastructure not in place in Jambi.

- Forage introduction has been more difficult because of acid soils and need for liming.

- Developed area of farm still small, need for draft power less since much of cleared areas going into tree crops.

- Demand for manure is very hig'. in Jambi as well as in Lampung. Not a major difference.

- Farmers have virtually no working capital in the transmigration areas visited in Jambi.

- Cattle were well adopted for both provinces, not a factor.

- Project management structure similar, not a factor.

- The cattle were only recently distributed in Jambi. IFAD Project experience has shown rapid increases in reproduction and decreases in animal mortality over the first 3 years, from 10% reproduction in year 1 to 45% in years 2 and 3. Utilization of animal for draft power has also increased over the life of the project.



381

### c. South Kalimantan Livestock Development Project

8.29 This project illustrates the problems inherent in starting a major animal distribution scheme in an area without the technical or physical infrastructure for necessary support. It also illustrates the flexibility shown by both the donor agency (ADB) and GOI which allowed mid-course adjustments to be made which have resulted in much improved performance, particularly by goats. The project was due for completion by late 1985. By December, 1984, only 606 males and 6,482 female cattle had been distributed as opposed to project targets of 17,000 females and 850 males (40% of target, table VIII.4). For goats, a total of 3,533 had been distributed while the project target was 32,000. About 11% had been distributed relative to the target.

8.30 Changes in project policy can be seen from data presented in table VIII.4. The very high mortality rates found for the breeds that were initially imported into the project site (Ettawah goats, Brahman cross cattle) led to the decision to use different breeds. Mortality rates were much lower for the breeds used after the policy change (kacang goats, S.O. and Bali cattle). The same result can be seen by comparing reproduction rates (table VIII.4) for the initial breed chosen (Brahman cross) as compared to the breed selected after problems arose (Bali cattle) with the original Brahman crosses.

8.31 The lessons to be learned from this project is that monitoring and flexibility are key components when introducing a range of new activities into areas with little infrastructure and into institutions with little experience in project implementation. Therefore, broader objectives must be considered when formulating "pioneer" types of projects and should include an element which allows for consideration to be given to building up the basic physical and institutional infrastructure as well as the benefits to be realized from the experience gained to help acheive better performance from subsequent activities of a similar nature.

### d. Summary and conclusions

8.32 The conclusions for utilization of animals for draft obviously applies only to cattle and buffalo but the other conclusions regarding forages, animal management, health problems, breeding/reproduction, and nutrition apply equally well to small ruminants. Distribution program involving other species (poultry, pigs, rabbits) have been very small and are not considered here.

8.33 Use of animal manure has been widely accepted and plays a larger role the poorer is the farming system. Lime, animal manure and chemical fertilizers are a key package in many of the transmigration areas. As transmigration continues to expand into areas of more marginal soils, the role of animals will become even more critical. However, unless there is a high probability of using large ruminants for draft power, sheep or goats (particularly goats) should be carefully considered because of their higher reproduction rates, ability to selectively utilize a wide variety of forages, by-products, tree leaves and shrub legumes, and their high quality manure. However, as ADB I project has found, selection of local breeds for suitability is critical as well as being able to mount an effective scabies and orf (sore mouth) control program.

Table VIII.4: Distribution and performance of cattle and goats, ADB South Kalimantan Livestock Project

Distribution:

Cattle:

| Bali | | S O | | Brahman Cross | | Total | |
|---|---|---|---|---|---|---|---|
| male | female | male | female | male | female | male | female |
| 299 | 2,639 | 201 | 1,092 | 106 | 2,751 | 606 | 6,482 |

Target: 17,000 females
850 males    40% distributed

Goats:

| male | female | |
|---|---|---|
| 418 | 3,115 | planned 32,000<br>11% distributed |

Mortality rates as of March, 1985

Ettawa goats: 1938 distributed
305 survived
85% mortality

Kacang goats: 1872 distributed
1749 survived
7% mortality

| Brahamn cross cattle: | 1982 | 1983 |
|---|---|---|
| | 2249 distributed | 567 distributed |
| | 1953 survived | 507 survived |
| | 13% mortality | 10.5% mortality |

Sumba Ongole cattle: 1983

660 distributed
612 survived
7% mortality

Reproduction (as of March, 1985): 3597 Bali cows 1865 calves
2751 Brahman cows 627 calves

Credit package: one heifer - 18 month old offspring in yr 3
18 month old offspring in yr 5

one male + five female goats - 12 kids, 6-8 months old within a five year period

Source: ADB (1985)



382

8.34 Utilization of animals for draft has almost always been much less than planned for. While utilization levels will eventually increase over time in most project areas, we feel that all project plans and budgets that we examined grossly overstate the economic and financial benefits of distributing animals in transmigration areas. Conversely, we feel the value of manure is usually understated although estimating precise benefits from manure in these diverse farming systems would be a difficult task.

8.35 Animal health problems, by themselves, have not been a major problem with the exception of Ettawah goats in South Kalimantan and a few other isolated cases (e.g., IBRD project in Jambi). However, animal health problems in conjunction with severe nutritional stress has had serious effects on reproduction, young animal growth, animal mortality and working ability of draft animals. Therefore, a team or "Task Force" approach is called for with high levels of support from the A-type and B-type labs.

8.36 It is felt that the gap between the number of transmigrant households being set up each year and the number of animals available for distribution is so large that animal distribution programs must be targeted towards limited areas where they will have the maximum impact. It is also recommended that recipients be provided with a high quality Javanese steel plowshare and the provision of rubber-tired cart chassis be considered for selected recipients. The review of the transmigration program highlighted some criteria that seem relevant. However, these criteria also imply that animals should be distributed to transmigration areas that are relatively better off in terms of soils, general infrastructure and household economic status. Unfortunately, transmigrants that have the most critical need for animals to provide manure and cash income tend to be those that have poorest resource base for animal production and the lowest probability of using the animals for draft power. Despite these equity considerations, it is recommended that distribution schemes be carefully targeted to those areas where they will have the maximum economic impact in terms of reproduction performance and utilization for draft power. Selection of target areas and selection of farmers therefore needs to consider not only criteria such as farm size and farmers experience with draft animals but also must consider the physical condition of the fields (stumps, rocks, slope, suitability of soils for plowing, etc.) as it affects the ability to plow, the likely mineral nutrition of the animal based on the soils of the area, sources of feedstuffs and suitability of the area for forages, distance from animals pens to fields to be fertilized. and the farmers ability to purchase a plow or cart.

8.37 Where animal manure will obviously be needed to develop a viable cropping system but there are several negative factors working against using animals for draft power, sheep and/or goats should be targeted for these sites. The existing and potential feed resource base and the availability of adequate family labor to operate a cut-and-carry feeding system must then be carefully assessed. Introduction of hair sheep into specific areas should also be considered.

8.38 Despite problems encountered in the field, the study team was generally impressed with the flexibility project staff had shown in dealing with the problems and the many innovative approaches being tried by Task Force teams to overcome some of these problems.

2. Potential role of Nucleus Estate Schemes as a component of a livestock development stratey:

8.39 A number of potential projects that we describe could logically be structured under a Nuclear Estate Scheme (NES) framework, particularly in cases where animal distribution and support services could then be conveniently grouped as an operating unit with responsibility for a project within a given geographic area. However, we feel that there are enough differences between the NES projects operated in the Estate Crops sector and the organizational structure needed to implement most of the projects described in Chapter IV below that to attempt to introduce NES concepts into livestock projects would, in most cases, be confusing and inappropriate. An exception are the NES-type schemes for poultry that are being set up by poultry shops, sometimes in cooperation with Provincial Livestock Services. For other projects such as draft cattle improvement, animal distribution, dairy projects, pig projects or smallholder fattening, we favor the "Task Force" approach for implementation for most of the projects. These allow the formation of goal or task oriented multidisciplinary team of technical staff on a project-by-project basis yet does no require the costs or bureaucracy associated with NES type of schemes.

3. Role of BULOG in the livestock sector and its impact on development

8.40 Chapter VI described briefly the institutional role of the National Logistics Organization (BULOG) in the livestock industries in Indonesia. The main function of BULOG has centered around both stabilization and support of rice prices. It also has a role in the procurement and distribution of other "strategic" commodities such as imported soybeans, soybean meal, and fish meal, local chicken meat, and local beef. The role of BULOG in the latter two commodities has centered around building up adequate stocks of meat prior to major Islamic Holidays and then releasing these stocks (primarily in the Jakarta market) to prevent rapid price increase during these periods. No further analysis of this role is carried out here.

8.41 BULOG's role in the maize market has been much more limited than for rice. Floor prices that BULOG has established for maize have generally been below existing market prices so producers have little incentive to sell to BULOG. There have been periods when maize imports have been necessary to meet feed industry requirements in which case BULOG acts as the sole importer and resells to feed mills or agents. Virtually all of this corn is from Thailand. Total shipping, handling and inspection costs incurred by BULOG are detailed in the report by De Boer (1984) and averaged $26/ton for 1982/83. The other key feed ingredient controlled by BULOG is soybean meal. Although soybeans are also imported by BULOG, they are resold to soybean food product manufacturers and enter the animal feed chain only through the use of soybean processing by-products. There is no soybean crushing facility in Indonesia at the current time so government policy regarding soybean imports does not affect soybean meal prices directly. However, there are plans to establish a soybean crushing facility in Indonesia within the next few years in which case soybean procurement and pricing policy would become very critical issues for the livestock industry. These issues are now developed in more detail.

a. Maize:

8.42 BULOG imports maize to fill short term needs of the feed milling industry. A much more detailed analysis of the maize industry in Indonesia is given by the recent study by the Food Research Institute, Stanford University. Since Indonesia is usually self-sufficient in maize, BULOG imports have little price effects on the market. Also, high internal transportation costs often make it cheaper to import maize from Thailand than from maize surplus areas in Indonesia. Therefore, we do not consider BULOG's role as the monopoly importer of maize a major issue for the livestock industry although there seems no good reason why the feed mills should not be allowed to import maize on their own account when domestic supplies are insufficient. A total of only 58,951 tons of maize were imported in 1984.

b. Soybean meal (SBM):

8.43 BULOG, as the sole importer, has been able to make substantial profit from soybean meal imports. In addition, in an effort to conserve foreign exchange, it has been directed to limit the quantity of soybean meal imported. Both these policies have resulted in high poultry feed costs in Indonesia and higher than necessary prices paid by poultry consumers. It also limits the ability of Indonesia poultry producers to compete in the export markets for frozen broilers, fresh eggs, or frozen liquid eggs.

8.44 Imports of soybean meal in 1983 were 142,344 tons rising to 195,746 tons in 1984 and the projected figure for 1985 is 110,000 tons. Feed mills have to apply to BULOG for allocations. These are seldom enough to meet their needs and the remainder of the meal has to be purchased from agents. About 70% of SBM is sold directly to feed mills and 30% is sold to agents. Every feed mill visited complained about soybean meal procurement procedures, erratic supplies and high prices. October 1985 f.o.b. U.S. Gulf prices for soybean meal were U.S.$160 per ton for 44% protein meal. Shipping and handling to Indonesia is approximately $40/ton for bagged meal making the landed cost $200/ton or Rp 180/kg. BULOG selling prices were Rp 274.5/kg while mills purchasing their additional needs from agents were paying Rp 290 - 310/kg. The impact that this has on feed costs is shown below:

8.45 Poultry feeds: Concentrate mixes are purchased by farmers, particularly smallholders, who then mix the concentrate with corn, rice bran and other high energy feeds to form a complete ration. The purchase concentrate forms about 25% of the complete ration and is 50% of the cost of the complete ration. Concentrate feed is typically 70% soybean meal and costs about Rp 450/kg. Reducing soybean meal prices to import parity would reduce the cost of the concentrate feed by about Rp 85/kg or 20% and reduce the cost of complete rations by about 10%. Final product prices would be reduced accordingly. Costs are also increased by the common practice of selling underweight sacks. The tenders are for standard bags of 61 kg but actual weights of bags upon delivery are often less so the feed mill loses. Much of this leakage then reappears in the hands of agents who then resell to the feed mills at a higher price.

8.46 The impact of lowering soybean meal prices can also be estimated based on the typical poultry rations below:

| Ingredients (%) | Ration | | | | |
|---|---|---|---|---|---|
| | Broiler starter | Broiler finisher | Layer starter | Layer grower | Laying mash |
| Corn | 54 | 55 | 52 | 55 | 48 |
| SBM | 26 | 23 | 17 | 10 | 14 |
| Copra meal | 6 | 6 | 7 | 6 | 6 |
| Fish meal | 7 | 7 | 7 | 6 | 7 |
| Meat and bone meal | 2.5 | 2.5 | 2.5 | 2 | 2 |
| Rice bran | 3.5 | 5.5 | 14 | 20 | 16 |
| Oyster shell, minerals, fat | 1 | 1 | 0.5 | 1 | 7 |
| Cost/kg | 302 | 288 | 267 | 235 | 240 |
| Cost/kg with cheaper SBM | 266 | 256 | 243 | 221 | 220 |
| % cost reduction | 12 | 11 | 9 | 6 | 9 |

8.47 The restricted supplies of soybean meal also affect feed quality, levels of animal performance and unit costs of production. This limits market growth, increase producer costs and depresses poultry farmers incomes.

8.48 This issue is particularly important in the proposed village poultry project (Chapter IX) since the major justification for the project is the ability of smallholders to purchase concentrate feed and mix this with their own rice bran and corn. The same holds true for smallholder duck development programs where concentrate feed has an even higher protein content and a higher soybean meal percentage.

8.49 Two other issues are of concern. First is the ability of the poultry industry to continue to expand if soybean meal imports are restricted since there is no readily available substitute at a reasonable cost. The second is the ability of Indonesia to develop local export markets for poultry products when faced with high feed costs and restricted imports of soybean meal.

8.50 Pig feed: Pig starter complete ration contains 30% soybean meal. Reducing the cost of soybean meal from Rp 300/kg to Rp 180/kg would reduce the cost of the feed from Rp 166/kg to Rp 130/kg, a reduction of 22%. For fattening rations, soybean meal is 15% so the cost per kg would be reduced from Rp 131/kg to Rp 113/kg, a reduction of 14%. The same arguments apply as they do to the poultry industry; that industry expansion will be limited under current policies and that the development of an export market for pigs or pork will be restricted. This is relevant because of current prospects for developing an export market to Singapore.

c. Soybeans

8.51 BULOG imports soybeans at world market prices and resells them on the local market at prevailing prices for processing into human food products. The price differential is such that considerable profits accrue to BULOG. Current world market prices (October, 1985) are $ 210/ton or about Rp 188/kg. After adding transport and handling, the landed cost Jakarta would be about $ 225/ton or Rp 200 kg. Open market prices in Indonesia are about Rp 500/kg. Soybean imports July 1984 - June 1985 were 325,500 tons so BULOG profits on soybean sales would be about $ 260/ton or about $ 85 million over the above period. There are plans to build a soybean crushing plant in Indonesia in 1987. The manner in which imported soybeans are priced for this plant will obviously have a major impact on the non-ruminant sector. If the plant can purchase soybeans at world market prices, it should be able to produce soybean meal for the Indonesia market at import parity prices. This would bring down soybean meal costs considerably. If soybeans were priced at current local market prices, soybean meal would become prohibitively expensive. Obviously, there would have to be some means of segregating beans imported for crushing from locally produced soybeans since the price differential is to large than incentives exists for diversion of soybeans to the higher priced local market.

4. Development strategies and policies for the dairy industry

8.52 Chapters III and VI presented a thorough review of the current status of the dairy industry in Indonesia and the current and future problems that the industry faces. In Chapter IX, we suggest a potential project that would help overcome some of these problems. This project proposal is based upon the following development strategy which reflects our study of the current industry. We also suggest some changes in policy which should be seriously considered and analyzed before major additional investments are made in the dairy sector.

8.53 Although the prices for dairy products in Indonesia are relatively high by international standards and are very high relative to Indonesian income levels, the industry has grown because of the stimulus afforded by increasing the effective rates of protection provided the producers and by large investments of public funds at every stage of the production, collection and distribution chain. While GOI has legitimate goals to promote the industry on both economic and social welfare grounds, we feel that there are more cost effective means by which to establish a viable industry and to better attack the current technical problems which plague the industry.

8.54 Our recommendations include the following:

- Incorporating milk collection and handling into the private sector using milk factories as the nucleus.
- Introducing different breeds of cows and semen into the breeding program to improve overall production efficiency.
- Increasing the milking herd through crossbreeding programs rather than through large-scale importations of costly cattle.
- Much better animal health services are needed at the farm level and overall milk quality control needs improvement. Dairy factories have a vested interest in this and would impose better overall control on milk quality.
- Increasing the base butter fat % from 2.8% to 3% or 3.2% to stop watering of milk which is now a common practice and adds to handling and processing costs and reduces quality.

8.55 It is felt that the above changes would help solve many of the procurement and marketing problems that the industry faces. Therefore, the focus of project activities in the dairy sector should be on the production side and should be channeled through DGLS and Provincial Livestock Services rather than through the Ministry of Cooperatives. The development strategy outlined above is also appropriate for dairy cattle and many of the low input-high return practices that are mentioned there are relevant to dairying. A much improved extension effort will also be required to obtain the substantial reduction in milk production costs that is needed.

8.56 We also recommend that GOI make a firm decision as to the desireable size of the domestic dairy industry and then formulate a development strategy to achieve that goal at the lowest possible cost. Current policy is too open-ended and will lead to uneconomic expansion of the industry, high cost of dairy products, and a low growth of consumption of dairy products.

### 5. Strategies and policies for overcoming animal disease constraints on production

8.57 Considerable progress has been made in the past decade in the development of animal health services in Indonesia. The provision and maintenance of adequate veterinary support in such a large country with a diverse animal population is, however, a massive task which is being made more difficult by constraints at three levels. The following section attempts to identify some of the constraints beginning at the field level. Methods of tackling these constraints are summarized in the list of recommendations.

#### a. Level 3: Disease status

8.58 Information now issuing from field and laboratory services provides a general perspective of animal disease. Data is most detailed in the regions supported by the Disease Investigation Centres (Sumatra, Java, Bali,Sulawesi) while the position in Kalimantan and eastern Indonesia is less clear at least in relation to endemic and sub-clinical conditions.

8.59 Nevertheless there is an urgent need to obtain more accurate data on both the total spectrum of disease in each livestock sector and to determine the real economic impact of the commonest problems. To accomplish this task it will be necessary to improve the efficiency of both field staff (veterinarians and veterinary assistants) and diagnostic laboratories.

8.60 Sufficient information is now available to identify some of the problems that require intensive investigation and to which more resources should be allocated. They include:

8.61 Protozoal and rickettsial diseases of ruminants (anaplasmosis, babesiosis, theileriosis): Laboratory data from West Sumatra indicates a high incidence of these infections in the region, especially in the wet season. Their related vectors and vector life-cycles are not clear but they must be understood if the best control methods are to be devised. The possibilty of vaccination does not seem to have been considered but expertise should be available from Australia.

8.62 There is a need for specific identification of the *Theileria* species in West Sumatra and elsewhere. If it is *T. mutans* it may be of little significance. If it turns out to be *T. annulata*, methods of control (e.g. vaccination) should be explored.

8.63 Trypanosomiasis (*T. evansi*), widespread in Indonesia, is already being investigated through joint research by BALITVET, Bogor and Provincial Livestock Services in Java but the work should be extended to other areas where a clinical problem appears to exist (Sulawesi). Geographic distribution, incidence and its effect on production indices all need to be determined.

8.64 Bacterial diseases of ruminants: Haemorrhagic septicaemia is reportedly common in parts of the country but laboratories of all types show few isolations of *Pasteurella* spp. More accurate information on the bacterial strains involved and the epidemiology of the disease is required. The development and use of vaccines giving longer immunity should be considered in areas where the disease is shown to be a problem. These may already be available from other countries but Indonesia should take steps to assess and justify its own needs.

8.65 Virus disease of ruminants: Several active centres of research are now making progress. At Medan infectious bovine rhinotracheitis has been intensively studied and it appears to be common in North Sumatra. Further data on morbidity, mortality and general epidemiology should help to define the economic importance of the disease and any control measures that may be applied.

8.66 Malignant catarrhal fever is being investigated at several laboratories (BALITVET (Bogor), Medan, Denpasar) and some success in exprerimental transmission of the disease has been obtained. More accurate information on the geographic distribution and prevalence of the disease is required as control may sometimes be applied by changes in management eg. separation from small ruminants. A similar condition, Jembrana disease, is the subject of research on Bali supported by IFAD.

8.67 Arbovirus infections: There is a need to clarify the nationwide status of production-limiting diseases such as ephemeral fever, Akabane disease and Orbivirus infection ("Bluetongue") that are known to be present. Work in progress at BALITVET should be expanded.

8.68 Infertility: Low reproduction rates are commonly reported in cattle and buffalo but little systematic work has been done on the problem. Laboratories should consider establishing multi-disciplinary studies in problem areas to define the nutritional, managerial and infectious factors that may be involved. The dairy industry and ranching operations need this service as much as the draught/beef system.

8.69 Neonatal mortality: Various authorities report serious losses in calves, small ruminants and poultry in the first few weeks of life. Such losses can be of great economic importance irrespective of the size of the unit and should be considered unacceptable. Most causes have proven methods of prevention which may not be expensive.

8.70 Mortality in imported cattle and buffaloes: Serious losses have been experienced among cattle imported from Australia and elsewhere. A 38.4% mortality rate from acute disease in buffaloes was reported from West Sumatra in 1984. Over a three-year period 46% of a consignment of dairy cattle to the same region had died. Such losses are unacceptable both in terms of animal and economic loss.

8.71 Closer collaboration should be developed between the exporting and importing authorities to select prophylactic methods against disease of the region and an intensive herd health program should be developed to monitor the animals after distribution at the rural level. Causes of death need to be more accurately diagnosed if disease is to be prevented. Lack of immunity to indigenous infections probably contribute substantially to these losses so that it is vital for the background of disease in the reception area to be accurately understood. Appropriate vaccination might reduce the losses significantly.

8.72 Regional disease patterns: Greater veterinary resources are required to monitor animal disease in Kalimantan and the large area east of Lombok. The new DIC laboratory at Banjar Baru will assist the former areas significantly. B and C type laboratories in the eastern islands should be strengthened by supplying basic diagnostic kits (microscopes, reagents, glassware).

b. Level 2: Veterinary services:

8.73 Field services: Good communications (roads, telephone, radio, transport) are necessary if veterinarians and veterinary assistants are to be fully effective. It is here that one of the weakest links exists. Progressive improvement may be expected as part of national development but the process could be reinforced by including infrastructural components in bilateral veterinary aid programs. Vehicles and petrol in particular are needed to allow staff to reach the farmers and their livestock.

8.74 The service fulfils two essential roles: (1) diagnosis and (2) prevention or treatment. Diagnostic services involve clinical examination and in some cases sampling and dispatch of samples to the laboratory. There is evidence that the field-laboratory transfer is often ineffective because of the time taken for samples to reach the laboratory (e.g. 9 days in one program). Such samples are useless for laboratory culture and a large amount of professional time and money is wasted. Formalin-fixed materials for pathological examination are usually satisfactory but often less useful for accurate diagnosis.

8.75 Field staff should give consideration to the efficiency of dispatch and samples should only be sent if the laboratory is able to process them within a short period (e.g. 1 day). Training programs in basic diagnostic procedures would be helpful.

8.76 Vaccination programs will fail if the vaccine is not properly stored and handled. The success of the foot and mouth disease eradication campaign (1973-83) depended heavily on the supply of refrigeration. Virus vaccines are especially vulnerable and programs for Newcastle disease and other avian diseases must be supported by coolers if biologicals are not being used immediately. This problem occurs mainly at village level as larger commercial producers are well aware of the need for viable vaccine. Their economic survival depends on it. Use of oral vaccination with heat-resistant strains of ND virus is being tested in Malaysia and may be applicable in Indonesia.

8.77 Research: Considerable impetus has been give to veterinary research by the establishment of Australian and British development projects at BALITVET, Bogor. A broad portfolio of research is now directed at the solution of major disease problems in Indonesia (Chapter V). New information and techniques are being distributed to the DIC laboratories and field services by staff training and written material.

8.78 Because of the magnitude of the disease problem in Indonesia, however, other sections of the veterinary service should be encouraged to develop mission-oriented projects. Already the DIC laboratories are active in this field but the universities, field services and pharmaceutical industries have considerable potential either independently or better, through joint investigations. There is no reason why private consultants should not carry out minor research such as epidemiological surveys as part of their routine work provided that they can obtain some laboratory support.

8.79 Diagnostic laboratories: Development of the DIC system is still in progress with the recent establishment of facilities in South Kalimantan. Many staff members are still in training and when this phase is completed the laboratories should have a good professional base.

8.80 It is essential that each laboratory should also have a core of well-trained technologists. Their experience and skills are as important as those of the scientists. More formal training of laboratory technologists should be regarded as essential if the DIC system is to be fully effective. Selected technical staff should be allowed to study overseas to at least diploma level to become familiar with both established and new techniques.

8.81 Since it is difficult for each laboratory to be proficient in all disciplines, consideration must be given to nominating individual DICs as specialist centres, e.g. in protozoology at Bukit Tinggi or toxicology at Maros, South Sulawesi. The higher level of technology at the Central Veterinary Laboratory, BALITVET, Bogor, should be recognized and a larger amount of material referred to it for identification or more detailed examination. Links with BALITVET should also be used to encourage joint research activities.

8.82 There is evidence from a number of centers that maintenance of equipment is seriously inadequate and must affect the quality of teaching, diagnosis and research. Microscopes in particular are highly vulnerable to fungal infection in the Indonesian environment if airconditioning is not available in the laboratory. Much greater care should be taken to protect instruments from contamination.

c. Level 1 : Training and finance:

8.83 Training: Reference has already been made to the universities and the need to strengthen teaching programs and the technical facilities at each faculty. Their role in graduate training and continuing education is of national importance but equally that role will remain difficult to fulfill as long as resources, including libraries, are inadequate (Chapter V).

8,84 Finance: Funding by central government in Indonesia as in all other countries will be influenced by its perception of the importance of animal disease in reducing food production, inhibiting exports or affecting animal health. The case for giving increased funding is weakened by lack of economic data on the effects of disease. There is a need for intensifed epidemiological studies and economic analysis of the major animal diseases which cause death, infertility, reduced weight gain or output of milk or eggs.

8.85 All parts of the veterinary services, research, laboratory diagnosis and field workers can assist in analyzing losses in the various production systems. It is essential that the real major causes of economic loss be identified.

6. Strategies for improving performance of livestock marketing and processing

8.86 As Chapter VI indicated, the marketing of livestock products is generally satisfactory and the conditions leading to competition are present at most locations. Low farm-gate prices are generally more related to distance, transport costs or lack of local effective demand than to lack of competition per se. The focus on development strategies for the marketing of live animals should be on further provision of cost-reducing ifrastructure rather than on direct public sector involvement in the marketing process. Infrastructure could include farm-to-market roads, establishment of new market sites, establishment or enlargement of holding grounds, improvement of selected port facilities to facilitate use of specialized livestock transport ships, and provision of more and better market information. Despite a current GOI program within DGLS to improve quality of livestock statistics, the study team still found many shortcomings in statistical information related to livestock and feed resources and further strengthening in this area will provide for much improved monitoring of overall sector performance.

8.87 In the area of slaughtering and meat processing, a clear trade-off was evident between cost of facilities and the hygienic status of the products. The continued preference for fresh, warm meat also acts as a constraint on improving product hygiene. There does, however, exist considerable need and scope for putting up intermediate (in terms of size, hygienic status, and efficiency of effluent disposal) size slaughterhouses in many of the provincial or district capitals to cope with the increasing complexity of the meat distribution system and with the rising externalities associated with traditional slaughtering facilities located in or near rapidly expanding urban areas.

8.88 The extra cost involved is a legitimate cost to be borne by the public sector because of the responsibility of the government for public health protection. This applies both to the products sold as well as those disposed of which can cause serious public health effects, particularly through public water systems.

### 7. Development strategies and policy options for feed resources

8.89 Smallholder production systems: As discussed in Chapter IV, Indonesian farmers are making good use of feed resources, both on-farm and harvested in the immediate area of the farm. Major constraints to animal productivity related to feed resources are in availability of forages during the dry season and the provision of balanced rations to support higher levels of performance. There is some indication that mineral imbalances may be responsible for low reproductive performance in cattle, particularly in areas of poor soils settled by transmigrants in the Outer Islands. A major effort needs to be undertaken to develop systems of feeding which integrate technology for preserving forages in the form of hay and silage for dry-season feeding, the provision and strategic use of mineral supplements, and the use of high-protein supplements, especially leucaena, for the balancing of rations. This effort should be based upon research results already available from the BPT and universities like Gadjah Mada and from the practical experiences of farmers in projects where introduced and adapted feeding systems have facilitated high performance of livestock.

8.90 Commercial systems: There is an immediate and serious need for an integrated, country-wide system of monitoring of quality control of commercial feeds. At present time, the only laboratory facilities for quality control are in the larger feed mills in Java and Sumatra. Considering the importance of the commercial poultry, swine and dairy industries to the country, the lack of DGLS quality control capabilities needs to be addressed with the development of appropriate laboratories and monitoring programs.

8.91 Chapter IV identified several feed resources not currently being used in Indonesia which have high potential for reducing costs for the production of meat, milk and eggs. An effort should be made to determine the economics of utilization of feedstuffs such as palm kernel meal which currently flows directly from palm oil mills to export markets.

8. Development strategy for animal resources

8.92 Chapter III provided detailed information on Indonesia's animal resource base, including current and potential levels of productivity. The general conclusion was that Indonesia has a unique mix of animal resources, most of which are capable of producing at much higher levels. Chapter IV through VII then examined the various constraints which cause this gap in perfomance. Our conclusion is that the most cost effective approach to improve output of the livestock sector is to increase the productivity of the existing stock of animals, most of which will continue to be managed under smallholder conditions.

8.93 Current GOI policy focuses heavily on increasing livestock populations rather than upon the output of the population. The Provincial Livestock Services are under constant pressure to achieve or surpass targets for growth in animal numbers. As we indicated in Chapter VI, there is some doubt about the validity and accuracy of these population figures. However, a much more serious problem is the impact that this policy has on livestock productivity and output of animal products. The immediate consequences of this policy are the ban on slaughter of potential reproducing females and the ban on live animal exports. Another has been the large scale imports of cattle and, to a lesser extent, water buffalo, in response to supposed declines in animal populations. As we have shown elsewhwere in this report, the Crash Import Programs have had virtually no impact on livestock populations because of high mortality and low reproduction rates.

8.94 As a result of this emphasis on numbers, many areas of Indonesia have large numbers of unproductive female animals and are heavily overstocked. Farmers have a very difficult time getting female animals certified as being incapable of reproduction and illegal slaughter under poor hygienic conditions is widespread. Confidential studies by Gunn Rural Management in Lombok showed that culling unproductive females and surplus males would result in a decrease in large ruminant population but a large increase in the annual marketable surplus of animals. We have no doubt that similar studies in other overstocked areas of Indonesia such as Sumba, Sumbawa and South Sulawesi would give similar results. Also, given the current animal price structure, it makes no economic sense for livestock holders to slaughter productive breeding cows and therefore there seems little justification for the current ban on slaughter of females. Individual producers have a much better idea of which females are productive and which should be culled for slaughter than do local Livestock Services staff.

8.95 Regarding the ban on livestock exports, no conclusive evidence was found that this contributed to increased livestock numbers in Indonesia. In fact, this policy seems contradictory to current GOI policy which emphasizes increasing non-oil exports. An excellent market exists in Malaysia where only 20% of red meat consumption is met by local production. There are two reasons why we feel that lifting the export ban would have little or no adverse effects on Indonesia consumers or on livestock populations. First, Indonesian prices for animals and for red



395

meat are close to international trading prices. This implies that export sales would be relatively small and would have little or no local market price effects that would harm Indonesian consumers. Second, export sales would basicaly substitute for local sales and would be unlikely to reduce animal populations. In certain areas of Indonesia, the development of export markets would help dispose of excess animals, encourage production efficiency, encourage the production of higher quality animals and animal products, and help create the demand for improved marketing infrastructure. We feel that certain areas of Indonesia would benefit substantially from removing the export ban and then actively encouraging exports of animals and animal products.

8.96 Finally, to implement these policies, the evaluation criteria for provincial livestock performance will have to change from one focusing on numbers to one focusing on production and productivity. Otherwise, there will be no incentive for Livestock Services officials to actively encourage policies to cull unproductive animals or to promote export sales overseas or even to other provinces within Indonesia.

8.97 Chapter III indicated that, in most cases, the existing animal resource base in Indonesia is well suited to the range of environments and farming systems under which livestock are produced. Furthermore, this chapter indicated that under good conditions of feeding and management, local livestock breeds are capable of excellent reproduction, growth and mature weights. With the exception of dairy cows, the widespread introduction of European and sub-tropical synthetic or crossbred cattle does not appear to have had any noticeable affect on the industry. In fact, study team field notes, Provincial Livestock Services animal monitoring data, and ADB Project Benefit Monitoring and Evaluation data clearly indicate that under adverse conditions, imported cattle perform much worse than local breeds It is therefore concluded that puting resources into a large A.I. program for beef cattle or dual-purpose buffalo is not justified. Neither is the proposal to introduce embryo transfer technolgies into Indonesia. We recommend a development strategy which makes more efficient use of existing animal resources. Most of the projects recommended are based upon this development strategy. Various sections of this report highlight areas where it is felt that low cost, low input strategies would bring about substantial improvements in animal performance and very high returns per Rupiah invested. Examples include village poultry vaccination and feed supplementation, improvements in utilization of crop by-products and residues, distribution of mineral blocks in areas of problem soils, distribution of plow shares in conjunction with cattle/buffalo dropping programs, improved mastitis control in dairy cattle, routine control of internal parasites and scabies, development and dissemination of low-cost techniques for silage making, and expansion of the availability of selected forage planting materials. This strategy has two major implications for the livestock sector. First, more emphasis must be placed on putting relatively more technical staff in the field and in providing them with the inputs and transportation to get the job done. Second, most of these programs will require a "Task Force" structure to tackle the multiple problems that producers face. The task forces would normally require well-trained technical personnel in forage agronomy, animal health and nutrition/management. Both these policy issues are discussed in sections A and B of this chapter.

8.98 The simple herd simulation exercises carried out in Chapter III provide support to the strategy outline above. Relatively minor increases in overall herd/flock performance levels will have a much greater (and a more immediate) impact than long-term programs based on imported animals. An exception is the dairy industry discussed above. Many of the projects described in Chapter IX are designed specifically to provide the types of support needed to obtain these increases in productivity from the existing stock of animals. Selected changes in GOI approaches and policies towards the livestock sector would make these projects even more effective.

9. Strategy for institutional support

8.99 Many of the strategies and recommendations outlined in this chapter will require gradual changes in the institutions servicing the livestock sector. The same holds true with most of the project profiles developed in Chapter IX.

8.100 This report has clearly identified the trend in which both the DGLS and Provincial Livestock Services are becoming more involved in animal distribution and commodity development programs as well as in the provision of technical inputs to support these programs. This implies a growing need for well-trained technical staff to support these efforts as the responsibility of these agencies shifts away from their traditional roles (data colection, routine animal health and animal inspection services, market regulations, registration of firms, and animal quarantine) towards more active roles in technical support to development programs. In the opinion of the study team, the concerned agencies have been slow to adjust to these needs and staffing patterns still show a heavy imbalance towards administrative positions. The pattern is more lopsided than that shown in table VIII.5 since, in reality, a large proportion of listed technical staff are, in fact, acting in essentially administrative roles. While the provincial staffing patterns show considerable variation in the proportion of technical to administrative/clerical staff, many have well in excess of 50% administrative positions.

8.101 In our experience, technically oriented institutions seldom require over 30% of their staff to be classified as administrative/clerical. In addition, we are concerned about the overall level of financial and manpowwer support provided to the Directorate of Livestock Extension. This Directorate has less than 10% of total positions in DGLS. As a result of field visits by the study team it was determined that the most effective extension services were provided in conjunction with externally funded projects where Task Forces consisting of younger, well-trained and motivated staff were serving as effective extension personnel. In provinces where there were no major projects there was very little in the way of effective, goal oriented extension work being carried out.

8.102 Various sets of figures were provided on budget allocations for Livestock Services. The most figures made available to the study team are shown in table VIII.6. This table does not include provincial funding for the various Provincial Livestock Services. These figures represent considerable growth over the figures cited in the IBRD/FAO Report (1978) which quoted a budget of $ 8.7 million in 1976/77. This represents annual budget growth of slightly over 10% per annum compounded, a figure higher than the growth of Indonesia's GNP over this period and higher than the growth of GOI expenditures.

8.103 Specific recommendations for staffing patterns, manpower development and training needs are beyond the scope of this report. Virtually all of the projects developed in Chapter IX have training/manpower development components. Rather than developing an overall manpower development plan for the livestock sector, it may be preferable to tie training/manpower to specific types of activities where training could be focused on specific problem-solving situations. The increasing capacity of Indonesians educational institutions should help ensure an adequate supply of technical staff.

Table VII.5: Staffing patterns in the Directorate General of Livestock Services and in Provincial Livestock Services Departments

| Unit | Technical staff | Admin. staff | Total | % Technical staff | % Admin. staff |
|---|---|---|---|---|---|
| **Directorate General of Livestock Services, 1984** | | | | | |
| Secretarial | 26 | 122 | 148 | 18 | 82 |
| Direcotrate of Programming | 29 | 38 | 67 | 43 | 57 |
| Directorate of Production | 32 | 40 | 72 | 44 | 56 |
| Directorate Livestock Dist. + Devel. | 32 | 52 | 84 | 38 | 62 |
| Direct. Animal Health | 34 | 33 | 67 | 51 | 49 |
| Direct. of Economic and Processing | 33 | 28 | 61 | 54 | 46 |
| Direct. of Extension | 32 | 17 | 49 | 65 | 35 |
| Total, DGLS | 218 | 330 | 548 | 40 | 60 |
| **Provincial Livestock Services** | | | | | |
| Aceh | 200 | 71 | 271 | 74 | 26 |
| North Sumatra | 383 | 149 | 532 | 72 | 28 |
| West Sumatra | 92 | 26 | 118 | 86 | 14 |
| Riau | n.a. | n.a. | n.a. | n.a. | n.a. |
| Jambi | 57 | 82 | 139 | 41 | |
| South Sumatra | 164 | 118 | 282 | 52 | 42 |
| Lampung | 129 | 57 | 186 | 69 | 51 |
| Bengkulu | 49 | 51 | 100 | 49 | 51 |
| West Java | n.a. | n.a. | 490 | n.a. | n.a. |
| Central Java | 186 | 188 | 354 | 53 | 52 |
| D.I. Yogyakarta | 28 | 50 | 78 | 36 | 64 |
| East Java | 528 | 1,196 | 1,724 | 31 | 69 |
| West Kalimantan | 115 | 39 | 154 | 75 | 25 |
| Central Kalimantan | 39 | 78 | 117 | 33 | 67 |
| South Kalimantan | 60 | 61 | 121 | 50 | 50 |
| East Kalimantan | 73 | 51 | 124 | 59 | 41 |
| North Sulawesi | 74 | 76 | 150 | 49 | 51 |
| Central Sulawesi | 169 | 81 | 250 | 68 | 32 |
| South Sulawesi | 265 | 180 | 446 | 59 | 41 |
| South East Sulawesi | 73 | 85 | 158 | 47 | 53 |
| Bali | n.a. | n.a. | n.a | n.a. | n.a. |
| West Nusa Tenggara | 213 | 120 | 333 | 64 | 36 |
| East Nusa Tenggara | 345 | 314 | 659 | 52 | 48 |
| Mollucu | 152 | 78 | 230 | 66 | 34 |
| Irian Jaya | n.a. | n.a. | n.a. | n.a. | n.a. |
| East Timor | n.a. | n.a. | n.a. | n.a. | n.a. |

(continued)

Table VIII.5: (Continued)

| Unit | Technical staff | Admin. staff | Total | % Technical staff | % Admin. staff |
|---|---|---|---|---|---|
| Project Staff | | | | | |
| ADB I | | | | | |
| PMO | 15 | 31 | 46 | 33 | 67 |
| PMU | 78 | 15 | 93 | 84 | 16 |
| Satgas | - | - | - | - | - |
| ADB II | | | | | |
| PMO | 13 | 20 | 33 | 39 | 61 |
| PMU | 15 | 18 | 33 | 45 | 55 |
| Satgas | 41 | - | 41 | 100 | - |
| IFAD | | | | | |
| PMO | 15 | 31 | 46 | 33 | 67 |
| PMU | - | - | - | - | - |
| Satgas | 65 | - | 65 | 100 | - |
| Forage Station | | | | | |
| Indrapuri | 16 | 18 | 34 | 47 | 53 |
| Padang Mangatas | 12 | 19 | 31 | 39 | 61 |
| Sumbawa | 14 | 28 | 42 | 33 | 67 |
| Siborong-borong | 15 | 29 | 44 | 34 | 66 |
| Cisarua | 16 | 10 | 26 | 62 | 38 |
| Baturaden | 10 | 44 | 54 | 19 | 81 |
| Pleihari | 6 | 19 | 25 | 24 | 76 |
| Serading | 9 | 11 | 20 | 45 | 55 |
| Lili | 19 | 9 | 28 | 68 | 32 |
| Disease Investigation Centers | | | | | |
| Bukittinggi | 15 | 17 | 32 | 47 | 53 |
| Lampung | 17 | 34 | 51 | 33 | 67 |
| Banjarbaru | 12 | 16 | 28 | 43 | 57 |
| Yogyakarta | 12 | 13 | 25 | 48 | 52 |
| Denpasar | 32 | 28 | 60 | 53 | 47 |
| Medan | 20 | 21 | 41 | 49 | 51 |
| Ujung Pandang | 22 | 44 | 66 | 33 | 67 |

Source: DGLS personnel files, Jakarta, 1985

Table VIII.6: Budget for Directorate General of Livestock Services, 1984-85 and 1985-86 ('000 Rp)

| Categories | 1984-85 | 1985-86 |
|---|---|---|
| Livestock Production Improvement Programs | | |
| Provincial Livestock Services | 8,683,317 | 7,500,000 |
| Livestock breeding and forage multiplication centers (UPT) | 1,360,675 | 1,205,000 |
| Disease Investigation Centers | 650,603 | 695,000 |
| Animal quarantine | 351,051 | 315,000 |
| Center projects | 8,379,026 | 7,985,811 |
| Sub total | 19,424,672 | 17,700,811 |
| Transmigration projects | 1,305,000 | 3,428,620 |
| Statistical improvement and development | 73,665 | 80,000 |
| Efficiency improvement for Gov't offices and development supervision program | 193,525 | 119,860 |
| Grand total | 20,996,862 | 21,329,291 |
| Total in US$ at 1,117 Rp = $US 1.00 | $18,797,548 | $19,095,157 |

Source: DGLS budget submission to BAPPENAS, 1984, 1985

## Chapter IX. PROFILES OF POTENTIAL PROJECTS

### Project Profiles

9.1 These projects logically follow on from the first eight chapters of the report. An attempt has been made to limit the number of projects described below by keeping in mind the budgetary, manpower and institutional constraints faced by the potential implementing agencies and the availability of funds from donor agencies. Each project contains enough detail to allow terms of reference to be prepared for appropriate technical feasibility studies and for necessary economic and financial analysis. The study team is confident that most, if not all, of these projects would be technically and economically feasible. The Terms of Reference for the Livestock Sector Review did rot include the preparation of detailed project feasibility studies. No distinction has been made between which Ministries or Directorate-Generals would be lead agencies. Neither have we made any attempt to identify relative magnitudes of funds involved or posible donor agencies. Projects are described that the study team feels would make improve the overall performance of the livestock sector. Many of the projects described below (particularly numbers 3,4,5,6,7, and 9) could be incorporated into an overall support project described in Project 10.

1. Project title: Java and Sumatra Dairy Improvement Feasibility Study

   a. Background

9.2 Chapters III and VI provided an overview of the dairy industry in Indonesia and some of the problems faced in production, collection, processing and quality control were highlighted. The recent extensive review and analysis of milk marketing for the Ministry of Cooperatives (AMC, 1985,) indicated that with current levels of milk production costs and with continued implementation of increases in the ratio between domestically produced and imported solid non-fat, the growth in local demand would be constrained and the market for local pasteurized or fresh milk would be restricted. Perceptions of product quality also work against an increased share for local milk sales. While the study team has some reservations regarding the Consumer Survey component of this study, the overall conclusions of the study remain valid.

9.3 There are two areas where it is felt that well-defined project activities could help ease the burden on producers and on the consumers of milk products. An added beneficiary would be the Treasury by reducing current costs of the program and alleviating the possible need for large subsidies to encourage production and/or consumption of local milk products.

9.4 1) Marketing and provision of technical assistance to the producer sector: In contrast to the AMC (1985) study, the study team feels that milk collection and handling costs are too high, that KUD's



402

still have many problems in the provision of A.I. services and other inputs to producers, that the dairy extension program is still weak, that animal health problems are not receiving adequate attention through the KUD's, and that milk quality control at every level is still a serious problem that is reflected in a high degree of consumer awareness of poor quality product and restricted consumer acceptance of local milk products. The study we propose would carry out an in-depth analysis of KUD's and GKSI to ascertain if the problems cited above are due to the nature of the organizations involved and the need to operate under GOI public service regulations or whether these problems would exist under any alternative mode of operation, including the private sector. We feel that there are considerable potential benefits to both producers and consumers by linking milk production, collection, chilling and transport directly to the dairy factories since the factories have a direct financial interest in increasing farmers milk output and in improving product quality and reliability of delivery.

9.5 2) Milk production systems: Linked to the study on milk marketing should be a detailed study on the production systems under which milk is produced in Java and, if desired, on areas of Sumatra where market potential would indicate that a viable dairy industry could be supported. The AMC study did not consider the production side and how reduced milk production costs could influence demand, reducing consequences of gradual implementation of the ratio policy. Feeding, management, calf rearing and routine animal health practices need careful study. This aspect could also be linked with four other proposals listed below. First, intensive animal fattening schemes could improve dairy farmer's income by increasing the price of bull calves. Second, research institute support to UPT centers dealing with forages and to DIC's for improved health management (including research support specifically for dairying) is called for. Third, implementation of the Feed Resource Evaluation and Feeding Standards projects would complement the dairy study. Fourth, the Breed Evaluation/ Rationalization study would also assist. These latter studies would ease the load on the Dairy Study team and would also help provide a sound information base to support the project implementation phase.

9.6 Recent work by Balitvet (Bogor) staff and DGLS has shown serious disease problems in dairy herds on Java especially with respect to mastitis, calf mortality and infertility. As many as 63% of milk samples from 124 farms showed evidence of subclinical infectious mastitis. In addition up to 17% of cow quarters may be non-functional. Pathology on this scale could reduce total milk production by more than 15%. (Rompis et al., 1985). Losses of milk from nutritional deficiencies (energy, protein, minerals) have still to be determined.

9.7 Preliminary studies indicate a need for major improvement in reproductive programs in Indonesia dairy cattle (Chapters III and V). Some infertility is infectious in origin and pockets of brucellosis (e.g. around Surabaya) have both production and public health implications.

b. Purpose and Objectives

9.8 To study whether additional investment in the dairy industry on Java is justified in terms of technical, financial and economic grounds and to assess whether financial assistance is justified to help establish a



403

commercial dairy industry in selected areas of Sumatra. The objectives of such a study would be to provide to the GOI and other interested agencies a series of policy options regarding the size and structure of the dairy industry and to recommend investment programs needed to implement the recommended development strategies. Another area of critical importance is brucellosis control in dairy cattle. Currently, the disease is present in low levels and probably in isolated pockets. The rest of the Indonesian dairy herd is probably totally susceptible. Movement of infected cattle out of the pockets into concentrations of dairy cattle could result in classical abortion storms. Results will be heavy calf losses and a major public health risk. The project will thus require provision for an effective brucellosis eradication program.

c. Scope of project

9.9 The project should be restricted to Java and one or two selected areas of Sumatra, probably Medan and Padang. The study should be completed in about 2 months although lack of adequate information on the feeding value of local dairy cattle feed resources and of dairy cattle feed requirements under conditions of the humid tropics could cause some delays. However, Chapter IV and the Appendix to Chapter IV provide a good start in this direction.

d. Operational details

9.10 A consultant team plus high level staff support from DGLS and the Ministry of Cooperatives will be needed. Some technical representation from dairy factories and the Research Institute for Animal Health and Animal Production would also be very useful.

e. Funding Requirements:

9.11 A technical assistance (TA) grant would be required plus local counterpart financing.

2. Project title: Slaughterhouse and Livestock Marketing Improvement Study

a. Background

9.12 Chapter VI provided a review of livestock slaughtering, processing and marketing as well as a discussion of strengths and weaknesses of the current system. While it is concluded that the current system using private traders results in a low-cost, competitive market structure, there are several areas in which an improvement of market infrastructure would serve to lower marketing costs and improve product (live animals as well as processed products) quality. Areas where we identified a need for infrastructure improvements were the construction of modern, hygienic slaughterhouses in some of the larger cities which do not yet have them, improvement of animal handling facilities (particularly loading and unloading from ships) in the major shipment areas such as South Sulawesi, Sumbawa, Sumba and NTT and in the major receiving areas (Kalimantan, Surabaya, Jakarta), investment in more specialized livestock boats which could be easily modified to transport large ruminants, small ruminants or pigs, and investment in export-oriented livestock processing, shipping and handling facilities.

9.13 Depending on the concentration of livestock, the marketing flow of animals, and proximity to urban centers, such a system could include four levels of activity:

- Type 1 abattoir: At major urban centers with a large demand for beef and possible export,
- Type 2: Provincial cities (Palembang, Semarang, Manado),
- Type 3: Other provincial centers regional to livestock production,
- Type 4: Kabupaten units in more remote areas.

The present study may wish to concentrate on types 1-3.

9.14 While the study may be directed mainly at the needs of large animal slaughter, it is desirable to include such facilities as may be required for small ruminants and swine. Depending on government policy and in particular the attitude to maintaining smaller poultry units (e.g. 5,000 birds), poultry slaughtering areas might be required in some abattoirs.

b. Purpose and objectives

9.15 The purpose is to lower livestock and livestock product marketing costs by improvement of selected infrastructure facilities. Another purpose is to improve the levels of hygiene of animal products to Indonesian (and possibly overseas) consumers. The objective of this project is to conduct a detailed technical appraisal of the need for such investments, as well as conduct the economic and financial analyses needed. In this process, the study team would develop a series of policy options that must be considered for the project to have maximum effect. These would include aspects such as government regulations on inter-island shipping and freight rates, export policies for livestock and livestock products; regulations, taxes and fees imposed on animal inspection and slaughter, domestic shipbuilding policies, and the future impact of transmigration projects on inter-island shipments of animals.

c. Scope

9.16 The study should focus on two primary areas - the cities where an improved slaughterhouse may be needed, and the major animal shipping ports. Potential ports for animal export should also be included, although they may not now be major animal shipping ports.

d. Operational details

9.17 A three to four person team of consultants would be needed including specialists in livestock marketing, abbatoir design and operation, veterinary public health and financial analyst. The study team does not feel qualified to describe terms of reference for each of these consultants.

9.18 However, based on present information detailed elsewhere in this report on livestock numbers, distribution and potential, general consideration can be given to broader aspects of slaughter and marketing policy. The quality of existing facilities and need for upgrading or the establishment of new regional abattoirs may be identifiable at this stage.

9.19 Special consideration should be given to abattoir design having regard to basic and more specialized areas. Some of the more important of these are:

- land for pre-mortem accomodation of livestock
- pre-mortem inspection facilities
- killing areas
- carcass processing halls
- cold rooms for carcass storage
- offal treatment plant
- meat processing areas
- waste disposal systems
- unloading and loading bays
- water and electricity supplies

Added to the general animal facility the needs of personnel must be considered,

- office staff,
- slaughtering staff (preparation and work areas),
- veterinary staff (office, laboratory and work areas),
- meat processing (preparation done and work areas)

e. Funding requirements: TA Grant plus counterpart funds.

3. Project title: Veterinary Field Services Project

a. Background

9.20 The economic loss due to diseases of livestock appears to be very high in Indonesia (see Table IX.1). However, during the course of the consultancy it become very clear that, whereas veterinary support structures such as DIC's, research laboratories etc. were well provided,



406

the field veterinary service was functioning at a very low level and provided only minimal service to farmers. The reasons for this can be summarized :

- Inadequate numbers of veterinarians working in the field.

- Inefficient use of existing professional and para-veterinary field staff due to:

    - lack of transport
    - lack of equipment
    - lack of adequate training

- The diagnostic capabilities of provincial laboratories (B + C class) are very poor because of

    - lack of equipment lack of training

- There is less than adequate contact between field and laboratory staff resulting in:

    - technical information and research results do not go down the logical chain of Balitvet -- DIC -- provincial laboratories -- field staff

    - Specimens and surveillance data do not go up the system very efficiently i.e. field -- provincial labs -- DIC -- surveillance visit.

9.21 All of these problems result in a poor field service and a severe lack of surveillance data for decision-making at DGLS, and inadequate field material for research institutions.

b. Objectives

9.22 To increase the efficiency of the field veterinary service so that:

- The severe losses due to disease in livestock can be reduced by prevention and treatment

- Surveillance information can reach provincial and national capitals, allowing better policy decisions

- Research institutions have better access to field material

c. Operational details

9.23 The following changes would significantly increase the delivery of animal health services to the farmer and improve the national disease data base.

- Bring B + C laboratories to the same standard ("Provincial laboratories?")



407

- Join field and laboratory services into one force

- Build animal health centers in all areas of livestock concentrations

- Locate animal health posts as center outposts.

- New veterinary recruits should be placed at the centers (Pusat Keswan).

- Animal Health Centers should be equipped with refrigerator, basic veterinary and autopsy equipment and three motorcycles. Animal health centers may also act as a base for a PPS (Extension Specialist) who can share transport.

- Animal Health Posts should be equipped with refrigerator, basic veterinary equipment plus one motorcycle. The facility may also be shared by the PPL (extension officer).

- Activation of an effective surveillance system. linking the DIC laboratories and AH Centers. This is essential if accurate epidemiological information is to be acquired.

d. <u>Organizational details</u>

9.24 We suggest a joint field/laboratory service working out of the laboratories, the Pusat Keswan and Pos Keswan.

9.25 Service would remain under the control of the provincial Dinas Peternakan, but the DIC's would be made officially responsible for training of B + C lab staff, and for carrying out further investigations on problems outside the capabilities of the provincial labs.

e. <u>Economic justification and benefits</u>

9.26 There is an urgent need to know the cost of disease to the Indonesian livestock industries. An accurate figure is not available because of deficiencies in the surveillance program. However, a value of Rp 473,700 million (= US$ 445 million) each year has been calculated by DGLS (Table IX.1.). Not all of this could be prevented by an efficient field service but even a 25% improvement would result in an annual saving of over US$100 million. The estimated loss may be greater as many subclinical diseases e.g. mastitis, helminthiasis and reproductive losses are not included in the calculation.

Costs:

Salaries - Local
Buildings - Local
Equipment - B + C labs and Pos and Pusat Keswan, grant.
Training - DIC laboratories, local
Transport - Grant

Table IX.1 : Estimated annual economic losses from animal disease (Rp 1,000,000,000)

| Disease | Losses in: Milk prod. | Meat hide prod. | Egg prod. | Man power | Dead | Total | (%) |
|---|---|---|---|---|---|---|---|
| PMK | 1.3 | 7.6 | - | 7.0 | 10.9 | 26.8 | ( 5.66) |
| SE | - | 0.6 | - | 1.1 | 10.0 | 11.7 | ( 2.47) |
| ND | - | - | 115.2 | - | 27.5 | 142.7 | (30.13) |
| Surra | - | 7.9 | - | 7.1 | 15.7 | 30.7 | ( 6.48) |
| Anthrax | - | - | - | 5.5 | 16.3 | 21.8 | ( 4.60) |
| Brucellosis | + | - | - | - | 7.2 | 7.2 | ( 1.52) |
| Haemonchiasis | - | 13.2 | - | + | 93.1 | 106.3 | (22.44) |
| Distomatosis | - | 83.9 | - | - | - | 83.9 | (17.71) |
| Ascoriasis | - | 4.0 | - | - | 38.4 | 42.4 | ( 8.95) |
| Kaskado | - | 0.2 | - | - | - | 0.2 | ( 0.04) |
| Rabies | - | - | - | - | + | + | (-) |
| Total | 1.3 | 117.4 | 115.2 | 20.7 | 219.1 | 473.7 | |
| (%) | (0.28) | (24.78) | (24.32) | (4.37) | (46.25) | (100.0) | |

[a] Notes: + = Loss: - = No loss: (-) = %

Source: DGLS. 1984b. Sistim Pembangunan Peternakan Khususnya Kesehatan Ternak di Pedesaan. Directorate General of Livestock Services, Jakarta.



409

4. Project title: Integrated Draft Animal Improvement Project

a. Background

9.17 Considerable attention has been focused on draft animals in recent years with major reviews by FAO and research centers such as the Australian Center for International Agricultural Research. Excellent work in Indonesia was also done by Rollinson and Nell (1974) and a recent study on the Consequences of Mechanization in Indonesian Agriculture (Kasryno, et al., 1984.). These studies have all indicated the economic advantage that draft animals have over mechanized agriculture for Indonesian smallholders and also the large gap between current numbers of draft animals and numbers required to meet cultivation requirements. Our review indicated that while there is still unsatisfied demand for draft animals in many parts of Indonesia, there are also many problems with utilization and management of draft animals in Indonesia, particularly in areas where they have recently been distributed under GOI or Provincial projects. We feel that great improvement could be made in the productivity and use of the current stock of draft animals and that this information could also be used to make future draft animal distribution schemes much more effective.

b. Purpose and Objective

9.28 The purpose is to improve the returns on resources being invested in draft animal distribution programs and to increase economic benefits to smallholders who have received, or are projected to receive, draft animals.

9.29 Objectives include conducting research on nutrition, reproduction, health and management problems with draft animals in all of Indonesia, studying problems in using animals for field tasks as well as for transport with a focus on transmigration areas, developing guidelines for the distribution of draft animals to achieve maximum economic impact, and designing appropriate follow-up programs based on integrated "Task Forces" specializing in draft power. We also anticipate a credit package would be needed to assist in purchase of implements and mineral blocks.

c. Scope

9.30 The program would be national in scope but would focus on specific problem areas for draft animal use and performance. It would be logical for this project to focus on the main areas where IFAD, ADB I, ADB II, and IBRD Transmigration II have activities.

d. Operational details

9.31 It is envisaged that the major research component of this project will be provided through a cooperative program between the Australia Center for International Agricultural Research (ACIAR) and the Central Research Institute for Animal Sciences (CRIAS), Bogor. This will be a multidisciplinary research project to improve crop productivity and farmer incomes by increasing both numbers and efficiency of draft animals. However, the ACIAR/CRIAS project does not propose to work in Sumatra or Kalimantan so our proposed project should help fill that gap as well as to focus on field implementation of the CRIAS-ACIAR research findings. It is not necessary, in many cases, to even wait for these results as many of the



410

problems facing draft animals in Indonesia are already well known. The proposed field operations would then provide a good testing ground for the research program. A farming systems approach would be used where draft power needs, draft animals, cropping systems, and household objectives would all be carefully considered. Staffing would consist of project advisors, technical staff in animal nutrition/management, forage production, animal health, and farm machinery. The project team would work under DGLS as the coordinating agency and directly with Provincial Livestock Services and Transmigration staff. About a 5-8 year project would be needed.

e. Funding requirements

9.32 Including credit, TA, animals, staffing and animal inputs, a $20-30 million project would be needed. A combination of grant/loan funds would be desirable.

5. Project title: Intensive Animal Fattening Schemes for Large and Small Ruminants

a. Background

9.33 Recent studies have indicated attractive potential profits from growing out (fattening is not generally carried out although P.T. United Livestock does put a fat cover on their cattle to compete with imported grain fattened beef) immature or underweight animals on low cost, roughage based diets. This looks attractive at present given very low prices for rice bran, copra meal, cassava, corn and palm kernel meal. This project proposes to provide the basic levels of technical guidance, capital and marketing assistance to make these schemes more viable for smallholders. The rapid increase in dairy cattle populations on Java has also resulted in dairy bull calves now available for fattening. The big increase in animal dropping schemes under Sumba contract repayment terms has also increased the availability of males for growing out. In addition, a strong market continues to exist for sheep and goats, paricularly on Java and, as indicated in Chapters III and IV, both the feed resource and animal resource base for small ruminants is quite favorable to smallholder fattening schemes. A number of commercial firms are making impressive profits by fattening out between 20 and 100 small ruminants in specialized units. This project would also be complemented by our proposed projects dealing with the Feed Resource Base and Animal Nutrient Requirements as well as with the Animal Health Field Services proposal.

b. Purpose and objectives

9.34 Purpose is to more effectively utilize local feed resources in producing a high quality, high value product that can help replace imports, increase smallholder income, and increase the capacity of DGLS and Provincial Livestock Services to work effectively with smallholders.



411

Objectives include:

- Developing minimum resource feeding packages for smallholder, using small forage plots supplemented by locally available crop by-products, residues, agro-industrial by-products, and mineral/urea pre-mixes as appropriate.

- Develop realistic feeding standards for participants.

- Provide credit package covering animal plus other cash inputs.

- Provide technical back up in animal health, nutrition, forages and management through Task Forces with primary responsibility for this program.

- Assist producers by establishing contracts with slaughterhouses specializing in this type of beef and by obtaining local contracts where an outlet exists for this type of meat. The product would fall between fat, concentrate fed beef and the current product which is mainly cull draft animals.

c. Scope of project

9.35 Focus should be on areas of high animal density, primarily Java, Bali, Lombok and Madura. The market in the other areas probably will not support this project at present, although the project may identify areas where it will be feasible to grow out the animals and sell them locally at a profit.

d. Operational details

9.36 The project would require a PMO in Jakarta and 3-4 PMU's in participating provinces. Task Force units would be formed at the Kabupaten or Kecamatan levels. Credit and animals would be channeled through the PMU's. Marketing assistance provide by DGLS in cooperation with PMO and Department of Cooperatives. The project would also have direct linkages with the supporting proposed projects listed above. The organizational structure most appropriate would be similar to that being used in the IFAD or ADB Kalimantan II projects.

9.37 Health cover for the project area can be the sole responsibility of DGLS veterinarians who should therefore be involved in the planning process as soon as possible. The specific components of the program should be :

- Vaccination: depending on the disease status of the area cover may be provided for a range of infections. The include Haemorrhagic Septicaemia; Anthrax and Blackleg.



412

Routine disease monitoring: Initial screening for internal parasites e.g. Haemonchus, Fasciola would be useful and where appropriate treatment could be applied. Depending on the method of management and feeding (cut and carry, grazing) and the environment (wet, dry) routine treatment might be useful but financial constraints could enter at this stage.

Outbreak control: Acute disease may occur at a single farm or district basis. This should be handled by DGLS veterinary services preferably by the local veterinarian but certainly by the veterinary assistant.

9.38 Two elements are necessary for disease control at this stage, accurate diagnosis and treatment. The first may require adequate laboratory support within easy reach.

9.39 The establishment of this program is an opportunity for veterinary field services and laboratories (A, B or C type) to obtain new epidemiological information of national importance since the animal population will be under surveillance for 2-3 years. Properly designed, the program could be a fourth component of the veterinary inputs project.

e. Funding requirements

9.40 Combination of Grant/Loan desirable. Grant could cover consultants for TA, loan for other operating expenses, foreign exchange costs. GOI would cover counterpart costs, PMO, and PMU's.

6. Project title: Feed Resource Evaluation and Estimation of Animal Nutritional Requirements in Indonesia

a. Background:

9.41 Several recent publications have attempted to estimate feeding values of some of the major Indonesian feedstuffs. These include Tillman, et al. (1980), Soekanto (1982) and groups working in the various labs of the Central Research Institutes for Animal Science. These studies have all suffered, however, from using techniques that tended to overestimate the feeding values of the fibrous plants. Recent advances in analytical procedures now allow nutritionists to more accurately estimate the true feeding value of the material as it is actually utilized by the animal. For a country like Indonesia, where the vast majority of feedstuffs fall in this category, the difference can be quite significant and is probably one reason that dairy cattle lactation levels have been well below those levels predicted by planners and scientists who helped set up the pilot farm feeding systems. Several other projects proposed in this section will also require better quality information on feeding values in order to achieve project objectives. Looking at what the animals actually need, we find that tables of animal feed requirements have almost all been developed in temperate regions using temperate Bos taurus breeds. When comparing feed actually consumed by cattle and water buffalo in tropical regions with their predicted requirements based on these tables, it was found that feed requirements in the tropical regions were generally higher. The combination of these two factors has led to problems in trying to develop



413

realistic feeding programs in Indonesia. Since many of the projects we propose are heavily dependent on the ability to develop productive and realistic feeding programs for ruminants, we feel that this project will be of great benefit to the ruminant livestock sector.

b. Purpose and objectives

9.42 The purpose is to use recent advances in estimating tropical feedstuff quality and in estimating animal feed requirements under tropical conditions to produce a comprehensive publication covering the major feedstuffs and the major ruminant animal types in Indonesia. Objectives include:

- Setting up a plant sampling and crop by-product/crop residue/crop agro-industrial sampling system that provides relevant samples for subsequent laboratory analysis.

- Determining the true digestibility of these samples.

- Producing a table of Indonesian feedstuff feeding values.

- Setting up digestion trials with the various types of animals of interest to determine their actual feed requirements over a range of physiological requirements. This would include work on draft animals operating under different levels of stress.

- Producing a manual of standard animal nutrition requirements.

c. Scope

9.43 The project would be nationwide but would concentrate on those areas with the greatest concentrations of animals, areas where large numbers of animals are being dropped, and those areas which have particular nutrition problems such as mineral deficiencies.

d. Operational details:

9.44 The project would require 2-3 staff in Indonesia for 5-6 months to supervise the project. In addition, lab support in the U.S.A. would also be needed for 2-3 months to process the samples. Good local logistical support would also be needed. This project should be under DGLS control with some cooperation from CRIAS and their collaborative overseas technical assistance projects.

e. Funding requirements:

9.45 A TA grant of about $100,000 should be adequate, depending upon levels of DGLS support for travel, casual labor, etc.



414

7. Project title: Breed Evaluation and Rationalization Study

a. Background:

9.46 The study team found that Indonesia has some excellent animal breeds within every species and that these breeds were probably not being used to their full potential (Chapter III). It was also determined that there is a great deal of genotype - environment interaction, even for local Indonesian breeds taken from their major areas of concentration to other areas of Indonesia. Finally, we felt that the importation of many exotic breeds from both temperate and sub-tropical regions had added little to overall productivity of cattle, buffalo, sheep or goats and that, by the widespread use of AI for cattle, there was some danger of diluting the genetic resource base of some well adapted, highly productive local breeds. There is no rational, long-range policy for animal genetic improvement nor are there any large scale genotype evaluation and improvement programs in Indonesia that focus on local breeds. It is very important that such a policy be formulated, be put into action and that such a policy reflects the feed resource base and environmental constraints that these animals will be reared under. We feel that such a project will help reverse current attitudes that tend to neglect Indonesia's unique animal genetic resource base in favor of large exotic breeds, wool sheep, and dairy buffalo.

b. Purpose and objectives:

9.47 The purpose is to help GOI and donors formulate a long-term animal genetic improvement policy and develop an operational plan to put that policy into practice. The objectives are to carry out a detailed survey of animal productivity under different environments found throughout Indonesia, examine current animal breeding patterns and policies (including importation, A.I., embryo transfer), estimate potential gains to be made from alternative genetic improvement programs, and help develop a long-term, realistic national animal genetic resource conservation and improvement program.

c. Scope:

9.48 National in scope, limited primarily to cattle, water buffalo, sheep, goats, and ducks. Cattle the top priority.

d. Operational details:

9.49 Use existing data available from many sources supplemented by targeted farm surveys and a detailed description of the main agro-ecosystem as they influence animal production. A small consultant team could probably complete the study in one year.

e. Funding requirements:

9.50 About $150,000 in TA grant.



415

## 8. Project title: Village Poultry Development Project

### a. Background :

9.51 The study team was consistently impressed with the key role village poultry play in generating cash income for all types of farming systems, in supplementing household food supplies, and in the consistently high prices that village chickens, village chicken eggs and duck eggs brought in the market. Also impressive was the availability of marketing agents in even the more remote areas and the efficiency of village poultry marketing as measured by producers share of retail value. Studies cited in chapters III also showed impressive economic returns to village poultry in the absence of major disease outbreaks. We are aware that a number of village poultry improvement projects have been tried with very limited results. Part of the reasons for these failures was inadequate attention to farming conditions under which village poultry are produced, the key role of limited supplemental feeding, and the inability to put in place long-term solutions to disease control (particularly Newcastle Disease (ND) in chickens) that could ultimately be managed by farmers, farmer groups or KUD's. We feel that the implementation capacity of DGLS, the Provincial Livestock Services and the poultry shops is now at a level where it may be worthwhile to make another attempt. Chapter III provided basic details of the industry including the ability of village poultry to produce impressive returns with limited inputs in the absence of a major disease outbreak.

### b. Justification:

9.52 ND outbreaks occur in populations of village poultry somewhere between once a year and once every four years. Mortality rates vary depending on previous exposure, but are usually over 90% in chicks and 60% in adults. When calculating losses in adults however, it should be realized that most owners eat infected chickens before they die, which reduces the overall financial loss. (Half eaten, half die before they reach the pot). The government - distributed Komorov vaccine must be given twice annually for adequate protection. Vaccine costs Rp 3.25/dose (twice per year). Labor costs about Rp 2,000 per day for a vaccinator who will vaccinate 3-400 birds/day. From a number of field observations it would appear that the Kampung hen in Indonesia produces an average clutch of 10 eggs up to five times per year. Of these between 9 and 10 per clutch will hatch, but only 3 will reach point-of-lay. Thus, out of a potential for an approximately 50 offspring/year, only 15 (30%) will reach reproductive age.

### c. Purpose and objectives

9.53 The purpose is to increase the economic contribution of village poultry to smallholders, increase rural consumption of poultry products and establish the minimum infrastructure needed to control disease outbreaks and treat routine health problems. This project has the limited objective of reducing ND outbreaks, eradicating ND in certain islands, dramatically increasing survivability up to 4 weeks of age, providing limited feed supplements, and providing inputs to help with other areas of routine health treatments.

d. Scope of the project

9.54 Starting on a pilot project basis on selected Island, the first priority would be village chickens but a duck improvement program could also be included if initial analysis suggested potentially high rates of return.

e. Operational details

9.55 The study team strongly suggests a pilot scheme on a small island to test eradication techniques and perfect measures to prevent re-infection. We also suggest research on which vaccines to use and best method of delivery. Research into oral vaccination using pellets in Malaysia is worth following closely. If pilot schemes are successful, a slow island by island scheme is recommended, with Java last. The reasons for chick losses quoted by farmers and government officials alike are:

- disease - mostly ND but occasionaly others such as fowl pox and eyeworm

- predation - dogs, hawks and civet cats

- exposure - to rain and wind

9.56 Observations have shown that the large majority of mortalities occur within the first 8 weeks. Hence it follows that survival rates could be dramatically improved by two simple measures: vaccinate against ND (F strain in young ducks, Komorov in hens) and protect chicks for first 6-8 weeks in a brooder (cold brooder made of bamboo - no heating required).

9.57 A village poultry kelompok in Lombok has done this and reduced mortalities to below 10% and work as on the Australian project in Zamboanga-del-Sur, Philippines, have got it lower than this. The net results is to go from 15 chickens to over 40 chickens/year per brooder hen.

f. Funding requirements

9.58 Probably in the range of $1-2 million/annum for 5 years. Should be primarily in grant TA because project will not generate or save substantial amounts of foreign exchange.

9. Project title: Integration of Veterinary Research

a. Background

9.59 Aspects of veterinary research in Indonesia are carried out by three types of organizations that are not fully linked to each other, with consequent loss of coordination. They are:

| | |
|---|---|
| - Balitvet (Bogor) | AARD |
| - DIC Laboratories | DGLS |
| - Field services | DGLS-Provincial Government |



417

9.60 Efficient research and development with consequent benefits to the livestock producer is a matter of national importance. Improvement can be attained through organizational changes and increased funding.

b. Objectives

9.61 The existing veterinary network in Indonesia has been established in the past decade. The project here is designed to increase efficiency in disease diagnosis and surveillance, epidemiological support, research programming, and communication and extension services.

Present resources are as follows:

```
                     Ministry of Agriculture
                  (including epidemiology unit)

AARD                        DGLS                   Provincial
  !                           !                    Government
  !                           !                         !
  !                           !                         !
Balitvet <-------> DIC Laboratories (7) <----> Field
(Bogor)                       !                  Services
                              !                     !
              BC type laboratories           Pusat hewan
```

9.62 The lines indicate relationships that are not yet fully utilized. The B and C laboratory system is still incomplete and requires both rationalization and improved equipment with concurrent training programs for staff. This project would also help support several of the projects listed above.

c. Operational details

9.63 Improvements suggested here can be refined and detailed by a consultant, who would also suggest appropriate types and avenues for funding.

9.64 1) Epidemiological services: An epidemiology unit has recently been established at DGLS headquarters in Jakarta, but is still in an embryonic stage of development. At present, it is handling limited amounts of data processed by the national statistics unit. At Balitvet, an epidemiology unit serving both the research and diagnostic resources of the Institute will be set up in 1986. Already, preliminary discussions have been held between DGLS and Balitvet about rationalization of Indonesian veterinary epidemiological services. This move is commendable and should be a continual joint consultation.

9.65 2) Balitvet-DIC relationships: There is already agreement on coordination between the research and diagnostic functions of these laboratories. Development is already taking place, with new technology and materials being supplied by Balitvet and some cooperation in regional research. With continuation of the development aid project at Balitvet, an increasingly strong linkage between units of this important Indonesian scientific network can be expected.



418

9.66 3) DIC-field services: Although field services already provide material for diagnosis by the DIC system, closer collaboration would give better results both in diagnostic efficiency and the collection of epidemiological information for the national data bank. Because of the value of geographic proximity of personnel, consideration should be given to locating field officers (Dokter hewan) in DIC laboratories to facilitate exchange of information.

9.67 4) DIC-B/C laboratory relationships: While the DIC system has made considerable progress in the last decade, the B and C units are still at a very early stage of development and of limited effectiveness. Several options are now present, including up-grading of B and C units separately and the combining of B and C units to provide stronger provincial laboratories with more staff and better diagnostic capability. This would help to avoid wastage of diagnostic material caused by delays in sending specimens. The pros and cons of these options can be discussed against the background of local need with DGLS. Allied to this part of the veterinary services is the relationship between B and C laboratories and field services at the Kabupaten level. It is recommended that consideration also be given to B and C laboratory-field service units (Animal Health Centers). This structure would create a multidisciplinary facility which could improve both the delivery of field samples to a primary screening laboratory and, at the same time, improve transmission of extension and advisory information to village and farm.

9.68 The organizational structure outlined in 4) and 5) would have the additional advantage of improving the distribution of technical information to laboratory and field staff. The clustering of personnel should encourage multidisciplinary mission-oriented research for the diagnosis and control of livestock diseases.

d. Funding requirement

9.69 A TA Grant to support a 4 month consultancy. If the report is favorable, then a major grant or loan/grant request would follow.

## 10. Project title: Livestock Support Services and Credit Project

a. Background

9.70 The sector analysis indicated that even with the existing stock of animals, major gains in livestock output are possible by increasing productivity of dual-purpose cattle and buffalo, dairy cattle, sheep, goats and poultry. Earlier chapters pinpointed low reproduction rates, slow growth rates, and high young stock mortality rates as basic causes of low overall productivity, and linked these constraints to animal nutrition, and management problems. The Review also indicated: (a) that there are adequate feed resources to increase livestock production in most parts of Indonesia, particularly with such low-cost crop by-products as rice bran, copra meal, molasses, and palm kernel oil meal; (b) that a few key nutrition-reproduction management strategies have wide applicability in Indonesia; (c) field support services, including livestock extension, are inadequate to implement these development strategies; (d) decision-making regarding livestock production and marketing usually involves the wife as well as the husband, and some reorientation of extension services is needed to target more information towards women; (e) improved economic incentives and market information will often be essential to complement the nutrition-reproduction management strategies; and (f) livestock credit in kind will be required to provide additional animals to project participants.

b. Justification

9.71 The rationale for this project is based on the review of animal productivity and management in Chapter III, and the national herd simulations also carried out in Chapter III. This latter exercise indicated that a 1% increase in the extraction (offtake) rate of the national cattle and water buffalo herd would add about 90,000 slaughter animals to the annual total slaughtered (a 5% increase in annual slaughterings) and increase gross value of meat production in the sector by $45 million per annum based on $500 per animal slaughtered. A 1% increase in the extraction rate for sheep and goats, based on a national population of 12.6 million head, would add 126,000 slaughter animals, increase annual slaughterings by 2% and add $3.78 million to value of meat produced per annum based on slaughter prices of $30 per animal. These figures exclude additional value from increased output of manure and draft power.

c. Purpose and objectives

9.72 Purpose of this project is to increase output and income from dual-purpose cattle and buffalo, sheep and goats, using a low-cost input approach complemented by strengthened livestock support services focused on provincial-level Livestock Development Centers, a livestock credit program, and strong linkages with other projects proposed in this section, including the livestock feed resources assessment, the veterinary field services project, the slaughterhouse and livestock marketing improvement project, the integrated draft animal improvement project, the smallholder animal fattening scheme, and the integration of veterinary research project. Careful consideration should be given to the possibility of including most of the above projects within the overall project proposed here (with the exception of the Slaughterhouse and Marketing study). This is discussed in more detail below. Project objectives include:

- Development of an effective, problem-solving livestock development support service

- Putting in place the complementary support services such as credit, marketing information, marketing infrastructure, research support, and animal health programs to maximize benefits from the livestock support service above

- Putting Livestock Development Centers in a majority of Provinces and staffing them with Task Forces similar to those being used in the ADB, IFAD, and World Bank Livestock Projects. These would include breeding and forage activities;

- Develop and institutionalize strong linkages between research carried out in AARD and universities, and livestock extension services

- Reorientation of livestock extension services and

- Carrying out a policy dialogue with GOI to reduce restrictions and controls on livestock slaughter, movement of livestock between provinces, and reallocation of Livestock Services resources away from administration and towards more technical staff and support services (transport, equipment, inputs) for them to operate effectively at the village level.

d. Scope of the project

9.73 The focus will be on dual-purpose cattle and buffalo, plus sheep and goats. A separate proposal was prepared for dairy cattle (project no. 1) due to the unique characteristics of that industry. A separate project was also developed for poultry (project no. 8). In the section dealing with operational details, we propose two alternative projects - one that would be narrowly focused on improving services that would focus on nutrition-management aspects, and a second that would be much more comprehensive and would include projects 3, 4, 5, 6, 7 and 9 into a master project for supporting the entire range of productivity problems identified in this report for dual-purpose cattle and buffalo, as well as sheep and goats.

9.74 The geographical focus of project activities would be on Provinces not covered under current ADB, IFAD, and World Bank projects. Initial project activities would be concentrated upon those areas that were judged to have the most promising feed resource base for expanded livestock output and on Java, where the majority of crop by-products, crop residues, and agro-industrial by-products are produced.

e. Operational details

9.75 The main focus of project activites would be provincial Livestock Services. Close cooperation would also be needed between the Directorate-General of Livestock Services in Jakarta, the regional planning authority (BAPPEDA), and District (Kabupaten) level administration. The project administrative framework would have to reflect this, as would the framework devised for channeling of funds. As mentioned earlier, this project can be developed on a fairly limited scale or on the basis of a comprehensive project which covers the full range of needs of Provincial Livestock Services, including animal health, feed resources, breeding programs, and draft animal utilization.

f. Limited scope project:

9.76 This project would focus efforts on improving farm-level animal nutrition, reproduction, and calf survivability. Components would include:

9.77 1) Strengthening support services of Provincial Livestock Services units through training, support of transportation, provision of inputs, and extension materials, the creation of Livestock Development Centers in selected districts and the setting up of livestock and forage multiplication and distribution units at these centers; and



421

creation of task force teams that would work directly with producers on specific local problems.

9.78 2) Provision of credit in the form of livestock when farms have developed their feed resource base to the level that satisfactory performance can be achieved by distributed animals.

9.79 3) Provision of market information, marketing assistance and marketing incentives to encourage producers to cull unproductive animals and replace them with higher producing animals.

9.80 4) Assistance with policy analysis and policy studies to encourage changes in Government policy that will encourage farmers to commercialize small-scale livestock production units.

g. Comprehensive Scope Project

9.81 Would include components above plus the components set out in Projects 3, 4, 5, 6, 7, and 9. Therefore, the project would also include a major effort to improve animal health delivery services, to link animal health research and extension efforts more closely, to establish small-scale fattening units where appropriate, and to improve utilization and productivity of draft animals, again in areas where this aspect is appropriate. This project would require additional linkages with AARD and the Directorate-General of Livestock Services through the Disease Investigation Centers, would require more farm-level credit for the smallholder fattening schemes and the draft animal improvement scheme, and would have a wider range of geographical coverage.

h. Funding requirements

9.82 Limited Scope Project: About $25 million in foreign exchange and $40-50 million in local funds.

9.83 Comprehensive Scope Project: $50-$60 million in foreign exchange and $80-$90 million in local funds.

BIBLIOGRAPHY

A REVIEW OF THE LIVESTOCK SECTOR
IN THE REPUBLIC OF INDONESIA


ACIL. (not dated). NTT Pilot Livestock Development Project ACIL, Melbourne, Australia.

ACIL. 1983. Livestock development projects, Nusa Tenggara Timur and Nusa Tenggara Barat. Final Report. Livestock Development Project. GOI-UNDP/IBRD.

ACIL, 1983. Project Preparation Study, Phase 1 Extension. NTT Livestock Development Project, Australian Development Assistance Bureau, Canberra, Australia.

Adiwinata, T. and A. Dachlan, 1972. A brief note on surra in Indonesia. BLVEKA Folio Veteriner, no. 3.

AF/INS/72/009. 1972. Technical Report. Dirrectorate General of Animal Husbandry, Ministry of Agriculture, Jakarta, Indonesia.

Afwan, S. Ismah, Sri Sumarni and Kustadi. 1984. Kerjasama Antar Department Lembaga Dalam Penyelenggaraan, Transmigrasi dari daerah asal sampaibentuaranBudaya de tempat pemukiman. Univ Kristen Satya Wacana (ed.). Jakarta, Indonesia. CV Rajawali. pp 187-240.

Akoso, B.T. and H.M.S. Siregar, 1984. Penyidikan wabah brucellosis di propinsi Sulawesi Utara. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia, 1982-83. Direktorat Jenderal Peternakan, Jakarta.

Alton, G.G. 1984. Report on a consultancy in animal brucellosis in Indonesia. Research Institute for Animal Health, Bogor.

Anderson, A.G. 1980. The rural market in West Java. Econ. Dev. and Cult. Change, 28:4: 753-777.

Anon. 1976. Peat and podzolic soils and their potential for agriculture in Indonesia. Seminar Proc. ATA 106 Bull. 3. Soils Research Institute, Bogor, Indonesia.

Anon. 1983. Peta Penyakit Hewan di Indonesia. Tahun 1983. Direktorat Jenderal Peternakan, Jakarta.

Anon. 1984. Atlas Penggunaan Tanah Republik Indonesia (Land Use Atlas of the Republic of Indonesia). Publ. No. 333, Dir. Gen. Agraria. Jakarta, Indonesia.




423

Anon. 1984. Bulletin Epidemiologi Veterinar 43.II. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia, 1982-83. Direktorat Kesehatan Hewan, Direktorat Jenderal Peternakan, Jakarta.

Anon. 1984. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. Periode Tahun 1982-83. Directorat Kesehatan Hewan, Direktorat Jenderal Peternakan, Jakarta.

Anon. 1985. Draught animal power for production. Proc. Workshop James Cook University, Townville. Australia Center for International Agricultural Research.

Anon. 1980. Proc. BIOTROP Workshop on Alang-alang 1976. BIOTROP Spec. Publ. 5, Bogor, Indonesia.

Anon. 1983. Dairy cattle production systems: integrated applied research for West Java. Mimeo, Research Institute for Animal Production, Bogor.

Anon. 1984. Laporan Evaluasi Terbatas Gaduhan Ternak Kambing dan Domba di daerah Propinsi Jawa Tengah, Semarang: Kerjasama USAID-Dinas Perternakan Propinsi daerah Tingkat I Jawa Tengah dalam Rangka Program Pengembangan Wilayah Propinsi I di Jawa Tengah.

Arfiatiningsih, S. and S. Arjono, 1982. Penyidikan Marek's disease pada ayam di Lampung. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. Direktorat Jenderal Peternakan, Jakarta.

Arganosa, F.C., V.G. Arganosa and I.P. Ibarra, 1972. Carcass evaluation and utilization of carabau (buffalo). In: The Asiatic Water Buffalo. Food and Fertilizer Technology Center (ASPAC), Taipei.

ASEAN Livestock Transport Workshop Report. 1983. ASEAN Food Handling Bureau, Kuala Lumpur, Malaysia.

Ashworth-Morrison, Cooper. 1983. Indonesia: Milk Marketing Study, New Zealand Ministry of Foreign Affairs, Auckland, New Zealand.

Asian Development Bank. 1981. Appraisal of the Sumatra Livestock Project in the Republic of Indonesia. Report no. INO:AP-67. Asian Development Bank, Manila.

Asian Developement Bank. 1985. Appraisal Report of the Fisheries Industries Credit Project in Indonesia. Report no. INO: AP-98. Asian Developement Bank, Manila.

Asian Developement Bank. 1984. Appraisal of the Second Kalimanton Livestock Developement Project in the Republic of Indonesia. Report no. INO: AP-92. Asian Developement Bank, Manila.

Asian Development Bank. 1985b. Proceedings, Regional workshop on livestock production management. Agriculture Department, Asian Development Bank, Manila.

Asian Development Bank. 1985a. Livestock development in South Kalimantan. Project benefit monitoring and evaluation report. ADB Report with the cooperation of Lambung Mangkurat University, Banjabaru.

ADB/DGLS. 1985. Asian Development Bank/Diretorate General of Livestock Services. Survey questionnaire of the Indonesian livestock sector, Jakarta.

Astuti, M. 1984. Production parameters of goat and sheep in Tretep Upland Area, District of Temanggung. In: Sheep and Goats in Indonesia. Bogor, Indonesia. pp 114-117.

Bain, R.V.S. 1963. Haemorrhagic septicaemia. FAO Publication no. 62 FAO, Rome.

Banks, D.J.D. 1985. Report on livestock survey, NTT. NTT Livestock Developement Project, Beri Pae, West Timor.

Baum, Warren C. and Stokes M. Tolbert. 1985. Investing in Developement. Finance and Developement, 22(4): 26-36.

Bell, M., I. Inounu, B. Tiesnamurti, and Subandriyo. 1983. Variability in reproductive performance of sheep among twenty-two farms in Tenjonegara and Sindangratu villages, district of Garut, West Java. Small Ruminant Collaborative Research Support Program Working Paper No. 18. Research Institute for Animal Production, Bogor, Indonesia.

Biro Pusat Statistiks. 1983. Statistical Yearbook of Indonesia, Jakarta.

Biro Pusat Statistiks. 1984. Statistical Yearbook of Indonesia, Jakarta.

Biro Pusat Statistiks. 1983. Sensus Pertanian. Jakarta, Indonesia.

Blair, G. J., M.R. Hunt, and M.E. Siregar. 1981. Monitoring cattle productivity on pastures. Progress report. Reasearch Institute for Animal Production, Ciawi, Indonesia.

BPPH Wilaga VI Denpasar. 1982. Laporan evaluasi pilot projek pemberantasan penyakit ngorok (haemorrhagic septicaemia) di Pulau Lombok, 1982.

Budhi, S. P. S., R. Utomo and D. Sutrisno 1981. The utilization of rice straw for fattening cattle. Proc., 1st Asean Workshop on Technology of Animal Feed Production Utilizing Food Waste Materials. Paper no. 17. Bandung, Indonesia.

Budiarso, I.T. and Harsjosworo, S. 1977. Some notes on Jembrana disease in Bali cattle. Hemera Zoa. 69:94-98.

Budiman, Arief. 1984. Menuju pola transmigrasi tri-partial, sebuah agenda penelitian. Transmigrasi dari daerah asal sampai benturan pudaya di tempat pemukiman. Univ. Kristen Satya Wacana (ed.). Jakarta, Indonesia. CV Rajawal. pp 241-272.

Budi, Tri Akoso and Muhammad Gaus Siregar, H. 1984. Penyidikan wabah brucellosis di propinsi Sulawesi Utara. in Laporan Tahunan hasil Penyidikan Penyakit Hewan di Indonesia. 1982-83. Direktor Jenderal Peternakan, Jakarta.

Budoyo, S. Proyek Pembincan Ternak. Transmigration Center. Jakarta, Indonesia.

Buku Peternakan Java Tenggah. 1984. Ungaran, Central Java.

Bulletin Info Peternakan. 1984. Direktorat Jenderal Peternakan. Jakarta, Indonesia.

Burger, D.H., 1977. Perubahan-perubahan Stuktur dalam Masyarakat Desa. Bhratara. Jakarta, Indonesia.

Camoens, J.K, R.B. McDowell, A.J. Deboer, K.P. Wimaladharma, R.J. Bawden and F.A. Moog. (1985). Proceedings of the Regional Workshop on Livestock Production. Asian Development Bank (ADB), Manilla.

Camoens, J. C. 1976. The Buffalo in Malaysia. Bulletin no. 145, Ministry of Agriculture, Malaysia.

Central Bureau of Statistics. 1980. Population Census, Series Table 4. no. 3.

Chantalakhana, C. 1983. Bufalo research and development project, Kasetsart University. Annual Report, Bangkok.

Chavez, E.R. and A. Lasmini. 1977. Comparative performance of native Indonesian egg-laying ducks. Center Report No. 6. Centre for Animal Research and Development. Ciawi, Indonesia.

Chernichovsky, and Oey Astra Meesook. 1984. Patterns of Food Consumption in Indonesia: An Analysis of the National Socioeconomic Survey, 1978. World Bank Staff Working Paper no. 670. The World Bank, Washington, D.C.

Clavijo, H. and J.H. Maner. 1974. The use of waste bananas for swine feed. Series EE - No. 6. Centro Internacional de Agricultura Tropical (CIAT). Cali, Colombia.

Cresswell, D.C. and B. Gunawan. 1982. Indigenous chickens in Indonesia: production characteristics in an improved environment. Research Institute for Animal Production. Bogor, Indonesia.

Cumming, R.B. 1984. Report on consultancy on avian diseases. Research Institute for Animal Disease, Bogor.

Danamik, Konta Intan et al. 1984. Peranan Blantik dalam Sistem Produksi dan Pemasaran Kambing/Domba di Jawa Tengah. In Proceedings Scientific Meeting on Small Ruminant Research. pp 220-228. Bogor, Indonesia. Pusat Penelitian dan Pengembangan Peternakan.

Danandjaja, J. 1971. Kebudayaan Pendudu Kalimantan Tengah. In Koentjaraningrat (ed.). Manusia dan Kebudayaan di Indonesia. Jakarta, Indonesia. Djambatan. pp 119-144.

DBPP/FPIPB (Direktorat Bina Produksi Peternakan/Fakultas Peternakan Institute Pertanian Bogor. 1985. Laporan Inventarisasi Potensi dan Pemanfaatan limbah industri pertanian. Proyek pembinaan peternakan pusat. Institut Pertanian Bogor, Bogor. 95 pgs.

DBPP/FPGM (Direktorat Bina Produksi Peternakan/Fakultas Peternakan Universitas Gadjah Mada). 1983. Inventarisasi limba pertanian (Inventory of agricultural wastes). Soemarmo Peopspodihardjo, ed. Universitas Gadjah Mada. 61 pgs.

De Boer, J. 1984. Demand for secondary foodcrops as animal feedstuffs in Indonesia based on projected developments in the livestock sector. Consultant report, East Asia and Pacific Projects Department, The World Bank, Washington, D. C.

Devendra, C. and M.F. Fuller. 1979. Pig production in the tropics. Oxford University Press. Oxford, England.

Dick, H. W. 1985a. A Survey of Recent Developements. Bulletin of Indonesian Economic Studies. XXI (3): 1-29.

Dick, H. W. 1985b. Outer island shipping: progress, problems and prospects, Bull. of Indon. Econ. Studies XXI (2): 95-114.

Dinas Peternakan Bengkulu. 1983. Annual report. 1983-84.

Directorate General of Food Crops. 1984. Statistics of Food Crops in Indonesia. Jakarta.

Directorate General of Livestock Services. 1977. Replita III worksheets submitted to BAPPENAS. Mimeo, Jakarta.

Directorate General of Livestock Services. 1983. Replita IV worksheets submitted to BAPPENAS. Mimeo, Jakarta.

Directorate General of Livestock Services. 1983a. Informasi Data Peternakan. Jakarta.

Directorate General of Livestock Services. 1984b. Informasi Data Peternakan. Jakarta.

Directorate General of Livestock Services. 1985a. The dairy industry in Indonesia. Mimeo, Jakarta.

Directorate General of Livestock Services. 1980. National Livestock Census Survey. Jakarta.

Directorate General for Livestock Services. 1984b. Sistem Pembangunan Peternakan Khususnya Kesehatan Termokdi Pedesaan. Jakarta.

Directorate General for Livestock Services. 1985b. Proposal for the Livestock Slaughterhouse and Marketing Sub-Project (working draft). Jakarta.

Directorate General for Livestock Services, 1984a. Bull. Statistiks. Ekonomi Ternak, Vol 15 and 16. Jakarta.

Direktorat Bina Produksi. 1985. Pertemuan Koordinasi Regional Pembangunan Peternakan Wilayah II. Direktorat Jenderal Peternakan, Jakarta, Indonesia.

Direktorat Bina Program. 1983. Buku Statistik Peternakan. Direktorat Jenderal Peternakan. Jakarta, Indonesia.

Direktorat Bina Program. 1984. Buku Statistik Peternakan. Direktorat Jenderal Peternakan. Jakarta, Indonesia.

Directorat Jenderal Peternakan (DGP). 1984. Sistim pembangunan peternakan khususnya kesehatan ternak di pedesaan. Jakarta.

Direktorat Penyebaran dan Pengembangan Peternakan. 1985. Evaluasi Pembinaan dan Pengembangan Peternakan di Daeerah Transmigrasi Tahun 1979/70 s/d 1984/85. Jakarta, Indonesia. Direktorat Jenderal Peternakan.

Dixon, J.A. 1984. Suggested areas of research focus under the Agricultural Sector Research Project (ASRP) (mimeo), USAID, Jarkata.

Dyer, I.A. and C.C. O'Mary. 1977. The Feedlot. Lea and Feiberger. Phil. Pa. pgs 95-96.

Edney, J.S. and Muchlis, A. 1962. Fascioliasis in Indonesian livestock. Communicationes Veterinarie, 2. pp. 49-60.

Effendi, M. Soenardi and Mulyawan Sapardi. 1984. Pengamatan penyakit scabies pada ternak kambing di Sumatera Barat. In Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1982-83. Direktorat Jenderal Peternakan, Jakarta.

Fakultas Ekonomi Universitas Kristen Satya Wacana. 1984. Sistem Penguasaan/Gaduhan Kambing dan Domba serta Peranan Blantik dalam sistem Pemasaran dan Produksi Kambing, Domba. Salatiga: Univ. Kristen Satya Wacana.

Falvey, J.L. 1981. *Imperata cylindrica* and animal production in Southeast Asia: A Review. Tropical Grasslands. 15:52-56.

Farrell, D.J. 1984. A preliminary report and possible research opportunity in West Timur. Central Research Insitute for Animal Science, Bogor, Indonesia.

Farrell, D.J. and Y.C. Raharjo. 1984. The potential for meat production from rabbits. Central Research Institue for Animal Science, Bogor, Indonesia.

Food and Agriculture Organization of the United Nations (FAO). 1976. Report on veterinary education in Asia. RAFE 26, Bangkok.

Food and Agriculture Organization of the United Nations (FAO). 1985. Report on the meeting of livestock production under tropical and subtropical conditions. FAO, Rome.

Food and Agriculture Organization of the United Nations (FAO). 1985a. FAO Production Yearbooks, various issues. Rome, Italy.

Food and Agriculture Organization of the United Nations (FAO). 1985b. FAO Food Balance Sheets, various issues. Rome, Italy.

Food and Agriculture Organization of the United Nations (FAO). 1985c. FAO Trade Yearbooks, various issues. Rome, Italy.

Geertz, Hildred. 1967. Indonesia: Cultures and communities. In Ruth T. McVey (ed.), New Haven: HRAF Press, Indonesia. pp 24-96.

Ginting, N. 1979. Kasus penyakit ingusan (BMC) pada sapi Bali di Jawa Barat. Bull LPPH 11: 7-15.

Glassburner, B. 1985. Macroeconomics and the agricultural sector, Bulletin of Indonesian Economic Studies XXI (2): 51-73.

Gohl, Bo. 1981. Tropical feeds (feed information summaries and nutritive values). Food and Agricultural Organization of the United Nations (FAO-UN). Rome, Italy. 529 pgs.

Gunawan, M. 1984. Pengarah pengobatan neoascaris vitulorum dengan piperazin citrat pada pedet di Bali. Inilaporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1982-83. Direktorat Jenderal Peternakan, Jakarta.

Hanafi, Hassan. 1984. Pandangan agama tentang tanah, suatu Pendekatan Islam. Prisma 12 (4).

Hardjosubroto, W. and Supiyono. 1977. The performance of kampung and kedu chickens. Seminar Indonesia, Poultry No.2., Center for Animal Research and Development, Ciawi, Indonesia.

Hardjosubroto, W. and M. Astuti. 1979. Animal Genetic Resources in Indonesia. SABRAO Workshop on Animal Genetic Resources, Tsukuba City, Japan.

Harmadji, G. Sudiono and G. Murdjito. 1981. Pengendallion pemotongon sapi betina proderktif dan permasalahannya 1981. Proc. Seminar Penelitian Peternakan. Bogor, Indonesia.

Hartadi, H., S. Rekohadipnodjo, S. Lebdosukoyo, A.D. Tillman, L.C. Kearl, and L.E. Haris. 1980. Tables of Feed, Composition for Indonesia. International Feedstuffs Institute, Utah State University, Logan, Utah and University of Gadjah Mada Press, Yogyakarta, Indonesia.



429

Hartadi, H., Djoko Sutrisno and Soedomo Reksohadiprojo. 1981. Nutrititive evaluation of crop residues. In: Beef cattle and goat production. Final report of the Coordinated Research Project, Gadjah Mada University and The Rockefeller Foundation. Fakultas Peternakan, Gadjah Mada University, Yogyakarta. pg.35.

Hartaningsih, S.T., Malole, M. and Witono, S. 1982. Studi epidemiologi dan tindakan pengamanan pasteurellosis pada itik di Bali. LTHPPHSI. Direktorat Jenderal Peternakan, Jakarta.

Hasan, Basri, 1984. Goat marketing in the livestock market in Sibreh district of Aceh Besar. In: Seminar on Sheep and Goats in Indonesia, Research Institute for Animal Production, Bogor. pp: 175-178.

Hayman, J.M. 1972. Laporan Program Makanan (Report on pasture program). Inspektorat Dinas Peternakan, Prop. Sumatera Utara.

Hetzel, D.J.S. 1984. Comparative performance of intensively managed Khaki Campell and Native Indonesian ducks. Tropical Animal Health and Production 16:39-45.

Hetzel, D.J.S. 1983a. Growth and carcass characteristics of drakes of the Alabio and Tegal breeds and their reciprocal crosses. Sabrao Journal. 15:77-83.

Hetzel, D.J.S. 1983b. The egg production of intensively managed Alabio and Tegal ducks and their reciprocal crosses. (As cited in Hetzel and Gunawan, 1984). Submitted for publication in the Journal of Agricultural Science, Cambridge.

Hetzel, D.J.S. and B. Gunawan. 1984. Egg production of Indonesian native and crossbred ducks under intensive and extensive conditions. Tropical Animal Production. 9:203-215.

Hoffman, D., Soeripto, S., Sobironingsih, S., Campbell, R.S.F., and Clarke, B.C. 1984. The clinico-pathology of an MCF syndrome in the Indonesian swamp buffalo (Bubalus bubalis). Aust. vet. J. 61:108-112.

Huitema, H. 1982. Animal husbandry in the tropics, its economic importance and potentialities, Communication 73, Royal Tropical Institute, Amsterdam.

Hutasoit, H.J. 1974. Animal husbandry development prospectives in Indonesia. In: Seminar on research and animal production development in Indonesia. Directorate General of Livestock Services, Ministry of Agriculture, Jakarta, Indonesia.

Ihalauw, John et al. 1973. Penelitian tentang Kredit Tidak Resmi dikalangan Transmigran di Kabupaten Lampung Tengah. Lembaga Penelitian Ilmu-ilmu Sosial Univ. Kristen Satya Wacana. Salatiga, Indonesia.

Ihalauw, John. 1983. A summary of explorative research on various socio-economic aspects of the goat/sheep production systems in Central Java. Indonesian Agricultural Research and Development Journal. V (1).

Ihalauw, John, J. Sardi Kartoredjo, K. Suwondo, and L. Widjajanto. 1984. Penguasaa Tanah Serta Implikasinya Terhadap Keketatan Budidaya, Peluangan kerja dan Peluanga Berusaha de Pedesaan. Univ Kristen Satya Wacana. Salatiga, Indonesia.

Inas Nur' Aini, 1983. Pola perdagangan masukan dan keluaran usaha ternak ayam ras. Forum Agro Ekonomi II (2): 8-16, December

Inspektorat Peternakan Irian Jaya. 1984. Panca Usaha Ternak Potong Bibit di Irian Jaya. Kerjasama dengan JDF dan BRI. Jaya pura: Inspektorat Peternakan Irian Jaya.

Ishii, T., Ogawa, N. and Shimada, H. 1984. Report on the investigation of poultry diseases in Indonesia. Japan Overseas Technical Cooperation Agency. Tokyo.

Italconsult. 1984. South Kalimantan livestock development project. Special Report by Italconsult and Amythas Experts and Associates to the Directorate General of Livestock Services. Jakarta, Indonesia.

Ivory, D.A. and M.E. Siregar. 1984. Forage research in Indonesia: past and present. In Asian Pastures FFTC Book Series No. 25, Taipei, Taiwan.

Jan Nari and Sjamsudin, A. 1973. Haemorrhagic septicaemia and an oil adjuvant HS vaccine. PDHI IV Congress, Surabaya.

Jones, R.J. 1982. Effect of leucaena feeding on Australian goats and thoughts on future work in Indonesia. Seminar program, Research Institute for Animal Production. Ciawi, Indonesia.

Jones, P.H. 1983. Lamtoro and the Amarasi model from Timor. Bulletin of Indonesian Economic Studies XIX (3):94-105.

Kanamik, Konta Intan et al. 1984. Peranan Blantik dalam Sistem Produksi dan Pemasaran Kambing/Domba di Jawa Tengah. In: Sheep and goats in Indonesia. pp 220-228. Bogor, Indonesia. Pusat Penelitian dan Pengembangan Peternakan.

Kasryno, F., M. Syam, Y. Saefuddin, S.O. Manurung, and P. Mundy (eds.). 1984. Consequences of small farm mechanization in Indonesia. Agency for Agricultural Research and Development, Directorate General for Food Crops and International Rice Research Institute. Bogor, Indonesia.

Kearl, Leonard C. 1982. Nutrient requirements of ruminants in developing countries. International Feedstuffs Institute. Utah Agricultural Experiment Station. Utah State University, Logan. 381 pgs.

Kertayadnya, I.G., Unruh, D.H.A., Gunawan, M. and Adhipatra, P.S. 1982.



431

Scabies epizootiologi pengobatan dan perkiraan kerugian ekonomi. In Laporan Tahunan Hasil Penyidikan Penyakit Hewan di indonesia. 1976-81. Directorat Jendral Peternakan, Jakarta.

Kingston, D.J. and D.C. Cresswell. 1982. Indigenous chickens in Indonesia: population and production characteristics in five villages in West Java. Research Institute for Animal Production. Bogor, Indonesia.

Knaap, W.R. 1935. De vee handel in de afdeeling Madoera. Ned. Ind. Bl. Vol 47: 135-149.

Knipscheer, H.C., T.D. Soedjana, and A. Prabowo. 1983. A survey of six specialized small ruminant farms in West Java. Small Ruminant Collaborative Research Support Program Working Paper No. 9. Bogor, Indonesia.

Knipscheer, H., J. De Boer, M. Sabrani, and T. Soedjana. 1983. The economic role of sheep and goats in Indonesia. A Case Study of West Java. Bulletin of Indonesian Economic Studies XIX(3) 74-93.

Knipscheer, H.C. and J. Levine. 1984. The status of ruminants in Indonesia with special reference to research needs. Balai Penelitian Ternak/USAID. Bogor/Jakarta, Indonesia.

Koentjaraningrat. 1971. Pendahuluan. In Koentjaraningrat (ed.), Manusia dan kebudayaan di Indonesia. Jakarta, Indonesia. Djambatan. pp 1-36.

Koentjaraningrat. 1971. Kebudayaan Flores. In Koentjaraningrat (ed.). Manusia dan Kebudayaan di Indonesia. Jakarta, Indonesia. Djambatan. pp 186-200.

Koperasi Peternakan Bendung Selatan. 1983. Review: South Bandung Dairy Coop., Pengalegan.

Koperasi Peternakan Bandung Selatan. 1984. Berita Tahunan ke XVI Tahun Buku 1984. Pengalengan: KPBS.

Koperasi Unit Desa Mekar. 1984. Laporan 1984. Ungaran: KUD Mekar Sari.

Kristanto, Kustiah. 1982. The smallholder cattle economy in South Sulawesi. Bulletin of Indonesian Economic Studies XVIII (1): 61-85.

Lapoporan Hasil Pelaksanaan Supervisi/Pengendalian Proyek Pembinaan Ternak. 1985. Daerah Transmigrasi Tahun 1984/85. Jakarta, Indonesia. Direktorat Jenderal Peternakan.

Leake, J. 1980. The livestock industry. Bulletin of Indonesian Economic Studies XVI (1): 65-74.

Lebdosoekojo, Sukanto and Soedomo Reksohadiprodjo. 1982. Low-cost feed rations: the prospect for substitution. In: Livestock in Asia: Issues and Policies. Jefferey C. Fine and Ralph G. Lattimore, eds. International Development Research Centre (IDRC), Ottawa, Canada. pgs 79-83.

Lembang Balai Inseminasi Buatan. 1985. Laporan tinjauan hasil tahunan. Proyek produski semen beku Bandung. Tahun anggaran 1984-1985. Lembang, Bandung.

Lepley, K.C., 1981. Feed industry survey for Indonesia, 1981. (mimeo), American Soybean Association, St. Louis.

Levine, J. 1984. The potential for livestock in smallholder farming systems in Southeast Sulawesi. Southeast Sulawesi Transmigration and Development Project (ADB). SESTADP occasional paper no. 2.

Levine, Joel. 1984. An evaluation of Provincial Development Program duck projects in Nusa Tenggara Barat. Occasional Report no. 23. Provincial Development Program IIB/NTB.

Levine, Joel. 1984. An evaluation of provincial development program goat and cattle projects in Nusa Tenggara Barat. Provincial Development Program Occasional Report No. 24, Jakarta, Indonesia.

Levine, Joel and Setel Karo-Karo. 1985. Secondary village level data for fifteen villages of Kecamatans Sibolangit, Galang, and Per baungan, Kabupaten Deli Serdang, North Sumatra. SR/CRSP Program Working Paper No. 48. Research Institute for Animal Production. Bogor, Indonesia.

Luckins, A.G. 1983. Report on development of serological assays for studies on trypanosomiasis of livestock in Indonesia. BPPH, Bogor.

Mathius, I.W. and J.E. van Eys, 1983. Feeds and feeding of sheep in Sukawargi village, West Java: a profile study. BPT/SRCRSP Working paper 12. Research Institute for Animal Production, Ciawi, Bogor.

Mason, I.L. 1969. A world dictionary of livestock breeds and varieties. Tech. Com. Revised Commonwealth Agric. Bureau, Farnham, Bucks, England.

Mason, I.L. 1978. Sheep in Java. World Animal Review 27:17-22.

McDowell, L.R. and J.H. Conrad. 1977. Trace mineral nutrition in Latin America. World Animal Review. 24:24-33.

McDowell, R.E. and P.E. Hildebrand. (1980). Integrated crop and animal production: Making the most of resources available to small farms in developing countries. Working Papers, the Rockefeller Foundation, New York, p. 78.

McIntosh, J.L. 1985. Multiple cropping in mixed farming systems in Indonesia. Int'l Multiple Cropping Systems Conf., Chinese Acad. Sci., Nanjing, Peoples Rep. of China. Mimeo.

Metzner, J. 1983. Innovations in agriculture incorporating traditional production methods: The case of Amarasi (Timor). Bulletin of Indonesian Economic Studies XIX (3):106-112.

Metzner, Joachim. 1978. Paronisasi, Fase Baru Menuju Intensifikasi Peternakan di Nusa Tenggara Timur. Ende: Nusa Indah.

Mink, S. 1982. Prospects for small farm goat production in a transmigration area of Indonesia: results of a survey. SR/CRSP Program Working Paper No. 2. Research Institute for Animal Production. Bogor, Indonesia.

Mittendorf, H.J. 1981. Livestock and meat marketing in Asian countries. World Animal Review 40:34-42.

Moran, J. B. 1980. Performances of indigenous breeds of cattle when fed high concentrate diets. Mimeo Report, Center for Animal Research and Development. Ciawi, Indonesia.

Moran, J.B., R.E. Chambers, and D. Sastradipradja. 1978. Heat tolerance and blood thyroxine levels in Madura, Ongole, and Friesian crossbred bulls during exposure to sun at Caiwi. Seminar Ruminansia #1, Center for Animal Research and Development, Ciawi, Indonesia.

Mudigdo, R. and Peranginangin, Th.A. 1982. Penyidikan pendahuluan penyebaran penyakit Pullorum dan chronic respiratory disease secora serologik di daerah Sumatera Utara. In: Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1976-81. Direktorat Jenderal Peternakan, Jakarta.

Mudigdo, R. and Peranginangin, Th. A. 1983. Pelaksanaan pengujian penyakit Pullorum pada peternakan ayam bibit dan permasalahannya. Llaporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1981-82. Directorat Jendral Peternakan, Jakarta.

Muller, A.O. 1974. Livestock nutrition in Indonesia. AGA SF/INS/72/109 Tech. Report. Directorate General Livestock Services, Ministry of Agriculture, Jakarta, Indonesia.

Muller, A.O. 1974. Nutritive value of Indonesian feedstuffs. FAO/UNDP/INS/72/009. Directorate General of Livestock Services, Ministry of Agriculture, Jakarta, Indonesia.

Nitis, I.M. 1981. Raw materials for concentrates. First ASEAN Workshop on the Technology of Animal Feed Production Utilising Food Waste Materials. Bandung, Indonesia. pp. 21-48.

NRC (National Research Council). 1978. Nutritional requirements of dairy cattle (fifth revised edition). National Academy of Sciences. Washington, D.C. 76 pp.

NRC (National Research Council). 1973. Nutritional requirements of swine (seventh revised edition). National Academy of Sciences. Washington, D.C. 56 pgs.

NRC (National Research Council). 1975. Nutritional requirements of sheep (fifth revised edition). National Academy of Sciences, Washington, D.C. 72 pgs.

NRC (National Research Council). 1976. Nutrient requirements of beef cattle (fifth revised edition). National Academy of Sciences. Washington, D.C. 56 pgs.

NRC (National Research Council). 1981. Nutrient requirements of goats: Angora, dairy and meat goats in temperate and tropical countries. National Academy of Sciences. Washington, D.C. 91 pgs.

Page, Frank C., Agus Muljadi, H.C. Knipscheer and J. Levine. 1984. Three surveys on livestock in Indonesia: Aceh, South Kalimantan and East Java. BANGA/USAID. 87 pgs.

Pane, Ismed. 1983. Petunjuk Teknis Penetuan Uratan Nilai Mutu Genetik. Project Pembibitan Sapi Bali. Directorate General Livestock Development, Jakarta, Indonesia.

Panjaitan, M. and G.J. Blair. 1984. Research on the use of leucaena and other tree and shrub legumes in Indonesia. In Shrub and Legume in Indonesia and Australia. Proc. Workshop. E.T. Craswell and B. Tangendjaja (eds), Ciawi, Indonesia. pp 10-18.

Parsons, S.A. and Vere, D.T. 1984. Benefit-cost analysis of the Bakitwan project, Bogor Indonesia. Australian Development Assistance Bureau, Canberra.

Parsudi, Suparlan. 1971. Kebudayaan Timor. In Koentjaraningrat (ed.). Manusia dan Kebudayaan di Indonesia. Jakarta, Indonesia. Djambatan. pp 201-225.

Partadiredja, M. and Juniman, B. 1985. Isolasi dan identifikasi virus Bumboro di Indonesia. Hemera Zoo. 72:7-14.

Pane, Ismed. 1983. Petunjuk Teknis Penetuan Uratan Nilai Mutu Genetik. Proyek Sapi Bali. Direktorat General LIvestock Development, Jakarta.

Payne, W.J.H. and D.H.L. Rollison. 1973. Bali cattle. World Animal Rev. 7:7-13.

Pelzer, Karl J., 1967. Physical and human resource patterns, In Ruth T. McVey (ed.), New Haven, HRAF Press, Indonesia, pp 1-23.

Peran Ekonimis dan Sosiologis Wanita dalam Sistem Produksi dan Pemasaran Kambing/Domba. 1985. Salatiga: Univ. Kristen Satya Wacana.

Petheram, R.J. and A. Thahar. 1983. Duck egg production systems in West Java. Agricultural Systems 10:75-86.

Petheram, R.J., Ashari, T. and Bernsten, R.H. 1985. Socio-economic factors in draught animal power in southeast Asia with special reference to Indonesia. Draught Animal Power for Production Proc. Workshop. James Cook University, Townsville.

Piggin, D.M. and V. Parera. 1984. The use of leucaena in Nusa Tenggara Timur. In: Shrub Legumes in Indonesia, Proc. Workshop. E.T. Crosswell and B. Tangendjaja (eds.). Ciawi, Indonesia. pp. 19-27.

Piggin, C.M., et al. 1985. Report of results fro pasture research trials and development sowings, 1982-85. Indonesia-Australia NTT Livestock Development Project, Kupang, NTT, 111 p.

Prabowo, A., J.E. van Eys, I.W. Mathius, M. Rangkuti and W.L Johnson. 1984. Studies on the mineral nutrition of sheep in West Java, Indonesia. Working paper no. 40. Balai Penelitian Ternak/Small Ruminant Collaborative Research Support Program (SR-CRSP). Bogor. 23 pgs.

Purnomo, R. and Rastiko, P. 1982. Some epidemiological aspects and economic loss of a bovine ephemeral fever outbreak in Tuban and surrounding areas. East Java, Indonesia. Penyakit Hewan 14:25-29.

Purnomo, R. 1984. Research on poultry diseases in Indonesia. In: Proceedings of Field Workshop on Poultry Disease Among Devloping Countries. Bogor.

Purnomo, R., Koesharjono, C., Simandjuntak, G., and Barka, K. 1984. Penyakit Rading limp^ (Anthrax) pada babi di Kabupaten Paniai, Irian Jaya. Penyakit Hewan 16:238-241.

Purnomo, R., Wilson , A. J., and Hirst, R. G. 1985. Current livestock disease status in Indonesia. Research Institute for Animal Disease, Bogor.

Putra, A.A.G., and Gunawan, M. 1983. Laporan penyidikan Kasus scabies pada Kambing, efikasi conmophos 0.1%. Terhadap Sarcoptes scabiei var coprae dan gambaran haematologik. In: Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1981-82. Directorat Jendral Peternakan, Jakarta.

Putra, A.A.G., and Sudana, I. G. 1985. Peta Distribusi Penyabit Hewan di Wilahay Kerja BPPH. Wilayah VI Denpasar. 1982-83.

Rabold, K., H.J. Harborth, H.J. Jakob, M. Rhind, G. Rothmeyer, and H. Schotanus. 1980. Animal husbandry in the Middle Mahakam area. East Kalimantan Transmigration Area Development Project Report. TAD-Materialien 7, Hamburg, Germany.

Ramm, G., G. Balzer, M. Eckert, B. Massler, R. Muller, R. Hugo, and J. Richter. 1984. Possibilities of integration of animal husbandry into small-holder farming systems in East Kalimantan. Center for advanced studies in agricultural development, Institute of Socio-Economics of Agricultural Development. Technical University of Berlin.

Rangkuti, M., T.D. Soedjana, H.C. Knipscheer, P. Sitorus and A. Setiadi (Eds). 1984. Sheep and Goats in Indonesia (Proceedings scientific meeting on small ruminant researh, Bogor. Nov. 22-23, 1983), Central Research Institutes for Animal Sciences, Bogor.

Rekohadiprodjo, S. 1980. Ranching development in Eastern Indonesia preliminary observations. Seminal Ruminasia #2. Center for Animal Research and Development Ciawi, Indonesia.

Republik Indonesia. 1984. Pidato Kenegaraan Presidnet Republik Indonesia. President Soeharto. Jakarta, Indonesia.

Rika, I.K., J.M. Nitis, and L.R. Humphreys. 1981. Effect of stocking rate on cattle growth, pasture production, and coconut yield in Bali. Tropical Grasslands 15:149-156.

Robinson, D.W. 1977. Livestock in Indonesia. Research Report for Center for Animal Research and Development. Bogor, Indonesia.

Roll, Werner. 1981. Stuktur Pemilikan Tanah di Indonesia: Study Kasus Daerah Surakarta - Jatong. Yayasom Obor Indonesia. Jakarta, Indonesia.

Rollinson, D.L.H. and A.J. Nell, 1973. The present and future situation of working cattle and buffalo in Indonesia. UNDP/FAO INS/72/009 Working Paper, Jakarta.

Rollinson, D.L.H. and A.J. Nell, 1974. The present and future situation of pig production in Indonesia. UNDP/FAO INS/27/009 Working Paper, Jakarta.

Rollinson, D.H.L. and A.J. Nell,. 1975. Livestock development planning, Indonesia. Project findings and recommendations. UNDP/FAO. Rome.

Rosmijati, Sajuti. 1984. Perkembangan dan variasi harga daging dan telur pada berbagai kura besar di Indonesia. Forum Agro Ekonomi III (1): 1-9.

Sabrani, M. 1982. Analysis of Regional Demand for Red Meat in Java, Indonesia. In Animal Production and Health in the Tropics, Penerbit Agricultural University of Malaysia. pp: 383-386.

Sabrani, M. and H. Knipscheer. 1982. Small ruminants for small farmers. Indonesian Agricultural Reseaarch and Development Journal 4 (13): 86-90.

Sabrani, M., A.P. Siregar, R.J. Petheram, and H. Knipscheer. 1982. An introduction to livestock farming systems research for rural development. Mimeo, SR-CRSP, Balai Penelitian Ternak, Bogor, Indonesia.

Sabrani, M., P. Sitorius, M. Rangkuti, Subandriyo, I.W. Mathius, Tjeppy D. Soedjana and Armiada Semali. 1981. Lapoian Survey Baseline Ternak Kambing dan Domba. Balai Penelitian Pernak/Small Ruminant Collaborative Research Support Program (SR-CRSP). Bogor.

Santoso and Kedi Suradisastra. 1979. Analisa biaya produski dan penerimaan usaha produski telur itik alabio di Kalimantan Selatan. Bulletin Lembaga Penelitian Peternakan. No. 30. pgs 1-14. Bogor.

Schwocar, D. C., 1973. Land capability appraisal.Indonesia-Land Use Appraisal, FAO, Bogor, Indonesia.

Scott-Orr, H., Darodjat, M., Jajuk, A., and Soeroso, M. 1980. Proceedings of seminar on reproductive diseases. Bogor. 31-58.

Sediono, M.P. Tjondronegoro dan Gunawan Wiradi (ed.). 1984. Dua Abad Penguasaan Tanah. Jakarta, Indonesia. Gramedia.

Setiadi, B. and P. Sitorus. 1984(a). Performance of Etawah grade and Kacang goats. SR/CRSP Program Working Paper No. 37. Research Institute for Animal Production. Bogor, Indonesia.

Setiadi, B. and P. Sitorus. 1984(b). Reproduction and production performances of Etawah grade goats. In: Sheep and Goats in Indonesia Workshop, Bogor, Indonesia, pp. 118-121.

Singarimbun, Masri. 1975. Kinship, descent, and alliance among the Batak Karo. University of California Press. Berkeley.

Singosari Balai Inseminasi Buatan. 1985. Laporan kegiatan tahunan. Tahun 1984. Singosari, Malang.

Siregar, A.R., C. Talib, K. Diwyanto, P. Sitepu, H. Prasityo, U. Kusnadi, P. Sitaruk, and D. Budiwiyono. 1984. Performance sapi madura di pulau Madura. Direktorat Bina Produksi, Direktorat Jenderal Peternakan dan Balai Penelitian Ternak. Jakarta and Bogor, Indonesia.

Siregar, M.E. 1983. Effect of cutting management on the yield and quality of tropical forage species. Proc. 5th World Anim. Prod. Conf. Tokyo, Japan.

Siregar, M.E. and A. Semali. 1982. Pengaruh leguminosa tanaman makanan ternak ditumpangsarikan degan jagung terhadap produksi. Ilmu dan Peternakan 1:35-38.

Siregar, S.B. 1984. Research program for improving milk production in Indonesia. Balai Penelitian Ternak, Ciawi, Indonesia. Mimeo.

Siti, Chotiah. 1982. Penyidikan terhadap kemungkinan adanya leucocytozoonosis di Lampung. In: Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. Direktorat Jenderal Peternakan, Jakarta.

Siti, Chotiah 1983. Penyidikan infestasi Haemonchus pada sapi, kerbau, kambing dan domba di Lampung Selatan dan Lampung Tengah. In Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1981-82. Direktorat Jenderal Peternakan, Jakarta.

Soedjana, T. D. and H. Knipscheer. 1984. The marketing of small ruminants in East Java, Indonesia. In: Sheep and Goats in Indonesia. pp.179-183.

Soerjani, M. 1970. Alang-alang (*Imperata cylindria (L.) Beauv*). Pattern of growth as related to its problem control. BIOTROP Bull. 1, Bogor, Indonesia.

Soeroso, M., Darodjat, M., Nurhadi, A., Hirst, R. G., Chasanah, U., and Hardjoutomo, S. 1985. Animal Brucellosis in Indonesia. Cited by Partoutomo, S. et al. 1985.

Soetedjo and Stoltz, D. (Ed.) 1983. Annual Report: Research Institute for Animal Disease, Bogor, Indonesia.

Soewardi, B. and D. Sastradipradja. 1980. Alang-alang (*Imperata cylindrica (L.) Beauv.*) and animal husbandry. In Proc. BIOTROP Workshop on Alang-alang. BIOTROP Spec. Publ. 5:157-178.

Stevenson, P., Beriajaya, and Day, A. 1983. Gastrointestinal nematodes in sheep in West Java and the effect of anthelmintics on liveweight gain. Proceedings World Association for the Advancement of Veterinary Parasitology, Perth, Australia.

Sudana, I. G., and Malole, M. 1982. Penyidikan penyakit hewan "Bluetongue" di desa Coringin Kabupaten Bogor. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1976-81. Direktorat Jenderal Peternakan, Jakarta.

Sudana, I. G. 1982. Pasteurella multocida pada itik di Bali. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. Direktorat Jenderal Peternakan, Jakarta.

Sudaryanto, Bambang, I.W. Mathius and M. Rangkuti. 1984. Utilization of cassava leaf meal in sheep diets. In: Proceedings of the Scientific Meeting on Small Ruminant Research. November 22-23, 1983. Bogor. pg. 67.

Sugianto and S. Linnge. 1981. Perkreditan oleh BRI ke sub sektor peternakan. Proc. Seminar Penelitian Peternakan. Bogor, Indonesia.

Sukobagyo, P. 1985. Disease investigation centers in Indonesia. Proceedings of Seminar on Goal Oriented Planning Project. Bukittinggi, Indonesia.

Sukobagyo, P., Malole, M., Siregar, G., Gde Sudana, Mandala, K.A., Suyudono, R., and Budiharta, S. 1979. "Foot and Mouth Disease Eradication Programme in Indonesia: Bali Case." In: FAO Seminar on Veterinary Epidemiology: Disease Surveillance Systems and Economics of Disease Control. Denpasar. Direktorat Jenderal Peternakan, Jakarta.

Sukra, Y., 1980. Indonesian Higher Education Development with reference to agricultural-related Universities. In: Animal Health and Nutrition (Ed. R.S.F. Campbell). Research for Development Seminar 1. Australian Developement Asistance Bureau, James Cook University, Townsville.



429

Sulaiman, I., Tri Akoso, B., and Sulaiman, T., 1983. Isolasi Pasteurella antipestifer sebagai agen penyebab infectious serositis pada anak itik di Sulawesi Selatan. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. Direktorat Jenderal Peternakan, Jakarta.

Sumardjan, Selo. 1981. Perubahan Social de Yogyakarta. Gadjah Mada University Press. Yogyakarta, Indonesia.

Sutiono, P., Purnomo, R., Wilson, A. J., and Stevenson, P., 1985. A review of diseases in Indonesia which will affect draught power in domestic animals. Proc. Workshop on Draught Animal Power for Production. Australian Centre for International Agricultural Research: James Cook University, Townsville.

SUSENAS. 1979. Survey Sosioekonomik Nasional (national socioeconomic survey). National Statistical Bureau, Jakarta.

Sutrisno, M., Wisynu, S., and Witono, S., 1984. Kasus coccidiosis pada ayam di BPPH Wil. IV Yogjakarta, Tahun, 1983. Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1982-83. Direktorat Jenderal Peternakan, Jakarta.

Syarifuddin, A., I.G. Ismail, and J.L. McIntosh. 1984. Review: cropping systems research and development in Indonesia. Workshop Farming Systems Research, Sukamundi, Indonesia. Mimeo.

Syarwani, J. and Made Djogera, I., 1984. "Survei Neoascaris Vitulorum pada anak sapi di Kabupaten Taneh Laut, Kalimantan Selatan." In Laporan Tahunan Hasil Penyidikan Penyakit Hewan di Indonesia. 1982-83. Direktorat Jenderal Peternakan, Jakarta.

Team Survey Pusat Pengembangan Agribisnis. 1980. Laporan Survey Sumba kontrak di Sulawesi Tengah, Sulawesi Selatan, Sumatra Utara dan Lampung. Pusat Pengembangan Agribisnis dan Direktorat Bina Program, Jakarta.

Tessema, Shankute. 1972. Nutritional value of some tropical grass species compared to some temperate grass species. Ph.D. thesis. Cornell University, Ithaca, N.Y. 199 pgs.

Tiesnamurti, B., Ismeth Inounu, P. Sitorus, and Subandriyo. 1985. Pre-weaning performance of Javanese lambs. SR/CRSP Program Working Paper No. 42. Research Institute for Animal Production. Bogor, Indonesia.

Tillman, A.D. 1980. Agricultural research in agricultural development - the role of the university. Mimeo Report Faculty of Animal Husbandry, Gadjah Mada University, Yogyakarta, Indonesia.

Tillman, A.D. 1981. Animal Agriculture in Indonesia. Winrock International, Morrilton, Arkansas, U.S.A.

Tillman, A.D. Harai Hartadi, S. Reksohadiprodjo, S. Lebdosukoji, L.C. Kearl and L.E. Harris. 1980. Tables of Feed Composition for Indonesia. International Feedstuffs Institute, Logan, Utah.



440

Turner, H.N. 1974. Some aspects on sheep breeding in the tropics. World Animal Review. 10:31-37.

Turner, H.N. 1978. Sheep and the smallholder. World Animal Rev. 28:4-8.

Ukur, F. and F.L. Cooley. 1977. Benih yan tumbuh 8. Gereja Kristen Irian Jaya. Jakarta, Indonesia. LPS-DGI.

Utami, Widya and J. Ihalauw. 1978. Farm Size: its consequences on production, land tenure, marketing and social relationship in kabupaten Klaten, Central Java. Salatiga: LPIS-Satya Wacana.

Van der Giessen, J., 1985. Swine brucellosis in Indonesia. Research Institute for Animal Disease, Bogor.

Van Eys, J.E., I.W. Mathius, N. Thomas, M. Rangkuti and W.L. Johnson. 1983. Forage composition of sheep and goat diets in West Java. Working paper no. 24. Balai Penelitian Ternak/Small Ruminant Collaborative Research Support Project (SR-CRSP). Bogor.

Vergouwen, J.C. 1964. The social organization and customary law of the Toba Batak of Northern Sumatra. The Hague: Martinus Nijhoft.

Vondal, P.J. 1983. Financing duck farms by Hulu Sungai Utara farmers. Provincial Area Development Program (PDPII). NTT-Bengkula-East Java-South Kalimantan-West Java-NTB. Occasionally Rpt. #21. Resources Management International, Inc. Jakarta, Indonesia.

Wartomo, Hardjosubroto. 1984. Breed evaluation of large ruminants in Indonesia. ACIAR Workshop on Evalution of Large Ruminants. Rockhampton, Australia.

World Bank/FAO. 1978. Indonesia Livestock Sector Survey. World Bank Report No. 6/78 Ind. Washington, D.C.

World Bank. 1981. Technical and professional manpower in agriculture. World Bank Report 3249a - Ind. Washington, D.C.

World Bank. 1983. Indonesia: Rural Credit Study. The World Bank, Washington, D. C.

Young, A. 1976. Tropical Soils and Soil Survey. Cambridge Geographic studies. Cambridge Univ. Press, London, 468 p.

# A Review of the Livestock Sector in the Republic of Indonesia

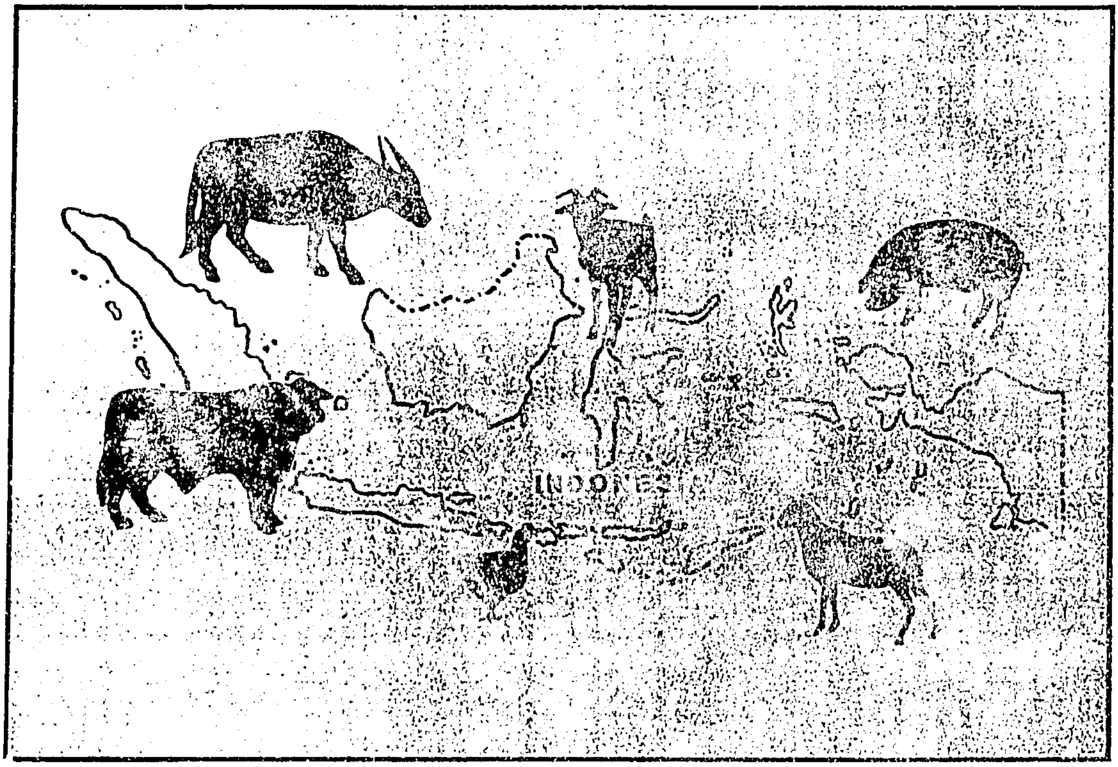
## VOLUME II: APPENDICES

Prepared for

The Asian Development Bank, Manila

and

The Republic of Indonesia



Winrock International Institute for Agricultural Development

A REVIEW OF THE LIVESTOCK SECTOR
IN THE REPUBLIC OF INDONESIA

VOLUME II: APPENDICES

443

# A REVIEW OF THE LIVESTOCK SECTOR IN THE REPULIC OF INDONESIA

Prepared for:

The Asian Development Bank, Manila

and

The Republic of Indonesia

Prepared by:

Winrock International Institute
for Agricultural Development
Morrilton, Arkansas 72110
U. S. A.

March, 1986

444

A REVIEW OF THE LIVESTOCK SECTOR
IN THE REPULIC OF INDONESIA

TABLE OF CONTENTS

Title                                                                 Page

VOLUME I: MAIN REPORT

VOLUME II: APPENDICES

APPENDICES





U4

## LIST OF APPENDIX TABLES



(continued)



4.6

(continued)



447

(continued)

(continued)

(continued)



450

CHAPTER 6



(continued)



451

(continued)

CHAPTER 7





453

**APPENDIX I**

**TABLES FOR CHAPTER I:**

**THE ECONOMY**

Appendix Table 1.1: Projected draft animal requirements in Repelita IV, 1984-1988 ('000 heads)

| | 1984 | 1985 | 1986 | 1987 | 1988 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Cattle (50.1%) | 3,382 | 3,422 | 3,463 | 3,504 | 3,545 | 1.18 |
| Buffalo (57.4%) | 1,454 | 1,469 | 1,483 | 1,499 | 1,515 | 1.03 |
| Total | 4,836 | 4,891 | 4,946 | 5,003 | 5,060 | 1.12 |
| Cultivatable land ('000 ha) | 12,090.0 | 12,227.5 | 12,365.0 | 12,507.5 | 12,650 | 1.14 |

Source: DGLS (1983b). Worksheets prepared for Bappenas

Appendix table 1.2: Draft animal potential and value, 1978-1982

| | 1978 | 1979 | 1980 | 1981 | 1982 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Population: | | | | | | |
| Cattle | 6,330 | 6,362 | 6,440 | 6,516 | 6,594 | 1.0 |
| Buffalo | 2,312 | 2,432 | 2,457 | 7,448 | 2,513 | 2.1 |
| Available draft animals ('000 heads) | | | | | | |
| Cattle (50,1%) | 3,171 | 3,187 | 3,226 | 3,264 | 3,303 | 1.0 |
| Buffalo (57,4%) | 1,327 | 1,395 | 1,410 | 1,428 | 1,442 | 2.1 |
| Total | 4,498 | 4,582 | 4,636 | 4,692 | 4,745 | - |
| Available area ('000 ha): | 11,245 | 11,455 | 11,590 | 11,730 | 11,862 | 1.3 |
| Value of draft power ($ millions) | 224.9 | 229.2 | 231.8 | 234.6 | 237.3 | 1.4 |

Source: DGLS (1977). Repelita III worksheets
Available draft power calculated from livestock population figures and assumes each head cultivates 2.5 ha per year. Draft services valued at $US 50/head/year.

Appendix table 1.3: Growth of livestock and draft animals in transmigration areas in Pelita III, 1978-1982

| | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|
| Total provinces | 18 | 18 | 18 | 18 |
| Total transmigration families | 35,979 | 119,578 | 203,182 | 328,182 |
| Livestock | | | | |
| Cattle/buffalo | 10,087 | 28,620 | 47,152 | 60,920 |
| Goat/sheep | 5,335 | 24,502 | 43,668 | 43,893 |
| Pig | 2,883 | 5,040 | 7,247 | 15,815 |
| Chicken | 360 | 732 | 1,104 | 1,407 |
| Duck | 19,953 | 54,643 | 89,333 | 97,524 |
| Draft animals | 3,908 | 3,009 | 3,099 | 12,524 |

Source: DGLS (1983b). Worksheets prepared for BAPPENAS

Appendix table 1.4: Volume and value of imports of meat, eggs and milk products, 1978-1982 ('000 tons)

| | 1978 | 1979 | 1980 | 1981 | 1982 | Average change (%) 78-82 | 81-82 |
|---|---|---|---|---|---|---|---|
| Volume: | | | | | | | |
| Meat | 1,328.4 | 1,650.6 | 1,625.2 | 2,164.2 | 2,572.0 | + 18.68 | + 18.84 |
| Milk prod. | 49,299.3 | 54,436.0 | 73,019.2 | 56,496.5 | 52,635.5 | + 3.77 | - 6.83 |
| Butter | 9,436.2 | 4,384.5 | 1,309.2 | 5,633.4 | 12,276.1 | + 81.13 | +117.92 |
| Cheese | 1,034.7 | 869.3 | 1,053.0 | 1,266.2 | 1,246.6 | + 5.96 | - 1.55 |
| Eggs | 35.5 | 164.4 | 143.6 | 187.3 | 182.2 | + 94.54 | 2.72 |
| Value ($'000): | | | | | | | |
| Meat | 1,620.7 | 3,056.7 | 4,118.9 | 6,424.8 | 7,007.1 | + 47.10 | + 9.06 |
| Milk prod. | 34,234.4 | 50,180.7 | 77,364.9 | 85,405.1 | 68,956.4 | + 22.97 | - 19.26 |
| Butter | 13,483.0 | 3,048.0 | 1,321.6 | 6,533.9 | 29,151.2 | +151.63 | -346.15 |
| Cheese | 1,641.9 | 1,231.2 | 1,188.2 | 2,280.4 | 2,218.6 | + 15.17 | - 2.71 |
| Eggs | 490.9 | 180.3 | 206.8 | 308.3 | 332.9 | + 2.12 | + 7.98 |
| Total | 51,470.9 | 57,696.9 | 84,200.9 | 100,952.5 | 107,666.2 | + 21.14 | + 6.65 |

Source: Biro Pusat Statistiks (1983). Statistical Yearbook of Indonesia.

Appendix table 1.5: Projected farm yard manure and compost production during Repelita IV ('000 tons)

| | 1984 | 1985 | 1986 | 1987 | 1988 |
|---|---|---|---|---|---|
| Cattle (6.5 ton/year) | 43,882 | 44,402 | 44,928 | 45,468 | 46,007 |
| Buffalo (7.5 ton/year) | 18,498 | 19,143 | 19,388 | 19,590 | 19,793 |
| Goat (0.95 ton/year) | 7,693 | 6,924 | 8,161 | 8,407 | 8,658 |
| Sheep (0.95 ton/year) | 4,126 | 4,249 | 4,377 | 4,509 | 4,644 |
| Pig (1.25 ton/year) | 5,099 | 5,435 | 5,794 | 6,176 | 6,584 |
| Layers (0.025 ton/year) | 754 | 808 | 865 | 927 | 992 |
| Broilers (0.0225 ton/year) | 2,484 | 2,732 | 3,006 | 3,306 | 3,637 |
| Dairy cattle (6.5 ton/year) | 1,098 | 1,352 | 1,651 | 1,905 | 2,139 |
| Horse (3.5 ton/year) | 2,464 | 2,489 | 2,513 | 2,528 | 2,566 |
| Total | 86,598 | 88,584 | 90,683 | 92,826 | 95,020 |
| Compost | 127,897 | 132,876 | 136,024 | 139,239 | 142,530 |

Source: DGLS (1983b). Worksheets for Repelita IV.

Appendix table 1.6: Impact of dairy cattle development during Repelita III

| | Unit | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|
| Population of dairy cattle | 000 head | 93 | 94 | 103 | 113 | 140 | 161 |
| Total imported cows | 000 head | - | 3.8 | 14.8 | 36.7 | 56.7 | 67 |
| Gross production of milk | 000 ton | 62.3 | 72.2 | 78.4 | 85.8 | 116.7 | 144.6 |
| Amount of imported milk powder replaced | 000 ton, FME [a] | 3.8 | 10.4 | 22.8 | 46.7 | 66.9 | 91.0 |
| Milk powder imports | 000 ton, FME | 440.3 | 474.2 | 594.3 | 521.1 | 536.0 | 482.4 |
| Target ratio, local : imported | ratio | 1:25 | 1:20 | 1:15 | 1:8 | 1:6 | 1:5 |
| Number of milk producers | 000 families | 48.6 | 52.1 | 55.8 | 59.7 | 64.0 | 66.0 |
| Number dairy cooperatives | No. | 11 | 32 | 63 | 133 | 162 | 173 |
| Number coop members | No. | 2,174 | 6,780 | 12,807 | 28,590 | 38,630 | 41,732 |
| Value of imports saved | $ million | 0.38 | 2.36 | 5.77 | 11.27 | 25.29 | 22.49 |
| Value of Milk, Meat and manure output | billion Rp. | 25.4 | 27.4 | 30.0 | 44.0 | 58.0 | 71.9 |
| Approximate cost of imported cows [b] | $ million | - | 5.7 | 16.5 | 32.85 | 30.0 | 15.45 |
| Net savings of foreign exchange, excluding equipment + semen | $ million | 0.38 | -3.34 | -10.73 | -21.58 | -4.71 | 7.04 |

Source : DGLS (1983a)
[a] FME : Fresh milk equivalent.
[b] Estimated at about US $ 1500 per cow delivered Java.
Estimates by consultant team

Appendix table 1.7: Production and consumption of meat, eggs and milk, 1972-1983 ( '000 tons)

| | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A. Production** | | | | | | | | | | | | |
| Meat: | | | | | | | | | | | | |
| Cattle | 196.1 | 202.6 | 212.8 | 224.5 | 225.3 | 224.5 | 225.4 | 213.7 | 220.3 | 227.8 | 235.5 | 237.8 |
| Buffalo | 57.1 | 69.6 | 62.3 | 65.2 | 64.6 | 65.5 | 64.2 | 64.4 | 65.4 | 67.8 | 70.2 | 72.7 |
| Goat | 13.9 | 14.9 | 15.4 | 17.4 | 19.4 | 23.5 | 26.3 | 35.2 | 36.3 | 38.5 | 40.2 | 43.8 |
| Sheep | 11.0 | 11.7 | 12.0 | 13.0 | 8.4 | 14.1 | 11.3 | 17.1 | 17.6 | 18.2 | 18.8 | 20.1 |
| Pork | 38.6 | 41.2 | 44.5 | 47.8 | 51.2 | 46.7 | 47.7 | 54.2 | 57.3 | 59.0 | 60.8 | 64.8 |
| Horse | 0.7 | 0.9 | 0.9 | 0.9 | 1.5 | 1.4 | 1.4 | 1.4 | 1.6 | 1.7 | 1.7 | 1.8 |
| Poultry | 48.8 | 48.5 | 55.2 | 66.2 | 78.3 | 92.0 | 95.3 | 100.3 | 172.3 | 183.0 | 201.3 | 230.0 |
| Total | 336.2 | 379.4 | 403.1 | 435.0 | 448.7 | 467.7 | 474.6 | 486.5 | 570.8 | 596.0 | 628.6 | 671.0 |
| Eggs: | | | | | | | | | | | | |
| Village chicken | 33.4 | 35.4 | 36.1 | 41.2 | 40.5 | 43.4 | 45.7 | 48.0 | 50.4 | 53.0 | 55.8 | 58.0 |
| Layers | 18.2 | 15.6 | 24.8 | 28.0 | 31.9 | 39.4 | 43.7 | 50.3 | 141.6 | 151.7 | 164.9 | 176.6 |
| Ducks | 25.9 | 30.4 | 37.2 | 43.0 | 43.2 | 48.6 | 61.6 | 65.6 | 67.4 | 70.5 | 76.3 | 81.4 |
| Total | 77.5 | 81.4 | 98.1 | 112.2 | 115.6 | 131.4 | 151.0 | 163.9 | 259.4 | 275.2 | 197.0 | 316.0 |
| Milk | 37.7 | 35.0 | 56.9 | 51.1 | 58.0 | 60.7 | 62.3 | 72.2 | 78.4 | 85.8 | 116.7 | 142.9 |
| **B. Per capita annual consumption (kg):** | | | | | | | | | | | | |
| Meat | 3.02 | 3.06 | 3.34 | 3.37 | 3.37 | 3.42 | 3.41 | 3.46 | 3.92 | 4.00 | 4.12 | 4.32 |
| Eggs | 0.35 | 0.35 | 0.45 | 0.50 | 0.52 | 0.80 | 0.88 | 0.94 | 1.44 | 1.50 | 1.58 | 1.66 |
| Milk | 1.73 | 1.64 | 1.96 | 1.95 | 2.82 | 3.06 | 3.53 | 3.72 | 4.36 | 3.98 | 4.17 | 3.88 |

Source: DGLS (1983a and 1984b)

Appendix table 1.8: Regional ruminant livestock population by species, 1978-1983 ('000 head)

| | | 1978 | 1983 | % change |
|---|---|---|---|---|
| Cattle: | | | | |
| | Sumatra | 1058 | 1268 | 20 |
| | Java | 3746 | 391B | 4 |
| | Kalimantan | 173 | 196 | 14 |
| | Sulawesi | 1036 | 1666 | 61 |
| | Nusa Tenggara | 910 | 1077 | 18 |
| Buffalo: | | | | |
| | Sumatra | 812 | 1077 | 24 |
| | Java | 1063 | 990 | 7 |
| | Kalimantan | 71 | 78 | 10 |
| | Sulawesi | 481 | 569 | 18 |
| | Nusa Tenggara | 317 | 317 | 5 |
| Goats: | | | | |
| | Sumatra | 1179 | 1730 | 47 |
| | Java | 4895 | 5459 | 12 |
| | Kalimantan | 137 | 175 | 28 |
| | Sulawesi | 577 | 767 | 33 |
| | Nusa Tenggara | 404 | 584 | 45 |
| Sheep: | | | | |
| | Sumatra | 276 | 364 | 32 |
| | Java | 3131 | 4033 | 29 |
| | Kalimantan | 19 | 24 | 26 |
| | Sulawesi | 29 | 52 | 78 |
| | Nusa Tenggara | 89 | 91 | 2 |

Source: These figures are compiled from provincial figures collected by the consultant team and differ substantially from national population figures. Only for Java and Nusa Tenggara are these statistics similar.

Appendix table 1.9: Estimates of meat production from cattle, 1979

| Regions: | Animal population (head) | Estimated slaughterings (head) | Estimated meat production (tons carcass) [a] | BPS 1979 slaughterings (head) |
|---|---|---|---|---|
| Sumatra | 691,326 | 88,651 | 11,082 | 87,926 |
| Java | 3,892,426 | 666,091 | 83,261 | 631,708 |
| Kalimantan | 105,063 | 31,720 | 3,965 | 32,079 |
| Sulawesi | 834,020 | 43,697 | 5,465 | 38,504 |
| Nusa Tenggara | 906,604 | 63,778 | 7,972 | 68,220 |

Source: Estimated by study team.
[a] Carcass weight = 125 kg

Appendix table 1.10: Estimates of meat production from buffalo, 1979

| Regions : | Animal population (head) | Estimated slaughterings (head) | Estimated meat production (tons carcass) [a] | BPS 1979 slaughterings (head) |
|---|---|---|---|---|
| Sumatra | 565,604 | 47,793 | 6,452 | 59,114 |
| Java | 1,058,231 | 185,006 | 24,976 | 127,831 |
| Kalimantan | 19,661 | 3,981 | 537 | 4,502 |
| Sulawesi | 410,957 | 29,392 | 3,968 | 13,778 |
| Nusa Tenggara | 358,912 | 23,849 | 3,220 | 15,025 |

Source: Estimated by study team.
[a] Carcass weight = 135 kg

Appendix table 1.11: Estimates of meat production from small ruminants, 1979

| Regions | Animal population (head) | Estimated slaughterings (head) | Estimated meat production (tons carcass) [a/] | BPS 1979 slaughterings (head) |
|---|---|---|---|---|
| Sumatra | 886,591 | 444,377 | 4,444 | 538,220 |
| Java | 9,968,082 | 5,727,229 | 57,273 | 5,370,260 |
| Kalimantan | 61,332 | 39,505 | 395 | 61,212 |
| Sulawesi | 333,044 | 106,122 | 1,062 | 94,587 |
| Nusa Tenggara | 426,369 | 128,274 | 1,283 | 122,862 |

Source: Estimated by study team.
[a/] Carcass weight = 10 kg

Appendix table 1.12: Estimates of meat production from poultry (chicken), 1979

| Regions : | Animal Population | | Estimated meat production (Tons dressed) |
|---|---|---|---|
| | Village (1000 head) | Commercial (1000 head) | |
| Sumatra | 18,879 | 548 | 47,612 |
| Java | 61,076 | 2,966 | 124,265 |
| Kalimantan | 4,366 | 196 | 11,063 |
| Sulawesi | 7,879 | 67 | 19,746 |
| Nusa Tenggara | 6,126 | 93 | 15,385 |

Source: Estimated by study team.

Appendix table 1.13: Estimates of meat production from swine, 1979

| Regions | Animal population back yard (head) | Animal population commercial (head) | Estimated Slaughterings (head) | Estimated meat production (tons) [a] | BPS 1979 slaughterings (head) |
|---|---|---|---|---|---|
| Sumatra | 721,333 | 31,992 | 1,014,514 | 24,316 | 872,222 |
| Java | - | 139,906 | 335,774 | 19,589 | 621,650 |
| Kalimantan | 406,716 | - | 528,731 | 11,185 | 228,341 |
| Sulawesi | 324,146 | - | 421,390 | 15,251 | 89,469 |
| Nusa Tenggara | 1,267,088 | - | 1,644,721 | 34,845 | 269,584 |

Source: Estimated by study team.
[a] Carcass weight commercial pig = 58 kg
Carcass weight backyard pig = 21 kg



463

Appendix table 1.14: Consumption of protein, calories and fat per capita per day, 1978-1982

| | 1978 | 1979 | 1980 | 1981 | 1982 | Avg change 78-82 (%) | Increase 81 to 82 (%) |
|---|---|---|---|---|---|---|---|
| Meat (grams) | 9.31 | 9.34 | 10.74 | 10.96 | 11.23 | 4.80 | 2.46 |
| Eggs (grams) | 2.95 | 3.12 | 4.88 | 5.04 | 5.32 | 15.88 | 5.56 |
| Milk (grams) | 9.84 | 10.47 | 12.60 | 11.12 | 11.67 | 4.36 | 4.95 |
| Protein: | | | | | | | |
| Meat | 1.25 | 1.21 | 1.40 | 1.43 | 1.46 | 4.18 | 2.10 |
| Eggs | 0.27 | 0.37 | 0.43 | 0.45 | 0.48 | 16.14 | 2.67 |
| Milk | 0.41 | 0.36 | 0.42 | 0.38 | 0.40 | 8.32 | 5.26 |
| Total | 1.91 | 1.94 | 2.25 | 2.26 | 2.34 | 5.58 | 3.54 |
| Calories: | | | | | | | |
| Meat | 19.29 | 21.01 | 22.59 | 23.11 | 24.49 | 6.18 | 5.97 |
| Eggs | 3.67 | 4.83 | 5.70 | 5.92 | 6.23 | 14.68 | 5.24 |
| Milk | 6.98 | 6.62 | 7.76 | 7.08 | 7.42 | 8.94 | 4.80 |
| Total | 27.94 | 32.46 | 36.05 | 36.11 | 38.14 | 6.71 | -5.62 |
| Fat (grams): | | | | | | | |
| Meat | 1.53 | 1.74 | 1.91 | 2.31 | 1.94 | 9.10 | -16.02 |
| Eggs | 0.26 | 0.35 | 0.41 | 0.43 | 0.45 | 15.32 | 4.65 |
| Milk | 0.41 | 0.36 | 0.42 | 0.38 | 0.40 | 12.84 | 5.26 |
| Total | 2.20 | 2.45 | 2.74 | 3.12 | 2.79 | 6.55 | -10.8 |

Source: FAO (1985b). Food Balance Sheets for Indonesia, 1984.

Appendix table 1.15: Volume and value of exports of animal products, 1978-1982

| | 1978 | 1979 | 1980 | 1981 | 1982 | Average change 78-82 (%) | Average change 81-82 (%) |
|---|---|---|---|---|---|---|---|
| **Volume** | | | | | | | |
| Livestock | | | | | | | |
| Cattle | 400 | 0 | 0 | 0 | 0 | - | - |
| Buffalo | 0 | 0 | 0 | 0 | 0 | - | - |
| Skin (tons) | | | | | | | |
| Cattle | 1,410.3 | 2,147.9 | 402.2 | 622.6 | 650.3 | + 7.57 | + 4.45 |
| Buffalo | 120.6 | 144.2 | 19.3 | 2.8 | 18.7 | +103.83 | +567.86 |
| Goat | 2,602.7 | 2,332.6 | 3,558.6 | 3,558.0 | 3,000.6 | + 6.62 | - 15.67 |
| Sheep | 1,007.6 | 893.7 | 564.1 | 784.3 | 933.6 | + 2.47 | + 19.04 |
| Bone & horn | 7,879.0 | 9,201.4 | 5,190.1 | 4,460.2 | 2,457.3 | - 21.44 | - 44.91 |
| **Value** | | | | | | | |
| Livestock | | | | | | | |
| Cattle | 70.3 | 0 | 0 | 0 | 0 | - | - |
| Buffalo | 0 | 0 | 0 | 0 | 0 | - | - |
| Skin | | | | | | | |
| Cattle | 2,516.3 | 5,368.4 | 990.4 | 1,800.0 | 2,246.3 | + 34.57 | + 24.79 |
| Buffal | 139.0 | 299.7 | 69.0 | 30.6 | 154.6 | + 97.05 | +405.23 |
| Goat | 11,810.2 | 24,112.0 | 18,026.5 | 14,694.7 | 14,694.7 | + 15.03 | + 1.87 |
| Sheep | 7,677.8 | 10,843.9 | 6,822.6 | 7,792.8 | 7,966.1 | + 5.15 | + 2.22 |
| Bone & Horn | 524.1 | 626.6 | 615.3 | 535.2 | 124.6 | - 16.00 | - 76.72 |
| Total | 22,738.2 | 41,250.6 | 26,523.8 | 25,133.3 | 25,186.3 | + 10.17 | + 0.21 |

Source: Biro Pusat Statistiks (1983). Statistical Yearbook of Indonesia

Appendix table 1.16: Rural wages (Rp) estimated by field survey teams, July-August, 1985

| Location | Crop + task | Cash wage/day | Meals [a] | Crop share (%) | Crop share/ person/day | Total | Total wage | Hours worked/day | Effective wage (Rp/hr) |
|---|---|---|---|---|---|---|---|---|---|
| Klepu | Rice, land Preparation | 400 | 250 | | | 250 | 650 | 4 | 160 |
| C.Java | Rice, harvest | - | - | 17 | 575 | 575 | 575 | 3 | 190 |
| • | Grass cutting | 500 | | | | | 500 | 3 | 170 |
| Kolamkiri, S. Kalimantan | Land preparation | 1250 | 500 | - | - | 500 | 1750 | 6 | 290 |
| Kolamkiri, S. Kalimantan | Rice harvest | - | - | 17 | 2600 | 2600 | 2600 | 8 | 325 |
| • | Fieldwork | 1500 | - | - | - | - | 1500 | 6 | 250 |
| Palangkaraya, C. Kalimantan | Fieldwork | 2500 | - | - | - | - | 2500 | 8 | 310 |
| E. Kalimantan | Fieldwork | 2000 | 500 | - | - | 500 | 2500 | 7 | 360 |
| Aceh | Fieldwork | 1000 | - | - | - | - | 1000 | 3 | 330 |
| Aceh | Sugarcane cutting | 1500 | 250 | - | - | 250 | 1750 | 7 | 250 |
| N. Sumatra | Rice land prep. | 2000 | - | - | - | - | 2000 | 8 | 250 |
| N. Sumatra | Harvest rice | - | 250 | 15 | 2000 | 2000 | 2250 | 10 | 225 |
| Yogyakarta | Rice field prep. | 1000 | - | - | - | - | 1000 | 6 | 170 |
| W. Java [b] | Hoeing rice field | - | - | - | - | - | - | - | 172 |
| C. Java [b] | Hoeing rice field | - | - | - | - | - | - | - | 127 |
| E. Java | Hoeing rice field | - | - | - | - | - | - | - | 170 |
| E. Java | Rice, land prep. | 1000 | 500 | - | - | 1500 | 1500 | 5 | 300 |
| E. Java | Harvesting | - | - | 14 | n.a. | n.a. | - | - | - |
| Flores & Timor (NTT) | Land prep. | 1000 | 250 | - | - | 1250 | 1250 | n.a. | - |
| S.E. Sulawesi | Rice harvest | - | - | 12.5 | - | - | - | - | - |
| Irian Jaya | Rice land | 2500 | 500 | - | - | 300 | - | 7 | 430 |

Source: Kasryno, et. al. 1984.

[a] Number of meals + Rp. 250/meal provided to worker. Payments in rough rice valued at Rp. 150/kg.

[b] Hours per task recorded in 1978-81 converted into rough rice equivalent and multiplied by current farm level price of rough rice @ Rp. 150/kg.

Appendix Table 1.17: Household expenditure patterns as % of disposable income spent on food, 1981

| | Urban | Rural |
|---|---|---|
| Cereals | 12.7 | 24.0 |
| Tubers | 0.4 | 1.2 |
| Fish | 5.2 | 7.2 |
| Meats | 3.6 | 1.8 |
| Eggs/milk | 2.3 | 1.3 |
| Vegetables | 4.8 | 6.2 |
| Legumes/Pulses | 2.3 | 2.2 |
| Fruits | 2.3 | 2.2 |
| Miscellaneous food | 8.0 | 10.9 |
| Prepared food | 5.6 | 3.3 |
| Alcoholic beverages | 0.1 | - |
| Tobacco | 4.3 | 5.4 |
| Subtotal, food | 51.6 | 65.7 |
| Subtotal, not food | 48.4 | 34.3 |
| TOTAL | 100.0 | 100.0 |

Source: Biro Pusat Statistiks (1983)

Appendix table 1.18: Analysis of survey responses about source of livestock products for home consumption (observed frequencies)

| Provincial groupings [a] | % of products from own production | | | | | Total responses |
|---|---|---|---|---|---|---|
| | 75-100 | 50-75 | 25-50 | <25 | none | |
| North Sumatra | 28 | 57 | 62 | 75 | 78 | 300 |
| South Sumatra | 137 | 106 | 47 | 38 | 72 | 400 |
| West Java | 6 | 6 | 24 | 64 | 0 | 100 |
| C. Java & Yogyakarta | 36 | 64 | 22 | 35 | 44 | 200 |
| East Java | 15 | 8 | 8 | 46 | 22 | 100 |
| Bali, NTT, NTB | 1 | 83 | 90 | 96 | 30 | 300 |
| Kalimantan | 193 | 89 | 50 | 22 | 45 | 399 |
| Sulawesi | 67 | 51 | 73 | 156 | 51 | 399 |
| Maluka | 12 | 2 | 18 | 20 | 0 | 52 |
| Irian Jaya | 10 | 29 | 2 | 26 | 33 | 100 |
| Totals | 506 | 496 | 396 | 578 | 375 | 2350 |

Source: ADB/DGLS (1985)

[a] 1. North Sumatra includes Aceh, North Sumatra, West Sumatra, and Riau.
2. South Sumatra includes Jambi, South Sumatra, Bengkulu, and Lampung.
3. Kalimantan includes South, East, West, and Central Kalimantan.
4. Sulawesi includes North, Central, South, and Southwest Sulawesi.

Appendix table 1.19: Analysis of survey responses about livestock products purchased

| Provincial groupings | 75-100 | 50-75 | 25-50 | <25 | none | Total responses |
|---|---|---|---|---|---|---|
| North Sumatra | 29 | 56 | 46 | 92 | 77 | 300 |
| South Sumatra | 63 | 47 | 43 | 104 | 138 | 400 |
| West Java | 52 | 47 | 0 | 1 | 0 | 100 |
| C. Java & Yogyakarta | 68 | 65 | 20 | 18 | 29 | 201 |
| East Java | 27 | 19 | 5 | 29 | 21 | 101 |
| Bali, NTT, NTB | 52 | 100 | 71 | 76 | 1 | 300 |
| Kalimantan | 46 | 36 | 25 | 77 | 216 | 400 |
| Sulawesi | 72 | 94 | 77 | 104 | 53 | 400 |
| Maluka | 1 | 51 | 22 | 26 | 0 | 100 |
| Irian Jaya | 29 | 0 | 9 | 26 | 36 | 100 |
| Totals | 444 | 515 | 319 | 553 | 571 | 2402 |

Source: ADB/DGLS (1985)

Appendix table 1.20: Analysis of survey responses about livestock products used for barter, exchange and gifts

| Provincial groupings | 75-100 | 50-75 | 25-50 | <25 | none | Total response |
|---|---|---|---|---|---|---|
| North Sumatra | 0 | 13 | 1 | 3 | 283 | 300 |
| South Sumatra | 0 | 0 | 3 | 61 | 336 | 400 |
| West Java | 0 | 0 | 0 | 3 | 193 | 197 |
| C. Java & Yogyakarta | 0 | 4 | 0 | 9 | 86 | 99 |
| East Java | 0 | 0 | 1 | 20 | 279 | 300 |
| Bali, NTT, NTB | 1 | 1 | 0 | 21 | 377 | 400 |
| Kalimantan | 0 | 0 | 2 | 3 | 393 | 398 |
| Sulawesi | 0 | 0 | 9 | 91 | 0 | 100 |
| Maluka | 0 | 0 | 0 | 0 | 100 | 100 |
| Irian Jaya (no responses) | - | - | - | - | - | - |
| Totals | 1 | 18 | 16 | 211 | 2047 | 2294 |

Source: ADB/DGLS (1985)

Appendix table 1.21: Projected consumption of meat, eggs and milk per capita per year during Repelita IV, 1984-1988 [a/]

| | 1984 | 1985 | 1986 | 1987 | 1988 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Meat | | | | | | |
| Cattle/buffelo/horse | 2.16 | 2.30 | 2.38 | 2.47 | 2.56 | 4.3 |
| Goat/sheep | 0.43 | 0.44 | 0.46 | 0.48 | 0.50 | 3.8 |
| Pig | 0.42 | 0.43 | 0.45 | 0.46 | 0.47 | 2.9 |
| Poultry | 1.40 | 1.45 | 1.50 | 1.55 | 1.61 | 3.6 |
| Total meat | 4.41 | 4.62 | 4.79 | 4.96 | 5.14 | 3.9 |
| Eggs (kg) | 1.69 | 1.77 | 1.84 | 1.92 | 2.01 | 4.4 |
| Milk | | | | | | |
| Liquid milk | 0.43 | 0.44 | 0.46 | 0.48 | 0.50 | 3.8 |
| Powdered milk | 4.01 | 4.13 | 4.24 | 4.37 | 4.49 | 2.9 |
| Total milk | 4.44 | 4.57 | 4.70 | 4.8[illegible] | 4.99 | 3.0 |

Source: Based year 1980 on projections of production and imports made by SUSENAS (1979).

a/ Demand projections are based on real growth incomes of: 1984: 3.84%, 1985: 3.857%, 1986: 3.874%, 1987: 3.891% and 1988: 3.91% and elasticities of income for: beef: 1.3, goat: 1.2, pork: 1.0, poultry: 1.2, liquid milk: 1.2 and powdered milk: 1.0.

Appendix table 1.22: Projected total consumption of meat, eggs and milk during Repelita IV, 1984-1988 ('000 tons)

| Product | 1984 | 1985 | 1986 | 1987 | 1988 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Meat: | | | | | | |
| Cattle/horse | 345.9 | 376.1 | 397.5 | 421.8 | 446.0 | 6.6 |
| Goat/sheep | 68.8 | 71.9 | 76.8 | 81.9 | 87.1 | 6.1 |
| Pig | 67.2 | 70.3 | 75.2 | 78.5 | 81.9 | 5.1 |
| Poultry | 224.1 | 237.1 | 250.5 | 264.4 | 280.4 | 5.7 |
| Total meat | 706.0 | 755.4 | 800 | 421.8 | 895.4 | 6.1 |
| Eggs | 270.0 | 288.2 | 307.7 | 328.4 | 350.5 | 6.7 |
| Milk | | | | | | |
| Liquid milk | 68.8 | 71.9 | 76.8 | 81.9 | 87.1 | 6.1 |
| Powdered milk | 641.8 | 675.3 | 708.2 | 745.4 | 782.0 | 5.1 |
| Total meat | 710.6 | 747.2 | 785.0 | 827.3 | 869.1 | 5.2 |

Source: See note, appendix table 1.21

Appendix table 1.23: Regional livestock prices, 1977 and 1982 (Rp per 100 kg liveweight)

| | | 1977 | 1982 | % change |
|---|---|---|---|---|
| Sumatra | | | | |
| | Cattle | 52.13 | 176.34 | 238 |
| | Buffalo | 42.28 | 147.04 | 248 |
| | Goats | 89.22 | 192.53 | 116 |
| | Chicken | 37.22 | 72.49 | 195 |
| | CPI [a] | 100.00 | 193.09 | 93 |
| Java | | | | |
| | Cattle | 42.50 | 133.56 | 214 |
| | Buffalo | 36.87 | 125.47 | 240 |
| | Goats | 63.50 | 178.17 | 180 |
| | Chicken | 29.80 | 77.10 | 159 |
| | CPI [a] | 100.00 | 199.06 | 99 |
| Kalimantan | | | | |
| | Cattle | 44.95 | 136.30 | 303 |
| | Buffalo | 40.47 | 140.30 | 347 |
| | Goats | 91.33 | 142.67 | 156 |
| | Chicken | 50.68 | 90.82 | 179 |
| | CPI [a] | 100.00 | 189.05 | 89 |
| Sulawesi | | | | |
| | Cattle | 40.45 | 115.33 | 285 |
| | Buffalo | 30.60 | 104.63 | 342 |
| | Goats | 47.33 | 120.00 | 254 |
| | Chicken | 27.55 | 71.73 | 260 |
| | CPI [a] | 100.00 | 194.81 | 95 |
| Nusa Tenggara | | | | |
| | Cattle | 20.97 | 78.00 | 272 |
| | Buffalo | 12.90 | 52.28 | 305 |
| | Goats | 39.33 | 91.33 | 132 |
| | Chicken | 37.68 | 56.93 | 51 |
| | CPI [a] | 100.00 | 201.51 | 102 |

Source : Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted).

[a] CPI = Consumers' price index for provincial capitals

Appendix table 1.24: Ratios of regional price indexes to Java price indexes, by species

| | | 1977 | 1982 | % change |
|---|---|---|---|---|
| Sumatra: | | | | |
| | Cattle | 1.23 | 1.32 | 7 |
| | Buffalo | 1.15 | 1.17 | 1 |
| | Goats | 1.41 | 1.08 | -23 |
| | Chicken | 1.25 | 0.94 | -25 |
| Kalimantan | | | | |
| | Cattle | 1.06 | 1.02 | -4 |
| | Buffalo | 1.10 | 1.12 | 1 |
| | Goats | 1.44 | 0.80 | -44 |
| | Chicken | 1 70 | 1.18 | -31 |
| Sulawesi | | | | |
| | Cattle | 0.95 | 0.86 | -9 |
| | Buffalo | 0.83 | 0.83 | 0 |
| | Goats | 0.74 | 0.67 | -9 |
| | Chicken | 0.92 | 0.93 | 1 |
| Nusa Tenggara | | | | |
| | Cattle | 0.44 | 0.58 | 19 |
| | Buffalo | 0.35 | 0.42 | 19 |
| | Goats | 0.62 | 0.51 | -17 |
| | Chicken | 1.26 | 0.74 | -59 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)



473

Appendix table 1.25 Ratios of red meat price indexes to poultry price indexes, by region

| | | 1977 | 1982 | % change |
|---|---|---|---|---|
| Sumatra | | | | |
| | Cattle | 1.40 | 2.43 | 74 |
| | Buffalo | 1.14 | 2.03 | 78 |
| | Goats | 2.40 | 2.66 | 11 |
| Java | | | | |
| | Cattle | 1.43 | 1.73 | 21 |
| | Buffalo | 1.24 | 1.63 | 31 |
| | Goats | 2.13 | 2.31 | 8 |
| Kalimantan | | | | |
| | Cattle | 0.89 | 1.50 | 69 |
| | Buffalo | 0.80 | 1.54 | 93 |
| | Goats | 1.80 | 1.57 | -13 |
| Sulawesi | | | | |
| | Cattle | 1.47 | 1.61 | 9 |
| | Buffalo | 1.11 | 1.46 | 31 |
| | Goats | 1.72 | 1.67 | -3 |
| Nusa Tenggara | | | | |
| | Cattle | 0.56 | 1.37 | 245 |
| | Buffalo | 0.34 | 0.92 | 270 |
| | Goats | 1.04 | 1.60 | 154 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.26: Provincial beef prices, 1976-1982 (Rp/kg)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 858 | 1,213 | 1,384 | 2,009 | 2,863 | 3,216 | 3,325 |
| North Sumatra | 828 | 1,066 | 1,182 | 1,509 | 2,245 | 2,647 | 2,893 |
| West Sumatra | 846 | 1,079 | 1,263 | 1,969 | 2,475 | 2,615 | 2,619 |
| Riau | 962 | 1,163 | 1,374 | 1,983 | 2,859 | 3,185 | 3,154 |
| Jambi | 906 | 1,250 | 1,425 | 2,217 | 2,900 | 3,292 | 3,578 |
| Bengkulu | 944 | 1,317 | 1,450 | 2,047 | 2,604 | 2,796 | 2,800 |
| South Sumatra | 1,109 | 1,366 | 1,627 | 2,204 | 2,689 | 2,994 | 2,859 |
| Lampung | 819 | 1,056 | 1,269 | 2,521 | 2,288 | 2,575 | 2,458 |
| D. I. Jakarta | 922 | 1,062 | 1,299 | 1,770 | 2,459 | 2,834 | 2,843 |
| West Java | 898 | 1,058 | 1,239 | 1,642 | 2,232 | 2,570 | 2,518 |
| Central Java | 828 | 911 | 1,060 | 1,449 | 2,166 | 2,517 | 2,616 |
| D.I. Yogyakarta | 900 | 1,017 | 1,306 | 1,600 | 2,341 | 2,625 | 2,629 |
| East Java | 817 | 967 | 1,139 | 1,542 | 2,124 | 2,445 | 2,554 |
| West Kalimantan | 916 | 1,045 | 1,054 | 1,533 | 1,930 | 2,014 | 2,028 |
| Central Kalimantan | 994 | 1,196 | 1,243 | 1,866 | 2,501 | 2,866 | 2,931 |
| South Kalimantan | 917 | 1,252 | 1,277 | 1,690 | 2,273 | 2,616 | 2,334 |
| East Kalimantan | 1,184 | 1,252 | 1,242 | 1,420 | 1,844 | 2,352 | 2,694 |
| North Sulawesi | 624 | 687 | 986 | 1,040 | 1,195 | 1,662 | 2,041 |
| South Sulawesi | 625 | 705 | 750 | 927 | 1,227 | 1,502 | 1,712 |
| Bali | 595 | 708 | 716 | 951 | 1,619 | 1,810 | 1,800 |
| NTB | 441 | 517 | 700 | 821 | 1,377 | 1,358 | 1,489 |
| NTT | 338 | 431 | 474 | 684 | 874 | 1,364 | 1,500 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted).

Appendix table 1.27: Provincial prices of buffalo meat, 1976-1982 (Rp/Kg)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 777 | 1,009 | 1,227 | 1,771 | 2,484 | 2,885 | 2,894 |
| North Sumatra | 815 | 1,032 | 1,264 | 1,527 | 2,130 | 2,628 | 2,717 |
| West Sumatra | 872 | 1,076 | 1,251 | 2,022 | 2,550 | 2,660 | 2,685 |
| Riau | 952 | 1,144 | 1,290 | 1,868 | 2,690 | 2,930 | 2,902 |
| Jambi | 919 | 1,240 | 1,425 | 2,217 | 2,900 | 3,292 | 3,182 |
| South Sumatra | 999 | 1,275 | 1,534 | 2,138 | 2,721 | 2,925 | 2,741 |
| Lampung | 814 | 1,073 | 1,365 | 1,608 | 2,346 | 2,638 | 2,495 |
| D.I. Jakarta | 944 | 1,058 | 1,329 | 1,794 | 2,475 | 2,724 | 2,846 |
| West Java | 807 | 876 | 926 | 1,331 | 1,863 | 2,256 | 2,499 |
| Central Java | 816 | 906 | 1,038 | 1,451 | 1,963 | 2,386 | 2,541 |
| East Java | 858 | 913 | 1,061 | 1,187 | 1,738 | 2,108 | - |
| South Kalimantan | 900 | 1,156 | 1,275 | 1,692 | 2,190 | 2,539 | 2,919 |
| South Sulawesi | 596 | 651 | 707 | 877 | 1,204 | 1,628 | 1,736 |
| N.T.B. | 441 | 422 | 475 | 735 | 1,178 | 1,456 | 1,499 |
| Bengkulu | - | - | - | - | - | 2,796 | 2,800 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.28: <u>Provincial prices of pork, 1976-1982 (Rp/kg)</u>

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (3) | (4) | (5) | (6) | (7) |
| North Sumatra | 779 | 900 | 772 | 898 | 992 | 1,798 | 2,046 |
| Riau | 1,809 | 1,244 | ,375 | 1,818 | 2,582 | 3,091 | 3,296 |
| Jambi | 722 | 800 | 842 | 1,225 | 1,492 | 1,867 | 2,000 |
| South Sumatra | 816 | 890 | 934 | 1,230 | 1,584 | 1,950 | - |
| D.I. Jakarta | 1,003 | 1,192 | 1,525 | 1,524 | 1,706 | 1,728 | 1,742 |
| West Java | 841 | 869 | 962 | 1,174 | 1,357 | 1,682 | 1,756 |
| Central Java | 874 | 896 | 1,186 | 1,325 | 1,578 | 1,619 | 1,659 |
| D.I. Yogyakarta | 734 | 979 | 1,390 | 1,590 | 1,623 | 1,613 | 1,933 |
| East Java | 933 | 1,105 | 1,261 | 1,701 | 1,953 | 2,013 | 2,055 |
| Central Kalimantan | 583 | 667 | 653 | 879 | 1,446 | 1,779 | 1,790 |
| South Kalimantan | 1,142 | 1,362 | 1,617 | 1,500 | 2,375 | 2,821 | 3,650 |
| West Kalimantan | 1,074 | 1,022 | 1,001 | 1,338 | 1,904 | 1,974 | 1,971 |
| East Kalimantan | 1,233 | 1,557 | 1,973 | 2,505 | 2,516 | 2,743 | 3,263 |
| North Sulawesi | - | - | - | - | - | 1,908 | - |
| Central Sulawesi | - | - | - | - | - | 1,392 | 1,533 |
| Bali | - | - | - | - | - | 1,398 | 1,483 |
| N.T.T. | - | - | - | - | - | 1,519 | 1,527 |
| Maluku | - | - | - | - | - | 3,947 | - |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.29: Provincial prices of goat meat, 1976-1982 (Rp/kg)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 1 ,045 | 1,160 | 1,361 | 1,733 | 2,202 | 2,814 | 2,921 |
| North Sumatra | 698 | 846 | 926 | 1,213 | 1,590 | 1,749 | 1,811 |
| West Sumatra | 875 | 1,036 | 1,092 | 1,567 | 2,117 | 2,600 | - |
| South Sumatra | 901 | 1,077 | 1,129 | 1,525 | 1,817 | 1,972 | - |
| Lampung | 772 | 800 | 992 | 1,395 | 2,075 | 2,350 | 2,512 |
| D. I. Jakarta | 893 | 961 | 1,147 | 1,455 | 1,970 | 2,511 | 2,565 |
| West Java | 828 | 907 | 1,000 | 1,325 | 1,761 | 2,019 | 2,144 |
| Central Java | 726 | 781 | 866 | 1,148 | 1,652 | 1,796 | 1,889 |
| D.I. Yogyakarta | 762 | 898 | 1,131 | 1,331 | 1,950 | 2,150 | 2,200 |
| East Java | 628 | 809 | 1,038 | 1,415 | 2,101 | 2,593 | 2,301 |
| South Kalimantan | 744 | 1,003 | 1,207 | 1,396 | 1,728 | 1,840 | 2,190 |
| East Kalimantan | - | - | - | - | - | - | 2,908 |
| N.T.B. | 417 | 462 | 508 | 808 | 1,132 | 1,321 | 1,700 |
| N.T.T. | - | - | - | - | - | 688 | - |
| Central Sulawesi | - | - | - | - | - | 1,733 | 2,229 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix Table 1.30: <u>Wholesale prices of village chicken, 1976-1982 (Rp/bird)</u>

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 394 | 440 | 576 | 782 | 985 | 1,232 | 1,459 |
| North Sumatra | 598 | 712 | 797 | 1,051 | 1,248 | 1,390 | 1,561 |
| West Sumatra | 812 | 778 | 809 | 1,292 | 1,369 | 1,622 | 1,364 |
| Riau | 673 | 735 | 892 | 1,159 | 1,583 | 1,622 | 1,748 |
| Jambi | 692 | 792 | 819 | 1,269 | 1,629 | 1,608 | 1,587 |
| South Sumatra | 706 | 919 | 896 | 1,482 | 1,723 | 1,912 | - |
| Lampung | 652 | 808 | 660 | 969 | 1,240 | 840 | 771 |
| West Java | 586 | 627 | 719 | 951 | 1,204 | 1,734 | 1,787 |
| Central Java | 579 | 561 | 627 | 819 | 1,187 | 1,290 | 1,444 |
| D. I. Yogyakarta | 746 | 683 | 850 | 972 | 1,273 | 1,300 | 1,683 |
| East Java | 400 | 513 | 607 | 745 | 899 | 1,281 | 1,254 |
| West Kalimantan | 713 | 800 | 922 | 1,254 | 1,655 | 1,831 | 1,932 |
| South Kalimatnan | 900 | 978 | 1,042 | 1,186 | 1,778 | 2,048 | 1,924 |
| East Kalimantan | 1,026 | 1,263 | 1,272 | 1,444 | 1,534 | 1,731 | 1,593 |
| North Sulawesi | - | 517 | 622 | 911 | 1,322 | 1,446 | 1,217 |
| South Sulawesi | 594 | 585 | 668 | 700 | 886 | 1,673 | 1,652 |
| Bali | 689 | 754 | 800 | 879 | 924 | 986 | 1,050 |
| N.T.B. | - | - | - | - | - | - | - |
| N.T.T. | - | 753 | 552 | 715 | 789 | 1,283 | 1,227 |
| D.I. Jakarta | - | - | - | - | - | 1,200 | 1,200 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.31: Provincial prices of village chicken meat, 1976-1982 (Rp/kg)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| North Sumatra | 640 | 778 | 888 | 1,254 | 1,630 | 1,787 | 1,756 |
| D.I. Jakarta | 942 | 941 | 1,047 | 1,206 | 1,401 | 1,494 | 1,558 |
| West Java | 798 | 900 | 969 | 1,166 | 1,453 | 1,772 | 1,668 |
| Central Java | 883 | 1,022 | 1,125 | 1,176 | 1,635 | 1,629 | 1,662 |
| D.I. Yogyakarta | 867 | 875 | 946 | 1,300 | 1,662 | 2,000 | 2,087 |
| East Java | 719 | 809 | 941 | 1,361 | 1,776 | 1,751 | 2,057 |
| South Sumatra | - | - | - | - | - | 1,350 | - |
| North Sulawesi | - | - | - | - | - | 1,775 | 2,400 |
| Bali | - | - | - | - | - | 1,250 | 1,304 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix Table 1.32: Provincial wholesale prices of eggs from local chicken, 1976-1982 (Rp/kg)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 3,621 | 3,714 | 3,976 | 5,325 | 6,834 | 8,511 | 9,049 |
| North Sumatra | 3,312 | 3,718 | 4,788 | 6,078 | 7,729 | 8,269 | 8,667 |
| West Sumatra | 3,478 | 3,971 | 4,170 | 5,934 | 7,227 | 7,610 | 8,294 |
| Riau | 3,754 | 4,394 | 4,367 | 6,142 | 7,075 | 9,233 | 8,243 |
| Jambi | 5,056 | 5,458 | 5,750 | 7,438 | 8,125 | 9,833 | 1,000 |
| South Sumatra | 3,222 | 3,896 | 4,355 | 5,699 | 5,536 | 6,063 | 4,213 |
| D.I. Jakarta | 3,992 | 4,226 | 4,378 | 5,142 | 6,758 | 7,594 | 8,377 |
| South Kalimantan | 3,834 | 4,539 | 5,169 | 6,270 | 7,595 | 7,795 | 9,178 |
| West Kalimantan | 4,506 | 4,744 | 4,632 | 6,014 | 6,137 | 8,408 | 9,244 |
| East Kalimantan | 6,208 | 5,790 | 5,567 | 7,409 | 8,333 | 1,429 | 1,563 |
| North Sulawesi | 4,167 | 5,969 | 6,264 | 6,039 | 7,904 | 9,815 | 11,962 |
| N.T.T. | 2,812 | 4,312 | 5,333 | 6,604 | 9,479 | 12,465 | 11,860 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix Table 1.33: Provincial wholesale prices of eggs from improved chicken, 1976-1982 (Rp/100 pieces)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Lampung | - | - | 800 | 1,029 | 1,788 | 1,158 | 950 |
| D.I. Jakarta | 586 | 598 | 616 | 750 | 908 | 911 | 883 |
| West Java | 592 | 710 | 734 | 841 | 1,099 | 1,011 | 1,051 |
| Central Java | 590 | 606 | 602 | 777 | 963 | 894 | 860 |
| D.I. Yogyakarta | 600 | 675 | 671 | 799 | 1,039 | 825 | 831 |
| East Java | 419 | 560 | 616 | 679 | 614 | 881 | 775 |
| Bali | 475 | 612 | 500 | 635 | 650 | 775 | 779 |
| South Sulawesi | 720 | 747 | 703 | 683 | 855 | 1,358 | 1,154 |
| D.I. Aceh | - | - | - | - | - | 6,061 | 1,154 |
| North Sumatra | - | - | - | - | - | 5,315 | 5,038 |
| West Sumatra | - | - | - | - | - | 5,107 | 5,313 |
| Jambi | - | - | - | - | - | 5,409 | 6,125 |
| Riau | - | - | - | - | - | 1,442 | 1,142 |
| South Sumatra | - | - | - | - | - | 6,807 | 6,973 |
| West Kalimantan | - | - | - | - | - | 7,149 | 5,277 |
| East Kalimantan | - | - | - | - | - | 1,505 | 1,440 |
| South Kalimantan | - | - | - | - | - | 850 | 8,267 |
| North Kalimantan | - | - | - | - | - | 1,505 | 1,795 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.34: Provincial prices of duck eggs, 1976-1982 (Rp/100 pieces)

| Province | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| D.I. Aceh | 3,988 | 4,271 | 4,374 | 5,560 | 6,887 | 7,092 | 7,277 |
| North Sumatra | 3,224 | 3,602 | 4,173 | 6,090 | 7,019 | 7,496 | 9,030 |
| West Sumatra | 3,764 | 6,304 | 4,676 | 6,419 | 6,606 | 6,790 | 7,588 |
| Riau | 3,858 | - | 4,926 | 6,896 | 7,753 | 8,990 | 8,360 |
| Jambi | 4,562 | 4,500 | 4,396 | 6,313 | 7,042 | 7,375 | 7,788 |
| South Sumatra | 4,056 | 4,439 | 4,380 | 7,233 | 6,617 | 6,167 | 8,227 |
| Lampung | 4,667 | 5,958 | 7,667 | 8,208 | 15,792 | 7,750 | 8,083 |
| D.I. Jakarta | 4,366 | 4,809 | 4,592 | 5,661 | 7,796 | 7,806 | 8,467 |
| West Java | 3,925 | 4,293 | 3,987 | 4,391 | 6,288 | 9,200 | 8,253 |
| Central Java | 4,006 | 4,330 | 4,224 | 5,157 | 6,328 | 6,377 | 8,062 |
| D.I. Yogyakarta | 3,740 | 4,408 | 4,042 | 5,208 | 6,375 | 7,167 | 8,417 |
| East Java | 3,958 | 4,145 | 4,392 | 5,549 | 6,861 | 4,450 | 7,914 |
| West Kalimantan | 4,569 | 5,062 | 4,286 | 5,522 | 6,917 | 7,884 | 8,422 |
| South Kalimantan | 3,750 | 3,996 | 4,990 | 6,222 | 8,114 | 9,229 | 9,396 |
| East Kalimantan | 4,925 | 4,547 | 5,000 | 6,801 | 9,133 | 10,822 | 9,226 |
| North Sulawesi | 4,276 | 5,188 | 6,085 | 5,819 | 6,140 | 3,263 | 4,362 |
| South Sulawesi | 3,750 | 4,021 | 3,987 | 5,873 | 8,987 | 9,982 | 11,490 |
| Bali | 4,000 | 3,792 | 3,500 | 5,000 | 4,842 | 5,000 | 6,021 |

Source: Direktorat Bina Program (1984). Buku Statistik Peternakan, 1983 (adapted)

Appendix table 1.35: Projected livestock population in Repelita IV, 1984-1988 ('000 heads)

| | 1984 | 1985 | 1986 | 1987 | 1988 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Cattle | 6,751 | 6,831 | 6,912 | 6,994 | 7,078 | 1.19 |
| Dairy Cattle | 169 | 208 | 254 | 293 | 329 | 18.12 |
| Buffalo | 2,533 | 2,559 | 2,585 | 2,612 | 2,639 | 1.03 |
| Horse | 704 | 711 | 718 | 725 | 733 | 1.0 |
| Goat | 8,098 | 8,341 | 8,591 | 8,849 | 9,114 | 3.0 |
| Sheep | 4,343 | 4,473 | 4,607 | 4,746 | 4,888 | 3.0 |
| Pig | 4,079 | 4,348 | 4,635 | 4,941 | 5,267 | 6.6 |
| Poultry | | | | | | |
| Dual Purpose | 154,203 | 162,747 | 171,210 | 180,113 | 189,479 | 5.2 |
| Layers | 30,181 | 32,324 | 34,619 | 37,077 | 39,709 | 7.1 |
| Broilers | 110,403 | 121,442 | 133,583 | 146,947 | 161,644 | 10.0 |
| Duck | 27,014 | 28,743 | 30,582 | 32,539 | 34,621 | 6.4 |

Source: DGLS (1983b). Worksheets for Repelita IV.



483

Appendix table 1.36: Projected production of meat, eggs and milk during Repelita IV, 1984-1988

| Product | 1984 | 1985 | 1986 | 1987 | 1988 | Inc/yr (%) |
|---|---|---|---|---|---|---|
| Meat ('000 tons): | | | | | | |
| Cattle | 251.8 | 260.4 | 269.2 | 278.4 | 287.9 | 3.4 |
| Dairy cattle | 9.8 | 12.3 | 16 | 19 | 22.3 | 17.3 |
| Buffalo | 75.3 | | 80.9 | 83.8 | 86.8 | 3.6 |
| Horse | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 5.0 |
| Sheep | 20.1 | 21.4 | 22.9 | 24.4 | 26.1 | 6.7 |
| Pig | 64.5 | 68.5 | 72.7 | 77.2 | 81.9 | 6.2 |
| Poultry: | | | | | | |
| Dual purpose | 181.8 | 193.6 | 206.2 | 219.6 | 233.9 | 5.2 |
| Layers | 4.0 | 4.2 | 4.5 | 4.8 | 5.1 | 6.4 |
| Broilers | 40.6 | 56.4 | 60.3 | 67.0 | 74.0 | 16.2 |
| Duck | 9.8 | 10.3 | 10.7 | 11.2 | 11.8 | 6.4 |
| Total meat | 704.1 | 753.4 | 797.6 | 844 | 893.1 | 6.1 |
| Eggs ('000 tons) | | | | | | |
| Dual purpose | 61.8 | 65.0 | 68.4 | 71.9 | 75.7 | 5.2 |
| Layers | 182.6 | 195.6 | 209.3 | 224.3 | 240.3 | 7.1 |
| Duck | 80.7 | 85.9 | 91.4 | 97.2 | 103.4 | 6.4 |
| Total Eggs | 325.1 | 346.5 | 369.3 | 393.4 | 419.4 | 6.6 |
| Milk ('000 tons) | 170.3 | 229.4 | 316.2 | 409.2 | 532.8 | 33.0 |

Source: DGLS (1983b). Worksheets for Repelita IV

## APPENDIX 2

## TABLES FOR CHAPTER II:

## THE SOCIOLOGICAL SETTING

Appendix table 2.1: Human population density per square kilometer

| Province/island | 1961 | 1971 | 1980 | % change 1961-1971 | % change 1971-1980 |
|---|---|---|---|---|---|
| D.I. Aceh | 29 | 26 | 47 | 24.1 | 30.6 |
| North Sumatra | 70 | 93 | 118 | 32.9 | 26.9 |
| West Suamtra | 47 | 56 | 68 | 19.1 | 21.4 |
| Riau | 13 | 17 | 23 | 30.8 | 35.3 |
| Jambi | 17 | 22 | 32 | 29.4 | 45.5 |
| South Sumatra | 27 | 33 | 45 | 22.2 | 36.4 |
| Bengkulu | 19 | 24 | 36 | 26.3 | 50.0 |
| Lampung | 50 | 83 | 139 | 66.0 | 67.5 |
| Sumatra | 33 | 44 | 59 | 33.3 | 34.1 |
| DKI Jakarta | 5039 | 7761 | 11023 | 54.0 | 42.0 |
| West Java | 380 | 467 | 593 | 22.9 | 27.0 |
| Central Java | 538 | 640 | 742 | 19.0 | 15.9 |
| D.I. Jogyakarta | 707 | 785 | 868 | 11.0 | 10.6 |
| East Java | 455 | 532 | 609 | 16.9 | 14.5 |
| Java | 476 | 576 | 690 | 21.0 | 19.8 |
| Bali | 320 | 381 | 444 | 19.1 | 16.5 |
| West Nusa Tenggara | 90 | 109 | 135 | 21.1 | 23.9 |
| East Nusa Tenggara | 41 | 48 | 57 | 17.1 | 18.8 |
| East Timor | - | - | 37 | - | - |
| Nusa Tenggara | 63 | 75 | 96 | 19.0 | 28.0 |
| West Kalimantan | 11 | 14 | 17 | 27.3 | 21.4 |
| Central Kalimantan | 3 | 5 | 6 | 66.7 | 20.0 |
| South Kalimantan | 39 | 45 | 55 | 15.4 | 22.2 |
| East Kalimantan | 3 | 4 | 6 | 33.3 | 50.0 |
| Kalimantan | 8 | 10 | 12 | 25.0 | 20.0 |

(continued)

Appendix table 2.1: (Continued)

| Province/island | 1961 | 1971 | 1980 | % change 1961-1971 | % change 1971-1980 |
|---|---|---|---|---|---|
| North Sulawesi | 69 | 90 | 111 | 30.4 | 23.3 |
| Central Sulawesi | 10 | 13 | 18 | 30.0 | 38.5 |
| South Sulawesi | 62 | 71 | 83 | 14.5 | 16.9 |
| Southeast Sulawesi | 20 | 26 | 34 | 30.0 | 30.8 |
| Sulawesi | 38 | 45 | 55 | 18.4 | 22.2 |
| Moluccas | 11 | 15 | 19 | 36.4 | 26.7 |
| Irian Jaya | 2 | 2 | 3 | 0 | 50.0 |
| Moluccas + Irian Jaya | 3 | 4 | 5 | 33.3 | 25.2 |
| Indonesia | 51 | 62 | 77 | 21.6 | 14.2 |

Source : Statistical Yearbook of Indonesia, 1983:44

Appendix table 2.2: Average number of household members by sex and age [a]

| Category | Number |
|---|---|
| Adult males | 1.24 |
| Adult females | 1.31 |
| Male children | 1.02 |
| Female children | .83 |
| Infants (<7 yrs) | 1.02 |
| Other adults | .22 |
| Total | 5.64 |

Source: ADB/DGLS (1985)

[a]/ Averages were calculated from frequency distributions showing the percentage of households with 0 adult males, 1 adult male, etc. assuming sample size of 2400.

Appendix table 2.3: Number of households working agricultural land, engaged in fisheries and livestock activities, 1980

| Province | Own land | Rented land | Own & rent land | Total | Engaged in aqua-culture | Engaged in fish -eries | Engaged in live-stock | Percentage of total in livestock |
|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | % |
| DI Aceh | 246550 | 70088 | 53466 | 370104 | 7862 | 6290 | 129802 | |
| North Sumatra | 640281 | 170308 | 101990 | 912579 | 2069 | 10362 | 113510 | |
| West Sumatra | 309368 | 108746 | 81698 | 499811 | 595 | 3316 | 152462 | |
| Riau | 201779 | 22417 | 2057 | 244770 | 752 | 11493 | 62183 | |
| Jambi | 159250 | 30797 | 17915 | 207962 | 602 | 704 | 24532 | |
| South Sumatra | 412133 | 74796 | 21622 | 508551 | - | 5504 | 35214 | |
| Bengkulu | 99423 | 9967 | 5204 | 114594 | - | 390 | 11612 | |
| Lampung | 546676 | 101914 | 62563 | 711153 | 699 | 2001 | 83242 | |
| Sumatra | 2615460 | 589032 | 365032 | 3569524 | 12679 | 40060 | 612557 | 17.2 |
| DKI Jakarta | 20387 | 5421 | 2455 | 28273 | 305 | 1050 | 1688 | |
| West Java | 2296040 | 578154 | 371970 | 3246164 | 11070 | 12380 | 546836 | |
| Central Java | 2192438 | 500711 | 452819 | 3145969 | 13968 | 15722 | 1419873 | |
| DI Yogyakarta | 285672 | 36876 | 81257 | 403805 | - | 154 | 295635 | |
| East Java | 2761201 | 410636 | 365332 | 3537169 | 15190 | 39320 | 2245912 | |
| Java | 7556738 | 1531798 | 1273843 | 10361379 | 40753 | 68626 | 4509953 | 43.5 |
| Bali | 196584 | 74414 | 46720 | 317718 | 502 | 7400 | 216320 | |
| West Nusa Tenggara | 242392 | 47389 | 50214 | 339995 | 3040 | 7914 | 192469 | |
| East Nusa Tenggara | 359661 | 51941 | 32099 | 443701 | 347 | 5919 | 154539 | |
| East Timor b/ | - | - | - | - | - | - | - | |
| Nusa Tenggara | 798637 | 173744 | 129033 | 1101414 | 3889 | 21233 | 563328 | 51.1 |
| West Kalimantan | 258029 | 42592 | 19391 | 320012 | 400 | 4134 | 93760 | |
| Central Kalimantan | 105110 | 6133 | 4465 | 115708 | 146 | 5331 | 8917 | |
| South Kalimantan | 196660 | 49816 | 30281 | 276777 | 1103 | 5960 | 40965 | |
| East Kalimantan | 89825 | 4626 | 4696 | 99147 | 1130 | 5317 | 13297 | |
| Kalimantan | 649644 | 103167 | 58833 | 811644 | 2781 | 20742 | 156939 | 19.3 |

(continued)

Appendix table 2.3: (Continued)

| Province | Utilization of agricultural land, engaged in fisheries and livestock | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Own land | Rented land | Own & rent land | Total | Engaged in aqua-culture | Engaged in fish-eries | Engaged in live-stock | Percentage engaged in livestock |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | % |
| North Sulawesi | 202184 | 50329 | 26499 | 279012 | 2072 | 8985 | 29233 | |
| Central Sulawesi | 159400 | 12222 | 7306 | 178928 | 570 | 3924 | 26014 | |
| South Sulawesi | 481364 | 114799 | 138590 | 734753 | 14091 | 31323 | 368434 | |
| Central Sulawesi | 124147 | 3850 | 2678 | 130675 | 542 | 13193 | 29590 | |
| Sulawesi | 967095 | 181200 | 175073 | 1323368 | 17275 | 57325 | 453271 | 34.3 |
| Maluku | 144925 | 15716 | 9959 | 170600 | 610 | 4491 | 11794 | |
| Irian Jaya | 117968 | 7134 | 5529 | 130531 | 190 | 4321 | 21083 | |
| Maluku & Irian Jaya | 262893 | 22850 | 15488 | 301231 | 800 | 8812 | 32877 | 10.9 |
| Total | 12649467 | 2601791 | 1017302 | 17458560 | 78077 | 216998 | 6328925 | 36.2 |

Source: Biro Pusat Statistiks (1983). Sensus Pertanian



490

Appendix table 2.4: Distribution of cattle and buffalo in Indonesia, 1983

| | Total no. of agri. hold. | Cattle: No. of hold. | Cattle: No. of anim. | Cattle: Anim. per hold. | Buffaloes: No. of hold. | Buffaloes: No. of anim. | Buffaloes: Anim. per hold. | No. of hold. with cattle or buffalo as a % of total hold. |
|---|---|---|---|---|---|---|---|---|
| | ('000) | | | | | | | |
| Aceh | 353 | 71 | 171 | 2.4 | 68 | 148 | 2.2 | 39 |
| North Sumatra | 316 | 11 | 101 | 2.4 | 43 | 101 | 2.3 | 10 |
| West Sumatra | 426 | 99 | 156 | 1.6 | 49 | 90 | 1.8 | 35 |
| Riau | 199 | 6 | 14 | 2.5 | 6 | 18 | 2.8 | 6 |
| Jambi | 143 | 9 | 18 | 2.0 | 13 | 32 | 2.4 | 15 |
| South Sumatra | 377 | 41 | 97 | 2.3 | 15 | 34 | 2.2 | 14 |
| Bengkulu | 85 | 6 | 13 | 2.0 | 12 | 29 | 2.5 | 21 |
| Lampung | 447 | 53 | 84 | 1.6 | 13 | 24 | 1.9 | 15 |
| DKI Jakarta | 21 | 1 | 2 | 2.4 | 3 | 7 | 2.2 | 19 |
| West Java | 2,468 | 67 | 128 | 1.9 | 249 | 487 | 2.0 | 13 |
| Central Java | 2,766 | 563 | 976 | 1.7 | 174 | 371 | 2.1 | 27 |
| DI Yogyakarta | 344 | 120 | 196 | 1.6 | 11 | 22 | 2.0 | 38 |
| East Java | 3,066 | 1,301 | 2,519 | 1.9 | 80 | 187 | 2.3 | 45 |
| Bali | 305 | 190 | 363 | 1.9 | 5 | 11 | 2.1 | 65 |
| West Nusa Tenggara | 281 | 82 | 174 | 2.1 | 43 | 203 | 4.7 | 44 |
| East Nusa Tenggara | 365 | 66 | 421 | 6.3 | 40 | 151 | 3.8 | 29 |
| West Kalimantan | 274 | 18 | 56 | 3.1 | 0 | 0 | 2.9 | 7 |
| Central Kalimantan | 100 | 4 | 13 | 3.0 | 0 | 1 | 2.1 | 4 |
| South Kalimantan | 258 | 8 | 21 | 2.6 | 3 | 11 | 4.5 | 4 |
| East Kalimantan | 58 | 1 | 2 | 2.0 | 0 | 1 | 2.1 | 2 |
| North Sulawesi | 218 | 61 | 155 | 2.5 | 0 | 1 | 2.4 | 28 |
| Central Sulawesi | 132 | 42 | 132 | 3.1 | 3 | 9 | 3.1 | 34 |
| South Sulawesi | 649 | 119 | 424 | 3.6 | 114 | 302 | 2.6 | 36 |
| Southeast Sulawesi | 103 | 2 | 16 | 6.9 | 3 | 11 | 3.7 | 5 |
| Total Indonesia (except Maluku, East Timor and West Irian | 14,254 | 2,971 | 6,243 | 2.1 | 947 | 2,251 | 2.3 | 27 |

Source: Directorate General of Livestock Services (1984b).



491

Appendix table 2.5: Number of farm families conducting specific income-generating activities, by area

| Area | Cropping No. | Cropping % | Livestock [a] No. | Livestock [a] % | Fishing No. | Fishing % | Trading No. | Trading % | Off-farm employment No. | Off-farm employment % | Other activities No. | Other activities % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Sumatra | 300 | 98 | 297 | 99 | 8 | 3 | 37 | 12 | 105 | 35 | 93 | 31 |
| S. Sumatra | 400 | 100 | 373 | 93 | 26 | 7 | 50 | 13 | 49 | 12 | 36 | 9 |
| West Java | 67 | 74 | 100 | 100 | - | - | 39 | 39 | 35 | 35 | 44 | 44 |
| Central Java | 152 | 95 | 95 | 95 | 22 | 11 | 59 | 30 | 96 | 48 | 85 | 100 |
| East Java | 75 | 75 | 89 | 90 | 10 | 10 | 34 | 34 | 28 | 28 | - | - |
| Nusa Tenggara | 297 | 99 | 184 | 92 | 24 | 12 | 120 | 40 | 146 | 49 | 100 | 33 |
| Kalimantan | 191 | 100 | 388 | 99 | 300 | 100 | 85 | 21 | 52 | 13 | 122 | 28 |
| Sulawesi | 233 | 100 | 379 | 100 | 66 | 17 | 59 | 15 | 144 | 48 | 84 | 21 |
| Molucca | 33 | 100 | 40 | 100 | 31 | 31 | 12 | 12 | - | - | 32 | 32 |
| Irian Jaya | 48 | 100 | 100 | 100 | 1 | 1 | 14 | 14 | 16 | 16 | 10 | 10 |
| Total | 1796 | 96 | 2045 | 97 | 488 | 23 | 509 | 21 | 671 | 30 | 606 | 27 |

Source: ADB/DGLS (1985)

[a]/ Households were selected because of their livestock production activities. Just 36.2% of agricultural households holds livestock of any kind (see Appendix Table 2.3).

Appendix table 2.6: Percentage of farm families ranking sources of income by importance

| Source of Income | Importance | | | | |
|---|---|---|---|---|---|
| | Very | High | Moderate | Low | None |
| | (%) | | | | |
| Crop production | 40 | 25 | 24 | 5 | 4 |
| Livestock production | 7 | 21 | 43 | 24 | 6 |
| Fishing | - | 1 | 2 | 7 | 90 |
| Trading | 6 | 3 | 6 | 7 | 79 |
| Off-farm employment | 6 | 2 | 11 | 12 | 70 |
| Other | 11 | 2 | 6 | 9 | 74 |

Source: ADB/DGLS (1985)

Appendix table 2.7: Average ranking of objectives for keeping livestock, by species [a/]

| Objective: | meat | savings | draft | manure | prestige |
|---|---|---|---|---|---|
| | (ranking) | | | | |
| Species: | | | | | |
| cattle | 3 | 1 | 2 | 4 | 5 |
| buffalo | 3 | 1 | 2 | 4 | 5 |
| goat | 3 | 1 | 5 | 2 | 4 |
| sheep | 3 | 1 | 5 | 2 | 4 |
| pigs | 2 | 1 | 5 | 3 | 4 |
| poultry | 1 | 2 | 5 | 3 | 4 |

Source: ADB/DGLS (1985)

[a/] Rankings were: 1 = very important to 5= not very important



493

Appendix table 2.8: Number of people and households transmigrated since 1905

| Year | REPELITA | Number of households [a] | Number of people [b] |
|---|---|---|---|
| 1905 - 1941 | | n.a. | 289,938 |
| 1950 - 1968 | | n.a. | 408,872 |
| 1969/70 - 1973/74 | I | n.a. | 210,403 |
| 1974/75 - 1978/79 | II | n.a. | 318,388 |
| 1979/80 - 1983/84 | III | 535,474 | |

Sources: [a] Pidato Kenegaraan President Republik Indonesia Soeharto 16 Augustus 1984: 772
[b] Mac Andrews, 1978 : 25 (for the year 1905 - 1941); Oey and Astika, 1982 ; 34,35 (for the year 1950 - 1968); Profil, without year: 123,125 (for Pelita I and II) as presented by Arief Budiman, 1984: 245

Appendix table 2.9: Source of household food supply

| Percentage | Own production | Purchase | Exchange [a] | Gather/ hunt |
|---|---|---|---|---|
| Grain/vegetable/fruit: | | | | |
| 75% - 100% | 41 | 12 | - | - |
| 50% - 75% | 31 | 19 | - | 1 |
| 25% - 50% | 13 | 22 | 1 | 1 |
| 1% - 25% | 11 | 27 | 8 | 3 |
| None | 4 | 23 | 91 | 95 |
| Animal products: | | | | |
| 75% - 100% | 23 | 19 | - | - |
| 50% - 75% | 21 | 19 | 1 | - |
| 25% - 50% | 16 | 14 | - | - |
| 1% - 25% | 24 | 23 | 6 | 8 |
| None | 16 | 25 | 93 | 92 |
| Fish: | | | | |
| 75% - 100% | 6 | 61 | | |
| 50% - 75% | 4 | 9 | | |
| 25% - 50% | 6 | 7 | | |
| 1% - 25% | 9 | 8 | | |
| None | 78 | 13 | | |

Source: ADB/DGLS (1985)
[a]/ Includes exchange, barter and gifts



495

## APPENDIX 3

## TABLES FOR CHAPTER III:

## THE ANIMAL RESOURCE BASE

Appendix table 3.1: Selected wage rates for draft animals in Indonesia

| Location and date | Task | Species | Single or pair | Cash wage/day | Payment wage [a] | Total wage | Hours worked per day | Wage/animal /hour | Hours/ hectare/task [b] |
|---|---|---|---|---|---|---|---|---|---|
| Yogyakarta, 1985 | Plowing | Cattle | Pair | 2400 | - | 2400 | 6 | 200 | 30 |
| Klepu | Plowing | Cattle | Pair | 1600 | 500 | 2100 | 4 | 260 | 32 |
| Central Java,1985 | Plowing | Buffalo | Pair | 2000 | 500 | 2500 | 4 | 310 | 20 |
| S. Kalimantan, 1985 [c] | Plowing | Cattle | Pair | 4500 | - | 4500 | 5 | 450 | 20 |
| S. Kalimantan, 1985 [c] | Plowing | Cattle | Pair | 4000 | - | 4000 | 4 | 500 | 16 |
| C. Kalimantan, 1985 | Plowing | Cattle | Pair | 5000 | - | - | 5 | 500 | 25 |
| E. Kalimantan, 1985 [d] | Plowing | Cattle | Pair | 5000 | 250 | 5250 | 4 | 660 | 28 |
| West Sumatra, 1985 | Plowing | Buffalo | Single | 2500 | 250 | 2750 | 6 | 460 | 48 |
| Sumedang, W. Java, 1985 | Plowing | Cattle | Pair | 4000 | 500 | 4500 | 4 | 560 | n.a. |
| Yogyakarta, 1985 | Plowing | Cattle | Pair | 2500 | - | 2500 | 6 | 208 | n.a. |
| W. Java, 1978-81 [e] | Plowing | - | - | - | - | - | 4.5 | 522 | n.a. |
| C. Java, 1978-81 [e] | Plowing | - | - | - | - | - | 4.25 | 572 | n.a. |
| E. Java, 1978-81 [e] | Plowing | - | - | - | - | - | 4.00 | 662 | n.a. |
| Madura, 1985 | Plowing | Cattle | Pair (males) | 2000 | - | - | 4.00 | 500 | 10 |
| Bali, 1985 | Plowing | Cattle | Pair | 1500-2000 | - | - | 6 | 300 | 10 |
| E. Java, 1985 | Plowing | Buffalo | Pair | 2500 | 250 | 2750 | 5 | 550 | 35 |
| C. Sulawesi, 1985 | Plowing | Cattle | Pair | 2000 | 250 | - | 6 | - | |

Source: Field visits by study team members

[a] Numbers of meals + Rp 250/meal. When payment in padi, Rp 150/kg used.

[b] Refers to hour per hectare for pair or single animals.

[c] Ambon corresponds to South Kalimantan.

[d] Irian Jaya corresponds to East Kalimantan.

[e] Kasryno, et.al, 1984.

Appendix table 3.2: Estimated production and value of farm manure, 1978 - 1982 (tons)

| | Prod./head/ year (tons) | 1978 | 1979 | 1980 | 1981 | 1982 | Avg. ann. Inc. (%) |
|---|---|---|---|---|---|---|---|
| Cattle | 6.5 | 41,145 | a/41,353 | 41,860 | 42,354 | 42,861 | |
| Buffalo | 6.5 | 17,340 | 18,240 | 18,427 | 18,660 | 18,847 | |
| Goat | 0.95 | 7,648 | 7,276 | 7,306 | 7,400 | 7,496 | |
| Sheep | 0.95 | 3,430 | 3,867 | 3,918 | 3,968 | 4,019 | |
| Pig | 1.25 | 3,628 | 3,979 | 3,944 | 4,205 | 4,484 | |
| Layers | 0.025 | 152 | 175 | 574 | 614 | 658 | |
| Broilers | 0.0225 | - | - | 572 | 632 | 698 | |
| Dairy Cattle | 6.5 | 605 | 611 | 670 | 735 | 910 | |
| Horse | 5.5 | 2,156 | 2,086 | 2,156 | 2,230 | 2,303 | |
| Manure | | 76,104 | 77,587 | 79,427 | 80,798 | 82,276 | |
| Value $ Million | | 456.6 | 465.5 | 476.6 | 484.4 | 493.7 | 1.9 |

Source: Estimation based on animal populations as reported by DGLS
a/ Manure value $6/ton

Appendix table 3.3: Sizes of grade Ongole vs purebred Ongole cattle

| | Ongole: Sumba (purebred) | Ongole: Java (grade) |
|---|---|---|
| Body weight (kg) | | |
| Male | 544 | 384 |
| Female | 408 | 325 |
| Height at withers (cm) | | |
| Male | 132 | 128 |
| Female | 125 | 110 |
| Girth of chest (cm) | | |
| Male | 210 | 169 |
| Female | 167 | 162 |

Source : Hardjosubroto and Astuti (1979). Data obtained from slaughterhouses on adult animals.

Appendix table 3.4: Distribution of Bali cattle in Bali by age and sex

| Age/Sex | | Number | Percent |
|---|---|---|---|
| Males: | | | |
| | Mature bulls | 53,514 | 15.7 |
| | Young (1 - 2 yrs) | 29,464 | 8.7 |
| | Calves (< 1yr) | 29,764 | 8.7 |
| | Steers | 20,790 | 6.1 |
| Females: | | | |
| | Mature cows | 138,625 | 40.5 |
| | Young (1 - 2 yrs) | 39,297 | 11.5 |
| | Calves (< 1 yr) | 30,270 | 8.9 |
| Total | | 341,772 | 100.0 |

Source: Pane (1983)

Appendix table 3.5: Some performance data on Bali cattle in Bali

| | Male | Female |
|---|---|---|
| Weight for age (kg): | | |
| A.I. Center | | |
| 205 days of age | 91 | 82 |
| 365 days of age | 137 | 124 |
| 550 days of age | 199 | 173 |
| Bull project | | |
| 205 days of age | 91 | 83 |
| 365 days of age | 138 | 125 |
| 550 days of age | 198 | 173 |
| Village animals | | |
| 205 days of age | 83 | 74 |
| 365 days of age | 124 | 112 |
| 550 days of age | 163 | 140 |
| Reproductive data on breeding females: | | |
| Age 1st calving (days) | | 890 |
| Breeding season (Aug.-Jan.) (% conceiving) | | 70.4 |
| Percent conceiving on 1st service | | 93.0 |
| Embryonic mortality (%) | | 8.0 |
| Aborted (%) | | 3.2 |
| Percent calving (%) | | 79.5 |
| Calving season (May-October) (%) | | 72.4 |
| Stillborn calves (%) | | 2.2 |
| Calves weak at birth (%) | | 1.4 |
| Calf mortality (up to 205 days) (%) | | 6.0 |
| Calving interval of cows (days) | | 420 |
| First estrus, post partum (%) | | |
| Less than 91 days | | 50.7 |
| 92 - 120 days | | 24.6 |
| 121 - 152 days | | 10.0 |
| 153 - 181 days | | 9.7 |
| More than 181 days | | 5.0 |
| Calf crop per year, % alive | | 71.3 |

Source: Pane (1983)

Appendix table 3.6: Carcass composition of Bali cattle

| | Percentage |
|---|---|
| **Liveweight:** | |
| Carcass | 52.0 |
| Head | 6.0 |
| Hide | 8.0 |
| Offal | 29.0 |
| Intestinal contents | 5.0 |
| Total | 100.0 |
| **Carcass comprised of:** | |
| Meat | 41.0 |
| Bone | 9.2 |
| Fat | 0.6 |
| Tail | 0.4 |
| Waste | 0.1 |
| Total | 52.0 |
| **Dressed carcass:** | |
| Meat | 80.0 |
| Bones | 18.0 |
| Fat | 2.0 |
| Total | 100.0 |

Source : Payne and Rollinson (1973)

Appendix table 3.7: <u>Average body measurements on Madura cattle at different ages</u>

| Age | Body weight (kg) | Height at withers (cm) | Body length (cm) | Chest girth (cm) |
|---|---|---|---|---|
| **Males** | | | | |
| 3 Mo. | 45 | 73 | 64 | 76 |
| 3 - 6 Mo. | 63 | 84 | 76 | 91 |
| 6 - 9 Mo. | 80 | 87 | 80 | 98 |
| 9 - 12 Mo. | 130 | 100 | 94 | 113 |
| 12 - 24 Mo. | 171 | 109 | 108 | 133 |
| 24 - 36 Mo. | 217 | 115 | 116 | 146 |
| 36 - 48 Mo. | 239 | 113 | 121 | 151 |
| 48 Mo. | 248 | 119 | 124 | 151 |
| **Females** | | | | |
| 3 Mo. | 51 | 81 | 71 | 87 |
| 3 - 6 Mo. | 71 | 86 | 80 | 94 |
| 6 - 9 Mo. | 71 | 86 | 81 | 98 |
| 9 - 12 Mo. | 105 | 96 | 93 | 112 |
| 12 - 24 Mo. | 154 | 106 | 106 | 128 |
| 24 - 36 Mo. | 212 | 113 | 117 | 140 |
| 36 - 48 Mo. | 194 | 113 | 117 | 139 |
| 48 Mo. | 204 | 113 | 117 | 141 |

Source: Siregar, <u>et al</u>. (1984)

Appendix table 3.8: <u>Some characteristics of Aceh cattle.</u>

| | Young calves | | Growing | | Adult | |
|---|---|---|---|---|---|---|
| | Female | Male | Female | Male | Female | Male |
| Body weight (kg) | 49 | 50 | 122 | 132 | 145 | 302 |
| Body length (cm) | 59 | 63 | 77 | 79 | 55 | 100 |
| Height at withers (cm) | 50 | 59 | 90 | 97 | 105 | 120 |
| Girth length (cm) | 98 | 108 | 121 | 127 | 140 | 165 |

Source : Direktorat Bina Produski (1985).

Appendix table 3.9: <u>Production characteristics of Aceh cattle in Aceh</u>

| | |
|---|---|
| Birth weight, (kg) | 10 - 18 |
| Yearling weight, (kg) | |
| Male | 90 - 110 |
| Female | 50 - 90 |
| Two-year old, weight (kg) | |
| Male | 110 - 200 |
| Female | 80 - 100 |
| Mature weight, (kg) | |
| Male | 200 - 300 |
| Female | 120 - 180 |
| Age at first calf (years) | 2 - 3 |
| Calving interval (year) | 1 - 1 1/2 |
| Calf crop, (%) | 30 - 75 |
| Calf mortality (%) | 5 - 8 |
| Adult mortality (%) | 1 - 5 |
| Dressing percentage | 30 - 56 |
| Lactation (kg/year) | 300 - 900 |

Source: Asian Development Bank (1981)

Appendix table 3.10: The Malaysian buffalo as described by various authors

| | Summary |
|---|---|
| Description | Colour: slate blue, black; pink groin, axilla, chevron; grey at birth; albinoids 5%; piebalds present |
| | Hair: calves hairy; adults hairless; black hair |
| | Horns: wide spreading and broad; Some polled; polled also occur |
| | Size: compact, short body, large girth, thin legs, short face |
| | Birth weight: males 72-103 lbs<br>average 84.4 lbs<br>females 65-86 lbs<br>average 72 lbs |
| | Yearling weight: 450 lbs |
| | Mature weight 1200 lbs; males 3/4 ton<br>females 1/2 ton<br>1169 lbs |
| | Weight gains 1 lb/day |
| | Voice: squeal |
| | Tongue: short and pointed<br>Teeth: |
| | Temperament: docile |
| | Testes: carried high |
| | Udder: small |
| | Senses: short sight; good hearing; dull sense of touch and pain; taste and smell same as in other species |
| | Chromosomes: 34-38<br>48 |

(continued)

Appendix table 3.10: (Continued)

| | Summary |
|---|---|
| Sexual maturity | Males: 2 years; Females: 2 1/2 years<br>Females: 2 1/2 - 3 years |
| Age at first calving | 3 1/2 - 4 years<br>above 4 years<br>range. 37-74 months<br>mean: 52.2 months<br>S.D.: 6.6 months |
| Interval between parturition and conception | 43-661 days; average 238 days<br>326 days (monsoon months)<br>264 days (dry months)<br>Age Groups<br>3-6 years 317 days<br>6-9 " 307 days<br>9 and older 254 days |
| Calving interval | 2-2 1/2 years<br>37-991 days; average 559 days<br>480 days<br><br>539 days<br>range: 11-46 months<br>mean: 22.3 months<br>S.D.: 7.2 months |
| Gestation period | roughly 10 months<br>332 days<br>330 days<br>330-340 days<br><br>Less than 330 days (by inference) |
| Postpartum service | rarely before 65th day<br>36 days (assuming a gestation period of 330 days) |
| Calving season | July-September<br>Mid-January-mid-April<br>August-October<br>February-July |

(continued)

Appendix table 3.10: (Continued)

| | Summary | |
|---|---|---|
| Estrous | 28 days, extends for 3-5 days<br>Regularly between March and July | |
| Calf crop | One every 1 1/2 years; 2 every 3 years<br>one every 1 1/2 - 2 years<br>1.7 every 3 years; 43% per annum<br>23.9-24.6% per annum | |
| Twinning | 0.003%<br>0.015% | |
| Sex parity ratio | M: :F | 101.09 : 100<br>99 : 100 |
| | At birth | 186-107 : 100 |
| | Survivors | 89-213 : 100 |
| Milk yield | 6 pints daily<br>3 pints daily; 50 gallons total<br>3 pints daily | |
| Lactation legnth | 15 months if not mated<br>7-9 months<br>6 months | |
| Libido | Males til 6-7 years | |
| Bull:cow ratio | recommended 1 : 10 | |
| Mating time | At night<br>also at sunrise and sunset<br>during the day | |
| Mortality | dams: | 12-21%; average 17% |
| | calves: | males 13-22%<br>females 16-18% |
| | all sexes | 16-20% |
| Culling | 3.8-16.1% | |
| Economic benefits | $8.75-$15.81 per annum per female reares | |
| Crossbreeding | With Arni possible; with Murrah not possible<br>with Murrah possible to obtain good sized calves and performance | |

Source: Camoens (1976). Summary of reports by various authors

Appendix table 3.11: Average herd stucture of swamp buffalo in Indonesia

| | East N.T.a/ | South Kal | East Kal | West N.T. | Nort Sum | West Java | Cent Java | Bali | Cent Sul | South Sul | Cent Sul | S.E. Sul |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of farmers interviewed | 51 | 48 | 43 | 50 | 55 | 28 | 50 | 50 | 107 | 54 | 30 | 31 |
| Av males 2 yrs | 4.9 | 0.9 | 1.0 | 2.1 | 1.8 | 2.2 | 0.3 | 0.8 | 0.7 | 1.4 | 0.7 | 2.9 |
| percent of herd | 13.0 | 12.0 | 14.0 | 15.0 | 12.0 | 17.0 | 10.0 | 20.0 | 9.0 | 7.0 | 8.0 | 16.0 |
| Av males 2-6 yrs | 4.2 | 1.2 | 1.1 | 1.6 | 1.1 | 2.2 | 0.3 | 0.9 | 1.2 | 2.4 | 0.8 | 1.9 |
| percent of herd | 11.0 | 16.0 | 15.0 | 12.0 | 7.0 | 17.0 | 10.0 | 23.0 | 15.0 | 12.0 | 9.0 | 11.0 |
| Av males 6 yrs | 1.7 | 0.2 | 0.4 | 1.6 | 0.6 | 0.3 | 0.5 | 0.3 | 1.6 | 1.5 | 0.2 | 1.9 |
| percent of herd | 4.0 | 3.0 | 5.0 | 12.0 | 4.0 | 2.0 | 1.0 | 8.0 | 20.0 | 7.0 | 2.0 | 11.0 |
| Av males/herd | 10.7 | 2.3 | 2.5 | 5.3 | 3.5 | 4.7 | 0.6 | 2.0 | 3.5 | 5.3 | 1.7 | 6.7 |
| Av females 2 yrs | 6.8 | 1.0 | 1.4 | 1.9 | 2.3 | 2.8 | 0.5 | 0.6 | 1.0 | 3.9 | 3.7 | 3.8 |
| percent of herd | 18.0 | 13.0 | 19.0 | 14.0 | 16.0 | 22.0 | 18.0 | 15.0 | 13.0 | 20.0 | 43.0 | 22.0 |
| Av females 2-6 yrs | 9.1 | 1.5 | 2.4 | 2.2 | 3.2 | 3.9 | 1.2 | 0.9 | 1.8 | 5.4 | 2.6 | 3.8 |
| percent of herd | 24.0 | 20.0 | 33.0 | 16.0 | 22.0 | 31.0 | 43.0 | 23.0 | 23.0 | 27.0 | 30.0 | 22.0 |
| Av females 6 yrs | 10.9 | 2.8 | 0.9 | 4.3 | 3.6 | 2.1 | 0.5 | 0.4 | 1.7 | 5.3 | 0.6 | 3.2 |
| percent of herd | 29.0 | 37.0 | 13.0 | 31.0 | 25.0 | 16.0 | 18.0 | 10.0 | 21.0 | 27.0 | 7.0 | 18.0 |
| Av females/herd | 26.8 | 5.3 | 4.7 | 8.4 | 9.1 | 8.8 | 2.2 | 1.9 | 4.5 | 14.6 | 6.9 | 10.8 |
| Av buffalo/herd | 37.5 | 7.6 | 7.2 | 13.7 | 14.6 | 12.7 | 2.8 | 3.9 | 8.0 | 19.0 | 8.6 | 17.5 |
| Male:female ratio | 2.5 | 2.4 | 1.9 | 1.6 | 2.6 | 1.9 | 3.5 | 1.0 | 1.3 | 2.7 | 3.8 | 1.6 |
| Percent working | 37.0 | 44.0 | 40.0 | 50.0 | 36.0 | 58.0 | 86.0 | 60.0 | 53.0 | 42.0 | 10.0 | 66.0 |

Source: Robinson (1977).

a/ N.T. = Nusa Tenggara; Kal = Kalimantan; Sum = Sumatra; Sul = Sulawesi

Appendix table 3.12: Reproductive characteristics of buffalo in Indonesia.

| | East N.T.[a] | South Kal | East Kal | West N.T. | North Sum | West Java | Cent Java | Bali | Cent Sul | South Sul | Cent Kal | S.E. Sul |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. calves born/female/5 yrs | | | | | | | | | | | | |
| 1 - 2 calves | 20 | 8 | 54 | 8 | 36 | 29 | 70 | 24 | 36 | 23 | 47 | 31 |
| 3 - 4 calves | 33 | 64 | 23 | 60 | 36 | 71 | 30 | 36 | 30 | 61 | 50 | 34 |
| 5 calves | 47 | 4 | 5 | 24 | - | - | - | 20 | 7 | 16 | 3 | 36 |
| Calculated calving interval (days) | 480 | 536 | 793 | 490 | 720 | 618 | 869 | 598 | 890 | 544 | 1007 | - |
| Time post partum at service[b] | | | | | | | | | | | | |
| 1 month | - | - | - | - | - | - | - | - | 2 | 4 | 3 | 10 |
| 1 - 2 month | 2 | 33 | 33 | 3 | 11 | - | 2 | 4 | 27 | 33 | 47 | 65 |
| 2 month | 77 | 40 | 42 | 64 | 100 | 88 | 76 | 41 | 41 | 57 | 47 | 25 |
| No. of services per pregnancy | | | | | | | | | | | | |
| 1 | 2 | 13 | 7 | 24 | 16 | 11 | 8 | 60 | 1 | 4 | 7 | 10 |
| 1 - 2 | 2 | 54 | 35 | 32 | 35 | 61 | 42 | 14 | 41 | 33 | 53 | 20 |
| 2 | 80 | 21 | 37 | 22 | 24 | 36 | 42 | 10 | 31 | 59 | 33 | 70 |
| Mortality rates[b] | | | | | | | | | | | | |
| Born dead | 24 | 17 | 28 | 24 | 30 | 38 | 6 | 6 | 12 | 24 | 13 | 13 |
| Range of % | 5-75 | 1-30 | 1-100 | 1-50 | 1-25 | - | 1-50 | 1-50 | 5-50 | 1-10 | 20-30 | 0-25 |
| Dead in 2 years | 34 | 6 | 28 | 40 | 27 | 38 | 6 | 8 | 8 | 68 | 13 | 10 |
| Range of % | 2-16 | 2-4 | 1-15 | 2-75 | 2-30 | - | - | 15-50 | 5-50 | 5-50 | 2-35 | 1-10 |
| Dead in 2-6 years | - | 17 | 21 | 32 | 11 | 25 | - | 6 | 16 | 28 | 17 | 6 |
| Range of % | 1-40 | 1-6 | 1-25 | 2-25 | 5-50 | - | - | - | 1-40 | 1-30 | - | 1-10 |
| Birth weight of calves (kg) | | | | | | | | | | | | |
| 25 | 39 | 44 | 56 | 42 | 53 | 36 | 46 | 44 | 42 | 70 | 69 | 50 |
| 25 - 30 | 29 | 25 | 30 | 24 | 20 | 64 | 44 | 30 | 25 | 30 | 31 | 22 |
| )30 | 4 | - | - | - | - | - | - | 6 | 1 | - | - | 13 |

Source: Robinson (1977)

[a] N.T. = Nusa Tenggara; Kal = Kalimantan; Sum = Sumatra; Sul = Sulawesi

[b] Represent the percentage of farmers interviewed who made the statements shown.



508

Appendix table 3.13: Some production characteristics of swamp buffalo.

| Parameters | Central [a/] Kalimantan | East [b/] Kalimantan | Thailand [c/] |
|---|---|---|---|
| | Location | | |
| Birth weight, kg | 24 | - | 26 - 38 |
| Weight in kg at : | | | |
| 8 mo. - male | - | - | 125 - 150 |
| 10 mo. - male | 151 | - | - |
| 12 mo. - male | 183 | - | - |
| 54 mo. - male | 372 | - | - |
| 60 mo. - male | 408 | - | - |
| 72 mo. - male | 453 | - | - |
| 84 mo. - male | 465 | - | - |
| Mature | | | |
| male, kg | - | - | 450 - 650 |
| female, kg | - | - | 350 - 450 |
| Age at puberty (yrs) | 3.3 | - | 1.6 - 3.0 |
| Age at 1st calf (yrs) | 4.3 | 4 - 5 | 3.5 - 4.7 |
| Estrus cycle (days) | - | - | 20 - 34 |
| Estrus period (hrs) | - | - | 24 - 36 |
| Gestation period (day) | 336 | - | 308 - 332 |
| Calving rate (%) | - | - | 23 - 82 |
| Calving interval (mos) | 19 | 24.7 | 370 - 670 |
| Length of reproductive life (yrs) | 10 | 20 | - |

Sources: a/ Study team consultation with farmer in Jenamas, Central Kalimantan
b/ Ramm *et al.* (1984)
c/ Chantalakhana (1983)



509

Appendix table 3.14: Carcass data comparing swamp buffalo and cattle

| | Swamp Buffalo | Cattle |
|---|---|---|
| Slaughter weight, kg | 334.23 | 349.33 |
| Dressing percentage | 46.3 | 50.3 |
| Carcass length, cm | 118.6 | 128.0 |
| Rib eye area, cm | 40.7 | 50.9 |
| Marbling score | 4.6 | 5.5 |
| Saleable cuts, cm | 75.9 | 77.3 |

Source: Arganosa *et al*. (1972)

Appendix table 3.15: Characteristics of local Indonesian cattle

| | Bali | Madura | Ongole |
|---|---|---|---|
| Fertilitity | +++ a/ | ++ | + |
| Calving difficulties | - | - | - |
| Calf mortalities | + | ++ | + |
| Birth weight, kg | 13 to 15 | 12 t0 18 | 20 to 25 |
| Weaning weight, kg | 70 | 60 | 85 |
| Daily gain (birth to slaughter), kg | 0.35 | 0.25 | 0.30 |
| Feed conversion | ++ | + | ++ |
| Age at puberty, months | 18 to 24 | 20 to 24 | 24 to 30 |
| Disease resistance | ++ | +++ | +++ |
| Heat tolerance | +++ | +++ | +++ |
| Male libido | ++ | + | + |
| Grazing ability | +++ | +++ | +++ |
| Mothering ability | +++ | +++ | +++ |
| Milk production | + | + | + |
| Mature weight, kg | | | |
| Male | 375 | 275 | 400 |
| Female | 275 | 250 | 300 |
| Dressing percentage | 56 | 48 | 45 |

Source: Directorate Penyebaran dan Pengembangan Peternakan (1985)
a/ + = poor, ++ = good, +++ = excellent.

Appendix table 3.16: Comparison of Bali, Brahman cross and Ongole cattle and swamp buffalo in East Kalimantan

| | Bali cattle | Brahman cross cattle | Ongole cattle | Swamp buffalo |
|---|---|---|---|---|
| Age at first calving | 36 months | 38 months [a/] | 42 months | 54 months [b/] |
| Intercalving period | 14 months | 18 months [b/] | 16 months | 20 months |
| Calf mortality | 7.1% | 5% | During the last two years no losses mentioned | During the last two years no losses mentioned |
| Adult mortality | 2.0% | 2.5% | | |
| Diseases | Ectoparasites play a minor role, control of endo-parasites necessary | Complex occurence of diseases requires rapid control measures, like dipping, culling, etc. | Control of endo-parasites necessary | Basic information about diseases required |
| Feed requirements | - less total feed requirement due to lower liveweight<br>-quality can be lower<br>-can graze in sawah and ladang<br>-salt in addition | -high daily feed intake<br>-higher quality necessary<br>-selective and difficult to graze<br>-minerals must be provided | -high daily feed intake<br>-high quality<br>-very selective and difficult to graze | -broader spectrum of feed resources (mature herbage, etc.) quality can be lower<br>-can graze well in swamps |
| Management requirement | medium level | high level | high level | medium high level |
| Ploughing | -both sexes can be used well<br>-stronger and faster than zebu types<br>-easy to tame and to handle | -bulls too heavy<br>-cannot be used in sawah<br>-careful handling necessary | -both sexes can be used<br>-cannot be used in deep sawah<br>-careful handling necessary | -bull-couple difficult to handle<br>-stronger than Bali cattle<br>-sometimes difficult to tame |

(continued)

Appendix table 3.16: (Continued)

| | | | | |
|---|---|---|---|---|
| General remarks | -very fertile<br>-surprisingly well adapted<br>-altogether easier to keep<br>-excellent suitability for ploughing<br>-apparently resistent to ticks | -under the conditions of Teluk-Dalam BC not suitable<br>-the animals require a well developed farming system<br>-high labor input<br>-high investment in stable<br>-high level of management is required<br>-problems with diseases and adaptation<br>-very low second calving rate | -very fertile under good nutritive and management conditions<br>-high labor input<br>-high investment in stable<br>-high level of management is required | -environmental conditions must be considered<br>-difficulties in draught season<br>-special knowledge about keeping is required (wallowing, etc.)<br>-high investment in stable<br>-well suited for ploughing especially in deep sawah fields |

Source: Rama, et. al., 1984

a/: Age of Bali cattle at time of distribution is supposed to be 18 months, the age of Kerbau 24 months.

b/: Very optimistic assumption that all cows would become pregnant shortly after investigation.

Appendix table 3.17: Production performance of indigenous Indonesian cattle and swamp buffalo fed a high concentrate diet

| | Madura | Ongole | Bali | Grati | Swamp Buffalo |
|---|---|---|---|---|---|
| Average daily gain (kg) | 0.60 | 0.75 | 0.66 | 0.90 | 0.73 |
| Dry matter intake (kg/day) | 5.33 | 6.42 | 6.02 | 7.97 | 5.80 |
| Dry matter intake per kg $BW^{0.75}$/day | 72.60 | 72.30 | 76.80 | 84.90 | 76.60 |
| Feed conversion (kg feed/kg gain) | 9.22 | 8.56 | 9.12 | 8.85 | 7.95 |
| Organic matter digestibility (%) | 70.6 | 72.6 | 68.6 | 73.7 | 68.3 |
| Dressing percentage | 63.2 | 57.9 | 56.6 | 57.3 | 51.8 |
| Rib eye area (cm) | 63.4 | 54.5 | 63.7 | 61.0 | 46.2 |
| Muscle:bone ratio | 5.34 | 4.23 | 4.44 | 3.89 | 3.34 |
| Relative rates of fat deposition | 0.49 | 0.34 | 0.52 | 0.33 | 0.57 |

Source: Moran (1980)

Appendix table 3.18: Estimates of weights of cattle and swamp buffalo at different ages.

| | Cattle (kg) | | | | Swamp buffalo (kg) |
|---|---|---|---|---|---|
| | Bali | Grati[a] | Madura | Ongole | |
| Birth weight | 16 | 22 | 14 | 20 | 30 |
| One year: | | | | | |
| Male | 110 | 150 | 90 | 120 | 170 |
| Female | 90 | 130 | 70 | 90 | 150 |
| Two years: | | | | | |
| Male | 220 | 280 | 180 | 230 | 300 |
| Female | 170 | 240 | 130 | 180 | 270 |
| Three years: | | | | | |
| Male | 320 | 400 | 250 | 330 | 430 |
| Female | 240 | 330 | 180 | 250 | 350 |
| Four years: | | | | | |
| Male | 400 | 500 | 300 | 430 | 550 |
| Female | 300 | 400 | 220 | 320 | 480 |
| Adults: | | | | | |
| Male | 400 | 500 | 300 | 430 | 600 |
| Female | 300 | 400 | 220 | 320 | 530 |

Source: World Bank/FAO (1978)

a/ Grati: Friesian x indigenous animal, usually much more than 75% Friesian genes.

Appendix table 3.19: Calculated average daily gains of cattle and swamp buffalo

| Age/Sex | Cattle (gm/day) | | | | Swamp buffalo, (gm/day) |
|---|---|---|---|---|---|
| | Bali | Grati | Madura | Ongole | |
| From birth to one: | | | | | |
| Male | 258 | 351 | 208 | 274 | 384 |
| Female | 203 | 296 | 153 | 192 | 356 |
| From one to two years: | | | | | |
| Male | 301 | 356 | 247 | 301 | 356 |
| Female | 219 | 301 | 164 | 247 | 329 |
| From two to three years: | | | | | |
| Male | 274 | 328 | 192 | 274 | 356 |
| Female | 192 | 247 | 137 | 192 | 301 |
| From three to four years: | | | | | |
| Male | 219 | 273 | 137 | 274 | 329 |
| Female | 164 | 192 | 110 | 192 | 274 |
| From four to adult: | | | | | |
| Male | - | - | - | - | 137 |
| Female | - | - | - | - | 137 |

Source: Calculated based on appendix table 3.20.

Appendix table 3.20: Body measurements on champion cattle in Central/West Java contests in 1978 - 1980

| | 1978 Contest at Kartosuro | | | | | |
|---|---|---|---|---|---|---|
| | Bulls | | | Cows | | |
| Body measurements | Bali | Madura | Ongole | Bali | Madura | Ongole |
| **First place (champion)** | | | | | | |
| Age, years | 5 | 3 | 4 | 3 | 4 | 5 |
| Height at withers, cm | 137 | 130 | 142 | 122 | 119 | 137 |
| Body length, cm | 143 | 131 | 164 | 121 | 135 | 149 |
| Girth, cm | 215 | 180 | 207 | 173 | 189 | 197 |
| Body weight, kg | 610 | 495 | 752 | 300 | 415 | 565 |
| **Second place (Runner up)** | | | | | | |
| Age, years | 5 | 5 | 5 | 4 | 4 | 5 |
| Height at withers, cm | 130 | 133 | 144 | 114 | 121 | 137 |
| Body length, cm | 135 | 144 | 160 | 129 | 136 | 158 |
| Girth, cm | 217 | 192 | 211 | 178 | 178 | 203 |
| Body weight, kg | 585 | 535 | 732 | 345 | 395 | 560 |
| **Third place (2nd Runner up)** | | | | | | |
| Age, years | 4 | 2.5 | 4 | 4 | 4 | 4 |
| Height at withers, cm | 133 | 128 | 144 | 111 | 121 | 124 |
| Body length, cm | 146 | 133 | 164 | 125 | 133 | 144 |
| Girth, cm | 202 | 179 | 214 | 176 | 163 | 176 |
| Body weight, kg | 495 | 375 | 615 | 285 | 340 | 425 |

| | 1980 Contest at Cipanas, West Java | | | | | |
|---|---|---|---|---|---|---|
| **First place (champion)** | | | | | | |
| Age, years | 4 | 4 | 3 | 4 | - | 4 |
| Height at withers, cm | 135 | 140 | 154 | 118 | 135 | 137 |
| Body length, cm | 142 | 152 | 161 | 125 | 149 | 160 |
| Girth, cm | 214 | 193 | 220 | 189 | 190 | 210 |
| Body weight, kg | 546 | 521 | 745 | 424 | 452 | 562 |

(continued)

Appendix table 3.20: (Continued)

| Body measurements | 1980 contest at Cipanas | | | | | |
|---|---|---|---|---|---|---|
| | Bulls | | | Cows | | |
| | Bali | Madura | Ongole | Bali | Madura | Ongole |
| Second place (Runner up) | | | | | | |
| Age, years | 4 | 4 | 4 | 3 | 4 | 4 |
| Height at withers, cm | 136 | 134 | 150 | 120 | 131 | 138 |
| Body length, cm | 151 | 165 | 177 | 125 | 142 | 156 |
| Girth, cm | 203 | 188 | 231 | 170 | 186 | 210 |
| Body weight, kg | 597 | 510 | 746 | 336 | 410 | 550 |
| Third place (2nd Runner up | | | | | | |
| Age, years | 4 | 3 | 4 | 4 | 4 | 4 |
| Height at withers, cm | 138 | 133 | 153 | 121 | 123 | 140 |
| Body length, cm | 149 | 142 | 160 | 126 | 133 | 140 |
| Girth, cm | 203 | 185 | 219 | 176 | 174 | 203.5 |
| Body weight, kg | 616 | 475 | 747 | 310 | 380 | 550. |

Source: Direktorat Bina Program (1984)

Appendix table 3.21: Production from a sample of milk producers, August, 1983.

| Province | Number lactating cows | Milk production (liters) Total/day | per day/cow | Disposition (%) for calf | family cons. | spoiled | sold |
|---|---|---|---|---|---|---|---|
| North Sumatera | 62 | 314 | 5 | 46 | 13 | 2 | 39 |
| Jakarta | 99 | 983 | 10 | 11 | 1 | - | 88 |
| West Java | 1963 | 22,240 | 11 | 9 | 1 | 0.5 | 90 |
| Central Java | 983 | 4,728 | 5 | 13 | 1 | - | 86 |
| Yogyakarta | 407 | 1,821 | 4.5 | 3 | 0.1 | .05 | 97 |
| East Java | 1622 | 16,993 | 10.5 | 10 | 2 | .36 | 88 |
| Average | - | - | 9.17 + 2.93 | 10 | 1.4 | .4 | 89 |

Source: DGLS (1984a)



5M

Appendix table 3.22: Dairy farm production costs in Java (Rp/hd/day), 1983 [a/]

| Cost Component | W. Java | C. Java | E. Java |
|---|---|---|---|
| Fixed costs: | | | |
| Depreciation | | | |
| Cattle | 158.51 | 156.00 | 156.65 |
| Cattle shed | 26.05 | 17.38 | 29.12 |
| Milk cans | 5.31 | 5.50 | 6.80 |
| Loan Amortization | 432.00 | 432.00 | 432.00 |
| Subtotal | 621.87 | 610.88 | 624.57 |
| Variable Costs: | | | |
| Pasture improvement | 38.36 | 18.60 | 26.55 |
| Forage | 112.40 | 180.00 | 114.63 |
| Feed concentrate | 533.90 | 342.70 | 649.30 |
| Labor | 405.00 | 204.24 | 413.95 |
| Farm equipment | 7.31 | 4.00 | 11.05 |
| Veterinary expenses | 3.79 | 3.70 | 3.06 |
| AI | 2.74 | 3.40 | 2.06 |
| Kerosene/others | 42.97 | 4.30 | 11.97 |
| Tax/fee | 1.03 | .30 | .68 |
| Shed rehab/expansion | 15.57 | 12.30 | 15.68 |
| Subtotal | 1,193.07 | 773.54 | 1,248.93 |
| Cost/head/day | 1,814.94 | 1,384.42 | 1,873.50 |
| Cost/head/year | 662,475.00 | 505,160.00 | 684,010.00 |
| Cost/liter: | | | |
| 2400 l/cow, 1983 average | 276.00 | 210.00 | 285.00 |
| 3500 l/cow, 1988 target | 189.00 | 144.00 | 195.00 |

Source: Kooperasi Peternakan Bandung Selatan (1983)



520

Appendix table 3.23: Estimated number of agricultural households (HH) producing small ruminants by region, 1979

| Region | Farm HH | Goat/sheep population [a] | Goat/sheep flocks [b] | Farm HH with sheep/goats |
|---|---|---|---|---|
| | (millions) | | | % |
| Java | 10,361 | 9,940 | 2,840 | 27.4 |
| W. Java | 3,246 | 3,314 | 947 | 29.2 |
| C. Java | 3,146 | 3,288 | 939 | 29.8 |
| D.I. Yogyakarta | 404 | 448 | 128 | 31.7 |
| E. Java | 3,537 | 2,890 | 826 | 23.4 |
| D.K.I. Jakarta | 26 | - | - | - |
| Sumatra | 3,570 | 886 | 253 | 7.1 |
| Kalimantan | 812 | 61 | 71 | 2.1 |
| Sulawesi | 1,323 | 333 | 95 | 7.2 |
| E. Indonesia | 1,272 | 510 | 145 | 11.4 |
| Indonesia | 17,338 | 11,730 | 3,351 | 19.3 |

Source: Knipscheer, et al. (1983)

a/ Derived assuming an average herd size of 3.5.

b/ Includes the provinces of Bali, NTB, NTT and Maluku

Appendix table 3.24: Weights of supplemented mature sheep and goats on Indonesia

| Breeds | | Male | Female |
|---|---|---|---|
| | | ----- (kg) ----- | |
| Sheep: | Thin-tailed | 40 | 30 |
| | Fat-tailed | 40 | 35 |
| Goats: | Kacang | 35 | 30 |
| | Grade Etawah | 60 | 50 |

Source : Hardjosubroto and Astuti (1979)

Table 3.25: Flock composition for selected samples of small ruminant herds/flocks

| Location | Number farms | Flock composition [a] | | | | |
|---|---|---|---|---|---|---|
| | | AM : | AF : | YM : | YF : | K/L |
| Cirebon | | | | | | |
| Sheep | 30 | 0.18 | 3.33 | 0.32 | 0.62 | 0.83 |
| Goats | 49 | 0.20 | 1.70 | 0.20 | 0.40 | 0.50 |
| Ciburuy | | | | | | |
| Sheep | 33 | 0.38 | 2.55 | 0.64 | 0.88 | 1.22 |
| Goats | 30 | 0.34 | 2.48 | 0.36 | 0.56 | 1.20 |
| Garut | | | | | | |
| Sheep | 135 | 0.37 | 2.07 | 0.37 | 0.58 | 0.74 |

Source: Knipscheer, et al (1983)
[a] AM = adult male; AF = Adult female; YM = Young male
YF = Young female; K/L = Kid or lamb



522

Appendix table 3.26: Summary of goat production traits in Indonesia

| | Forage Station Pleihari, South Kalimantan, [a] | | West Java village [b] | | Yogyakarta villages [c] | | SR-CRSP Bogor [d] | SR-CRSP Bogor [d] | |
|---|---|---|---|---|---|---|---|---|---|
| Year | 1984 | 1984 | 1981 | 1981 | 1981 | 1982 | 1982-1984 | 1983-84 | 1983-84 |
| Breed, if known | Etawah | Etawah X Local | Local Lowland | Local Upland | Local Upland | Etawah X Local | Grade Etawah | Grade Etawah | Local Goat |
| Production system | Breeding Center | Breeding Center | Semi Confined | Fully Confined | Semi-Confined | Semi-Confined | Research Station | Research Station | Research Station |
| Litter size (no.) | 1.125 | 1.17 | - | - | 1.73 | 1.70 | 1.18 | 1.32 | 1.29 |
| Kidding interval (days) | 238 | 233 | - | - | - | - | 269.5 | - | - |
| Kids/doe/year (no.) | 0.75 | 1.07 | 1.05 | 1.66 | 1.18 | 1.42 | - | - | - |
| % does giving birth/year | 66.7 | 91.3 | - | - | 68 | 83 | - | - | - |
| Kid weights (kg) | 3.72 | 2.26 | - | - | 2.4 | 2.5 | 2.51 | 3.0 | 2.0 |
| Weaning weights (kg) | 10.18 | 9.4 | - | - | 4.49 | 4.68 | 8.70 | 10.7 | 9.0 |
| Kid mortality (%) | 17.5 | 17.4 | 12 | 10 | - | - | 34.2 | 19.6 | 13.6 |
| Adult mortality (%) | - | - | 7 | 1 | - | - | - | - | - |
| Mature wt. (kg) male | - | - | - | - | 32.8 | 36.5 | - | 42.9 | 27.4 |
| female | - | - | - | - | 29.7 | 33.0 | - | 34.1 | 24.2 |

Sources: [a] Mimeo, Dinas Peternakan, Banjar Baru
[b] Knipscheer et. al. 1983
[c] Astuti. 1984
[d] Setiadi and Sitorus. 1984



523

Appendix table 3.27: <u>Reproduction parameters of sheep on some survey farms in the Garut District, West Java.</u>

| Villages: | Tenjonegara | | Sindang Ratu | | Sukawangi | |
|---|---|---|---|---|---|---|
| Dates Covered | 10/80-6/82 | 1980 - 81 | 10/80 - 9/81 | 10/80 - 9/81 | 8/81 - 6/82 | 8/81 - 6/82 |
| No. of months | 21 | 12 | 12 | 12 | 11 | 12 |
| No. Farms | 22 | 145 | 135 | 104 | 24 | 22 |
| Ewes/Ram | 3.07 | 1.87 | 2.07 | 2.30 | 2.19 | . |
| Rams//100 Ewes | 14 | n.a.[a] | 19 | 16 | 30 | 14 |
| % Ewes lambing | 66 | 65 | 61 | 61 | NA | 53 |
| Litter size | 1.9 | 1.7 | 1.6 | 1.6 | NA | 1.6 |
| % Lambs born of ewes available/ year | 126 | 109 | 96 | 98 | 109 | 85 |
| % Lambs mortality | 19 | 20 | 10 | 11 | NA | NA |
| % Lambs weaned of ewes available | 102 | 82 | 82 | 82 | 105 | 63 |

Source: Bell, <u>et. al.</u> (1983)
[a] NA = Not Available



524

Appendix table 3.31: Summary of sheep production traits in Indonesia

| | West Java a/ | West Java a/ | West Java a/ | Yogyakarta b/ | Bogor c/ | | West Java c/ | |
|---|---|---|---|---|---|---|---|---|
| Year | 1981 | 1981 | 1981 | 1981-82 | 1983-1984 | | | 1980-1982 |
| Breed, if known | Non-descript lowlands | Java thin-tailed, upland | Garut upland | Non-descript | Garut sheep | Java thin tail | Java fattail | Garut sheep upland farms |
| Prod. System, if known | Semi-confinement | Semi-confinement | Full-confinement | Semi-Confinement | Research station | Research station | Research station | - |
| Litter size | 1.28 | 1.27 | 1.69 | 1.61 | - | 2.1 | | 1.9 |
| Lambs/ewe/year (no) | 0.97 | 2.09 | 0.96 | 1.26 | - | - | | 1.25 |
| % ewes giving birth | 76 | 120 | 76 | 78 | - | - | | 66 |
| Lambs weights (kg) | - | - | - | 20 | 1.9 | 1.5 | 1.6 | - |
| Weaning weights (kg) | - | - | - | 4.88 | 7.7 | 8.3 | 8.2 | - |
| Lamb mortality (%) | 13 | 10 | 10 | - | 13.9 | 10.3 | 12.7 | 19.5 |
| Adult mortality (%) | 12 | 4 | 2.5 | - | - | - | 4.1 | |
| Mature weight (kg) | | | | | | | | |
| -male | - | - | - | 27.75 | - | - | - | - |
| -female | - | - | - | - | - | - | - | - |
| Dressing % | - | - | - | 81.3 | - | - | - | - |

Sources: a/ Knipscheer, et. al. (1983)
b/ Astuti, et. al. (1984)
c/ Tiesnamurti, et. al. (1985)

Appendix table 3.29: Estimated share of small ruminant income of total income for sheep and goat keepers at two locations in West Java, 1981 [a]

| Location | No. farms surveyed | Estimated annual income/farm 1980 | Small ruminant income 1980/81 | Small ruminant income as % of total income |
|---|---|---|---|---|
| | | ----- (Rp) ----- | | |
| Cirebon (lowland) | | | | |
| Strata I + II | 44 | 146,693 | 31,688 | 21.6 |
| Strata III | 2 | 200,906 | 26,938 | 13.4 |
| Strata IV + V | 33 | 318,899 | 43,038 | 13.5 |
| Average | 79 | 220,000 | 37,593 | 17.1 |
| Ciburuy (rubber plantations) [a] | | | | |
| Strata I - V | 66 | 180,000 | 46,671 | 25.9 |
| Garut (upland) | | | | |
| Strata I + II | 30 | 95,114 | 21,502 | 22.6 |
| Strata III | 31 | 158,376 | 35,207 | 22.2 |
| Strata IV + V | 74 | 442,391 | 45,692 | 10.3 |
| Average | (135) | 300,000 | 41,466 | 13.8 |

Source : Knipscheer, et. al. 1983.
[a] Strata - I + II: Landless and subsistence (0-0.15 ha)
III: Smallholders (0.16 - 0.30 ha)
IV: Medium landholders (0.31 - 1.00 ha)
V: Large landholders (over 1.0 ha)
[b] No estimates for total income per stratum available.



526

Appendix table 3.30: Gross farm income component at the kecamatan level in Kabupaten Deli Serdang, North Sumatra.

| | Kecamatan | | | | | |
|---|---|---|---|---|---|---|
| | Sibolangit | | Calang | | Perbaungan | |
| | Amount ('000 Rp) | Percent (%) | Amount ('000 Rp) | Percent (%) | Amount ('000 Rp) | Percent (%) |
| Food Crops | | | | | | |
| Rice | 22489.3 | 39.46 | 238055.0 | 66.19 | 223123.4 | 65.62 |
| Secondary | 2200.0 | 3.86 | 2322.0 | 0.65 | 3450.0 | 1.01 |
| Total | 24689.3 | 43.32 | 240377.5 | 66.83 | 226573.4 | 66.63 |
| Estate & Perennial Crops | | | | | | |
| Rubber | 10367.6 | 18.19 | 26697.1 | 7.42 | 0 | 0 |
| Oil Palm | 0 | 0 | 821.3 | 23.0 | 0 | 0 |
| Coffee | 217.9 | 0.38 | 0 | 0 | 0 | 0 |
| Fruit | 970.0 | 1.70 | 41068.8 | 11.42 | 78921.8 | 23.40 |
| Other | 5230.6 | 9.18 | 26798.1 | 7.45 | 650.0 | 0.19 |
| Total | 16786.1 | 29.46 | 95385.3 | 26.52 | 79571.8 | 23.40 |
| Livestock | | | | | | |
| Cattle | 1147.0 | 2.01 | 5287.5 | 1.47 | 2276.5 | 0.67 |
| Buffalo | 646.1 | 1.13 | 2196.5 | 0.60 | 3450.4 | 1.01 |
| Poultry | 4325.1 | 7.59 | 11882.4 | 3.30 | 22700.0 | 6.68 |
| Pigs | 3252.5 | 5.71 | 2429.3 | 0.68 | 0 | 0 |
| Goats | 141.6 | 0.25 | 1721.9 | 0.48 | 2338.8 | 0.69 |
| Sheep | 0 | 0 | 416.0 | 0.12 | 1121.3 | 0.33 |
| Total | 9513.0 | 16.69 | 23906.7 | 6.65 | 31887.0 | 9.38 |
| Fish Ponds | 6000.0 | 10.53 | 0 | 0 | 2000.0 | 0.59 |
| Grand total | 56988.4 | 100.00 | 359669.5 | 100.00 | 340032.2 | 100.00 |

Source: Levine and Karo - Karo (1985)



527

Appendix Table 3.31: Goat budgets (per doe) for East Kalimantan

**Parameters**

| | |
|---|---|
| Litter Size | 1,9/litter |
| Kidding interval | 8 months |
| Kids/year | 2.85 |
| Kid price at 8 months (Rp) | 25,000 |

**Income Statement**

| | |
|---|---|
| Income 1st litter (Rp) | 47,500 |
| Income 2nd litter (Rp) | 14,615 |
| Total income/year (Rp) | 62,115 |
| Losses per year at 18.4% (Rp) | 11,430 |
| Additional cost of fodder (Rp) | 5,000 |
| Gross margin (Rp) | 45,685 |
| Depreciation for stable (Rp) | 5,000 |
| Labor requirements/year | 175 hours |
| Returns to labor (Rp) | 232/hour |

Source : Ramm, et. al. (1984)

Appendix table 3.32: Annual net returns to goat recipients under different payback schemes (animals returned over 3 year period)

| | Repayment plan (animals returned/animals received) | | |
|---|---|---|---|
| | 2 / Female 1 / Male | 1 / Female 1 / Male | 0 / Female 0 / Male |
| Central Lombok | | | |
| 1980/81 | 63,300 | 79,300 | 93,300 |
| 1981/82 | 6,700 | 23,400 | 43,300 |
| 1982/83 | -37,200 | -6,225 | 30,525 |
| East Lombok | | | |
| 1980/81 | 16,600 | 30,600 | 39,290 |
| 1981/82 | -5,862 | 24,138 | 57,438 |
| 1982/83 | -58,800 | -20,825 | 25,900 |
| Both Areas | | | |
| 1980/81 | 40,950 | 54,950 | 71,330 |
| 1981/82 | 419 | 23,819 | 50,519 |
| 1982/83 | -45,840 | -12,065 | 28,710 |

Source : Levine (1984)



528

Appendix table 3.33: Breeding, feeding, health care and economic parameters of six specialized small ruminant farms (1982) [a]

| | I | II | III | IV [b] | V | VI |
|---|---|---|---|---|---|---|
| Mating [c] | h.m. | h.m. | h.m. | h.m. | h.m. | N/A |
| Weaning age (mo) | 3-4 | 3-4 | 3-4 | 3-4 | 3-4 | N/A |
| Litter size (av) | 1.8 | 2.0 | 2.0 | 1.5 | 2.0 | N/A |
| Lamb/kid interval (mo) | 6-8 | 6-7 | 11 | 8 | 8-10 | N/A |
| Lamb/kid mortality (%) | 36 | 38 | 30 | 9 | 1 | N/A |
| Age 1st mating female (mo) | 18 | 10 | N/A | 9 | 12 | N/A |
| Age 1st mating male (mo) | N/A | 12 | N/A | N/A | 18 | N/A |
| Culling age female (yrs) | 4 | N/A | 5 | 3-4 | 4 | N/A |
| Culling male (yrs) | 5 | N/A | 6 | 4-5 | 3.5 | N/A |
| Fodder supply | own grass | public grass | grass/ leaves bought | own grass | own grass | own grass or rice straw |
| Feeding: | | | | | | |
| Kg/head/day | 3.1 | 2.1 | 3.5 | 3 | 4.5 | 1 |
| Mineral supply | salt | salt | salt | salt | salt | cement/salt |
| Water | yes | yes | yes | no | no | with ampas tahu |
| No. ampas tahu feedings/day | 1 | 1 | 1 | 2 | 2 | 1 |
| Kg/head/day | 4 | 2 | 4 | 6 | 2-3 | 5 |
| Km to tahu factory | 10 | 4-5 | 4-5 | 0.5 | 10 | 5 |
| No. cleanings/month | 4 | 1/2 | 15 | 1 | 2 | 4 |
| No. veterinary checks/year | none | none | 4 | 24 | 12 | 12 |
| No. shearings/animal/year | 10 | N/A | N/A | 2 | 2 | 2 |
| Small ruminant species | sheep | goat | goat | sheep | sheep | sheep |
| Confinement | yes | yes | yes | yes | yes | yes |
| Selling age young stock (mo) | 13 | 11 | 10 | 14 | 12 | N/A |
| Cost of ampas tahu (Rp/kg) | 15 | 5 | 10 | 5 | 10 | 10 |
| Liveweight price (Rp/kg) | 800 | 1000 | 900 | 1400 | 1200 | 1100 |
| Manure price (Rp/kg) | 10 | 12 | 10 | 15 | 10 | 10 |
| Wool price (Rp/kg) [d] | N/A | N/A | N/A | N/A | 500 | 300 |

Source : Knipscheer, et. al., (1983)
[a] N/A means not available or not applicable.
[b] Farm IV buys wet ampas tahu
[c] H.M. = hand mating
[d] Farms do not sell wool

Appendix table 3.34: Budgets for six specialized small ruminant farms in Cirebon and Garut: costs and returns per adult female animal (1982)

| | Cirebon | | | Garut | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI [b] |
| Costs: | | | | | | |
| building | 7,773 | 887 | 2,667 | 7,143 | 1,667 | 1,875 |
| equipment | 1,705 | 1,313 | 2,200 | 595 | 375 | 75 |
| feed | 41,809 | 6,083 | 150,867 | 21,726 | 12,319 | 18,250 |
| salt/minerals | - | - | - | - | - | 176 |
| health care | - | 320 | 1,367 | 143 | 1,763 | 75 |
| labor | 10,909 | - | 73,000 | 19,267 | 25,585 | 8,775 |
| opportunity cost of capital | 11,250 | 4,200 | 7,000 | 8,571 | 8,344 | 4,800 |
| other | - | - | - | - | - | - |
| Total costs | 72,946 | 12,803 | 237,101 | 57,445 | 50,053 | 34,346 |
| Returns: | | | | | | |
| meat | 42,109 | 32,550 | 63,700 | 89,775 | 94,802 | 72,000 [c] |
| milk | - | - | 196,667 | - | - | - |
| manure | 6,968 | 720 | 10,220 | 8,343 | 5,977 | 3,650 |
| Total returns | 49,077 | 33,270 | 270,587 | 98,118 | 100,779 | 75,650 |
| Total profit | -23,869 | 20,467 | 33,486 | 40,673 | 50,726 | 41,304 |

[a] Source : Knipscheer, et. al., (1983)

[b] As farm VI was not a breeding farm, but specialized only is fattening adult animals, these costs and returns are calculated per adult animal rather than per adult female.

[c] This figure reflects the net weight gain per animal.



630

Appendix table 3.35: Performance of native chickens in five selected villages of East Kalimantan

| Production Parameters | Village: Melak | Bukit-Biru | Teluk-Dalam | Separi | Rimbayu | Average |
|---|---|---|---|---|---|---|
| Age at first laying (mos) | 7.6 | 5.9 | 5.8 | 6.3 | 6.1 | 6.3 |
| Eggs per laying period | 11.0 | 11.8 | 11.2 | 11.7 | 13.0 | 11.7 |
| Hatched chicks per clutch | 8.5 | 9.6 | 9.5 | 8.4 | 9.3 | 9.0 |
| Production losses | 2.4 | 2.3 | 2.6 | 2.4 | 3.0 | 2.5 |
| Avg. reared per clutch | 6.1 | 7.3 | 6.9 | 6.0 | 6.3 | 6.5 |
| Reared chicks per hen per year | 18.3 | 21.9 | 19.7 | 18.0 | 18.9 | 19.5 |

Source: Ramm, *et al.*, (1984)



(3)

Appendix table 3.36: Egg production data of kampung chickens from five West Javanese villages

| | Village | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 (1) | Average |
| No. hens | 25 | 38 | 34 | 31 | 24 | |
| Eggs laid per hen per year | 62 | 80 | 69 | 76 | 65 | 80 |
| Fate of eggs (%) | | | | | | |
| hatched | 81.0 | 82.0 | 87.8 | 96.0 | 89.3 | 87.0 |
| eaten | 10.0 | 9.7 | 4.4 | 4.0 | 3.2 | 6.0 |
| sold | 9.4 | 10.3 | 7.8 | 0.0 | 7.5 | 7.0 |
| Hatch-ability (%) | 80.7 | 80.2 | 79.9 | 85.9 | 85.5 | 82.0 |

Source: Kingston and Cresswell (1982)

Appendix table 3.37: Changes in populations of native chickens in five West Javanese villages

| | Village | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| No. birds observed | 433 | 566 | 142 | 148 | 342 |
| No adults/farmer at commencement | 15.0 | 17.6 | 7.3 | 10.5 | 11.5 |
| Losses of adults from population/month: | | | | | |
| % sold | 1.1 | 1.3 | 2.8 | 1.0 | 3.0 |
| % mortality | .01 | .01 | 2.8 | 1.0 | 2.5 |
| % lost | .06 | .26 | 0.0 | 0.0 | 0.0 |
| % stolen | 1.2 | .92 | 0.9 | 0.5 | 3.3 |
| % original population surviving 12 months | 51.4 | 54.0 | 44.0 | 48.1 | 46.3 |
| % sold at Lebaran | 12.9 | 10.3 | 9.6 | 12.2 | n.a.[a/] |
| % killed/eaten at Lebaran | 35.1 | 33.2 | 28.2 | 25.1 | n.a. |
| % total losses at Lebaran | 48.0 | 43.5 | 37.8 | 37.3 | n.a. |
| Composition of original population | | | | | |
| % adults | 69.2 | 47.0 | 72.0 | 80.2 | 58.2 |
| % 0-6 weeks | 5.8 | 23.6 | 12.2 | 0.0 | 6.5 |
| % 6-20 weeks | 25.0 | 29.4 | 15.8 | 20.8 | 25.3 |
| % females of adult population | 81.1 | 74.6 | 78.6 | 68.3 | 71.8 |
| Additions to populations | | | | | |
| % hatched | 83.0 | 95.6 | 98.0 | 100.0 | 95.6 |
| % gifts | 16.4 | 2.6 | 0.0 | 0.0 | 0.1 |
| % purchased | 0.6 | 1.8 | 2.0 | 0.0 | 0.3 |

Source: Kingston and Cresswell (1982)
[a/] N/A = data not available

Appendix table 3.38: Native chicken (ayam kampung) mortality data from five West Javanese villages

| Village | % mortality of total mortality 0-24 wks | | | % mortality of original adult pop'n |
|---|---|---|---|---|
| | 0-6 wks | 6-20 wks | 20+ wks | |
| 1 | 70.0 | 27.3 | 2.7 | 22.0 |
| 2 | 90.3 | 6.6 | 3.1 | 63.0 |
| 3 | 70.3 | 29.6 | 0.1 | 13.0 |
| 4 | 68.0 | 20.0 | 12.0 | 80.0 |
| 5 | 77.3 | 20.6 | 2.1 | 24.0 |

Source: Kingston and Cresswell (1982)

Appendix table 3.39: Body weights (gms) of native chickens at different ages at three different locations

| Age (wks) | Central Java | West Java | Kedu |
|---|---|---|---|
| 1 | 38 | 37 | 41 |
| 4 | 113 | 130 | 128 |
| 8 | 359 | 320 | 369 |
| 12 | 713 | 590 | 708 |
| 20 | 1170 | 1027 | 1220 |

Source: Hardjosubroto and Supiyono (1972); Kingston and Cresswell (1982)

Appendix table 3.40: Mean live weights of five types of local chickens (ayam kampung) to 20 weeks of age

| Breed of chicken: | Sayur | Black Kedu | White Kedu | Nunukan | Melung |
|---|---|---|---|---|---|
| No. started | 200 | :00 | 200 | 200 | 200 |
| Mortality to 20 weeks (%) a/ | 9.1 | 12.2 | 10.3 | 8.4 | 7.6 |
| Mean liveweight (g) b/: | | | | | |
| 1 day | 26.2 | 27.7 | 25.6 | 30.2 | 29.6 |
| 4 weeks | 180 | 171 | 151 | 168 | 186 |
| 8 weeks | 553 | 602 | 550 | 482 | 589 |
| 12 weeks | 1036 | 1087 | 975 | 843 | 1162 |
| 16 weeks | 1453 | 1462 | 1352 | 1304 | 1683 |
| 20 weeks | 1719 | 1753 | 1575 | 1507 | 2290 |

Source: Cresswell and Gunawan (1982)

a/ Mortality was attributed to E. coli (18%), Newcastle disease (30%), cannibalism (12%) and undiagnosed (25%)

b/ Corrected for unequal sex ratio

Appendix table 3.41: Some egg production traits of Alabio, Bali, Tegal and Khaki Campbell ducks under intensive management

| Trait | Alabio | Bali | Tegal | Khaki Campbell | s.e. (n=5) |
|---|---|---|---|---|---|
| Age (days) | | | | | |
| 5% production | 127 | 131 | 107 | 125 | 2 |
| 50% production | 169 | 148 | 132 | 142 | 3 |
| Peak weekly production (%) | 82 | 84 | 66 | 86 | - |
| Egg production to 68 weeks eggs/day/duck | 179.8 | 179.4 | 134.6 | 229.0 | 9.8 |
| Average egg weight (g) | 63.5 | 64.1 | 65.7 | 63.4 | 0.4 |
| Egg mass to 68 weeks (kg) | 11.42 | 11.50 | 8.86 | 14.52 | 0.67 |
| Feed intake (g/duck/day) | | | | | |
| 16-68 weeks | 143.4 | 150.4 | 154.7 | 147.8 | 1.3 |
| 0-68 weeks | 130.7 | 136.3 | 141.6 | 134.0 | 1.4 |
| Feed intake/egg mass (g/g) | | | | | |
| 16-68 weeks | 4.61 | 4.81 | 6.66 | 3.70 | 0.38 |
| 0-68 weeks | 5.50 | 5.70 | 7.98 | 4.20 | 0.46 |
| Feed intake/egg number (g/egg) | | | | | |
| 16-68 weeks | 292 | 308 | 437 | 235 | 23 |
| 0-68 weeks | 348 | 365 | 524 | 279 | 29 |

Source: Hetzel (1984)



536

Appendix table 3.42: Mean liveweight, feed conversion ratio and carcass characteristics of Alabio, Tegal and crossbred drakes at 4, 8, 12 and 16 weeks of age

| | Age (weeks) | Alabio | Alabio X Tegal | Tegal X Alabio | Tegal | S.E. |
|---|---|---|---|---|---|---|
| Liveweight (kg) | 4 | 0.65 | 0.67 | 0.66 | 0.74 | 0.01 |
| | 8 | 1.35 | 1.35 | 1.33 | 1.35 | 0.01 |
| | 12 | 1.59 | 1.51 | 1.54 | 1.48 | 0.02 |
| | 16 | 1.61 | 1.57 | 1.57 | 1.53 | 0.02 |
| Cumulative feed intake (kg) | 8 | 4.57 | 4.77 | 4.35 | 4.69 | 0.36 |
| | 12 | 7.90 | 8.21 | 7.49 | 7.85 | 0.31 |
| | 16 | 11.41 | 11.29 | 10.47 | 10.97 | 0.60 |
| Cumulative feed intake per kg liveweight (kg/kg) | 8 | 3.38 | 3.52 | 3.27 | 3.48 | 0.08 |
| | 12 | 4.97 | 5.42 | 4.85 | 5.42 | 0.15 |
| | 16 | 7.07 | 7.19 | 6.68 | 7.15 | 0.31 |
| Carcass weight (kg) | 8 | 0.79 (20)[a/] | 0.81 (18) | 0.78 (20) | 0.82 (18) | |
| | 12 | 0.99 (20) | 0.93 (18) | 0.95 (20) | 0.92 (18) | 0.02 |
| | 16 | 1.03 (20) | 1.04 (20) | 1.00 (20) | 0.97 (20) | |
| Dressing % | 8 | 58.6 | 60.0 | 58.6 | 60.5 | |
| | 12 | 61.5 | 62.1 | 61.1 | 63.6 | 0.06 |
| | 16 | 64.1 | 64.4 | 62.8 | 64.3 | |

Source: Hetzel (1983b)
[a/] Number of drakes



537

Appendix table 3.43: Characteristics of fully herded duck egg production systems

| System | Description | Flock size (hens) | Probable main food |
| --- | --- | --- | --- |
| Fully mobile herding | Travel all year with no home base. Follow harvest but may use swamps during lean periods or moulting. Nights spent usually in temporary camps. | 80-120 | Fallen rice and insects after harvest |
| Semi-mobile herding | Follow home harvests for part of year and travel for remainder. May use home base or swamps for lean periods or moulting | 80-120 | Fallen rice and insects after harvests |
| Home-based herding | (a) Follow local harvests all year from home base at night | 20-120 | Fallen rice and insects |
| | (b) Follow local harvests for part of year and herded in (flooded) rice fields for remainder. May be fed cassava or sago but production often low between harvests. | 20-120 | Fallen rice and insects after harvests. Weeds and frogs, etc. Energy supplement in some areas. |
| Opportunistic herding | Flock purchased prior to harvest and sold afterwards. In double-cropping areas, may be purchased in April and kept for two har vests before sale, but most people too busy to herd ducks between harvests. | 40-110 | Fallen rice and insects. Lean period if kept between two harvests |

Source: Petheram and Thahar (1983)

Appendix table 3.44: Prices for duck products, Kendal, Central Java, 1985

| Product | Value (Rp) |
|---|---|
| Feed ingredients (per kg): | |
| Rice bran | 50 |
| Small fish | 150 |
| Water weeds | 25 |
| Commercial complete feed | 470 |
| Products: | |
| Breeder eggs for hatching | 150 |
| 4 - 6 month-old hens ready to lay | 2,750 - 3,000 |
| Farmgate, fresh eggs | 100 |
| Village market, fresh eggs | 125 |
| Cull hens | 1,250 |
| Meat drakes, 6 months old | 1,500 |

Source: Interviews with producers during field visits, 1985

Appendix table 3.45: Annual enterprise budget (non-labor costs only) for semi-intensive 50-duck market egg production flock, Kec. Kendal, Central Java

| | Value (Rp) |
|---|---|
| Income: | |
| 50 ducks, average 120 eggs marketed per duck per year @Rp 100 each | 600,000 |
| 24 cull ducks sold per year (4% mortality, productive life of 2 years) at Rp 1,250 each | 30,000 |
| Total income | 630,000 |
| Costs: | |
| Fixed: | |
| Housing: Rp 50,000 over 5 years | 10,000 |
| Replacements: 25 per year @Rp 3,750 | 93,750 |
| Variable: | |
| Feed : Rp 1,000 per day | 365,000 |
| Total costs | 468,750 |
| Annual net return to labor and management | 161,250 |

Source: Field visits by study team members, 1985



540

Appendix table 3.46: Comparison of non-labor costs for purchasing and rearing a flock of 100 three-day old Alabio ducklings with purchasing 100 six-month-old Alabio ducks. Alabio, South Kalimantan

A. Cash outlay: Purchasing and rearing a flock of 100 3-day old ducklings to age six months (Rp)

| | | |
|---|---|---|
| Purchase price of 102 3-day old ducklings (assumes 2% mortality rate) | | Rp 56,100 |
| Cost of cage for 100 ducks | | 35,000 |
| Feed costs: | to age 1 month | 26,880 |
| | to age 2 months | 61,650 |
| | to age 3 months | 34,425 |
| | to age 4 months | 34,425 |
| | to age 5 months | 34,425 |
| | to age 6 months | 34,425 |
| Cost of capital | | 25,502 |
| Total | | 342,832 |

Note: Cost of capital is figured at a 27% yearly interest based on an average term of payment of four months. Figures calculated from commonly used diets. Diet assumes flock is confined in cage. Average yearly cost of each feed component is used (1982).

| | | |
|---|---|---|
| Alabio duckling, 3-day old | Rp. | 550/bird (avg.) |
| Rice bran | | 76.5/kg |
| Multivitamin-mineral mix | | 450/kg |
| Rice | | 250/kg |
| Snails | | 24/snail |

B. Cash outlay: Purchase price of 100 six-month old (ready laying eggs)

| | |
|---|---|
| Purchase price of 100 6-month old ducks [a/] | Rp 400,000 |
| Cost of cage for 100 ducks | 35,000 |
| Total | 435,000 |

Source: Vondal (1983)

[a/] 1982 price, Rp 4,000 per head, for 6-month old Alabio duck is used

Appendix table 3.47: Average monthly production rates for Alabio duck farmers of two different flock sizes in Kabupaten Hulu Sungai Utara

| | Scale I [a] | Scale II [b] |
|---|---|---|
| Average no. laying ducks | 57 | 137 |
| Average monthly eggs produced per flock | 808 | 2,317 |
| Average monthly egg production per laying duck | 14 | 16 |
| Laying rate (% of flock laying eggs) | 47.3 | 55.2 |

Source: Santoso and Suradisastra (1979)
[a] Scale I = 100 ducks per flock
[b] Scale II = 100 - 200 ducks per flock

Appendix table 3.48: Monthly costs for two different Alabio duck flock sizes in Kabupaten Hulu Sungai Utara, South Kalimantan

| | Scale I [a] | | | Scale II [b] | | |
|---|---|---|---|---|---|---|
| Cost | Rp | % of total | Rp per duck | Rp | % of total | Rp per duck |
| Feed | 24,625 | 59.2 | 432.0 | 37,807 | 67.6 | 276.0 |
| Replacement ducklings | 16,078 | 38.6 | 282.0 | 16,785 | 30.0 | 122.5 |
| Equipment and housing | 870 | 2.1 | 15.3 | 1,075 | 1.9 | 7.8 |
| Miscellaneous | 39 | 0.1 | 0.7 | 288 | 0.5 | 2.1 |
| Total | 41,612 | 100.0 | 730.0 | 59,955 | 100.0 | 408.4 |

Source: Santoso and Suradisastra (1979)
[a] Scale I = 100 ducks/flock
[b] Scale I = 100 - 200 ducks/flock

Appendix table 3.49: Average monthly economic performance for two sizes of Alabio duck egg flocks, Kabupaten Hulu Sungai Utara, South Kalimantan

| Items | Scale I [a] | Scale II [b] |
|---|---|---|
| | (Rp) | |
| Average gross income | 45,044 | 124,858 |
| Average prod'n costs | 41,612 | 55,955 |
| Monthly return to labor and management | 3,432 | 68,903 |
| per duck | 60.2 | 502.9 |

Source: Santoso and Suradistra (1979)
[a] Scale I = 100 ducks/flock, 57 ducks average
[b] Scale II = 100-200 ducks/flock, 137 ducks average

Appendix table 3.50: Egg production and mortality of ducks under intensive (I) and extensive (E) husbandry

| | | | | | | | | Eggs to 76 weeks | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Mort. (%) | |
| Farmer | Breed | Age at 5% production | Peak production | | | Mean wt | Spec. grav. | 6-24 | 24-76 |
| | | (weeks) | (%) | (wk) | (no.) | (g) | (g/ml) | -- (wks) | -- |
| E1 | Alagal | 24.[illegible] | 73 | 61 | 114 | 67.6 | 1.075 | 0 | 32 |
| | Tegal (local) | 22.6 | 73 | 55 | 127 | 69.2 | 1.078 | 13 | 32 |
| E2 | Tebio | 24.9 | 71 | 49 | 98 | 67.9 | 1.074 | 13 | 20 |
| | Tegal | 24.3 | 73 | 43 | 121 | 68.0 | 1.077 | 3 | 14 |
| I1 | Tebio | 24.4 | 80 | 32 | 114 | 66.3 | 1.072 | 4 | 14 |
| | Tegal | 24.7 | 79 | 72 | 101 | 64.9 | 1.071 | 0 | 16 |
| I2 | Tebio | 24.4 | 71 | 33 | 114 | 63.3 | 1.074 | 0 | 7 |
| | Alagal | 27.0 | 76 | 39 | 121 | 61.6 | 1.075 | 0 | 7 |
| | Tegal | 23.9 | 76 | 33 | 144 | 62.1 | 1.077 | 5 | 10 |
| | Tegal (local) | 24.9 | 64 | 58 | 105 | 63.2 | 1.081 | 46 | 45 |
| | Khaki Campbell | 23.6 | 77 | 33 | 184 | - | - | 6 | 15 |
| | Bali | 26.4 | 74 | 36 | 110 | - | - | 10 | 4 |

Source: Hetzel and Gunawan (1984)

Appendix table 3.51: Feed costs, egg returns, egg prices and profitability of ducks under intensive (I) and extensive (E) husbandry

| Farmer | Breed | Feed costs 6-24 | Feed costs 24-76 wks | Range in feed costs | Egg returns 76 weeks | Range in egg price | Gross margin 76 weeks |
|---|---|---|---|---|---|---|---|
| | | (Rp/duck) | | | | (Rp/egg) | (Rp/duck) |
| E1 | Alagal | 1225 | 2950 | 75-160 | 6740 | 40-78 | 2565 |
| | Tegal | 635 | 2420 | | 7945 | | 4890 |
| E2 | Tebio | 1185 | 2875 | 75-160 | 5815 | 40-78 | 1755 |
| | Tegal | 1165 | 2435 | | 7200 | | 3600 |
| I1 | Tebio | 840 | 3880 | 40-80 | 7800 | 50-80 | 3080 |
| | Tegal | 840 | 4130 | | 6835 | | 1865 |
| I2 | Tebio | 1365 | 6620 | 126-134 | 8070 | 85 | |
| | Alagal | 1335 | 6620 | | 8590 | 55-82 | 605 |
| | Tegal | 1395 | 7135 | | 10215 | | 1685 |
| | Tegal (local) | 1580 | 8370 | | 7385 | | -2565 |
| | Khaki Campbell | 1405 | 6890 | | 12185 | 48-78 | 3890 |
| | Bali | 1360 | 6765 | | 7130 | | -995 |

Note: Rp 625 = 1 $ U.S. at time of study
Source: Hetzel and Gunawan (1984)

Appendix table 3.52: Some performance estimates for pigs in Indonesia

| | Wamenen forest pigs Irian Jaya | NTT Livestock Dev. Project a/ unimproved | Improved | Ambon commercial unit b/ | Medan commercial unit b/ | Traditional Batak N. Sumatra b/ | Semi-improved Aceh b/ | Bandung commercial Unit b/ | Malang commercial Unit b/ |
|---|---|---|---|---|---|---|---|---|---|
| **Reproduction:** | | | | | | | | | |
| Age at first farrowing (years) | 1.5 | 1.5 | 1 | 1 | 1 | 2 | 1 | 1 | 1 |
| Inter-farrowing period (months) | 6 | 6 | 8 | 6 | 6.7 | 12 | 7 | 6 | 6 |
| Litter size | 6 to 7 | 4.5 | 4 to 10 | 8 to 10 | 10.2 | 6 | 8 to 10 | 10 to 12 | 10 to 12 |
| Litters/year | 2.6 | 2 | 4.5 | 2 | 1.8 | 1 | 1.7 | 2 | 2 |
| Total litters/sow lifetime | 5 | 5 | 6 | 6 | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Mortalities (%):** | | | | | | | | | |
| Piglets | 50 to 60 | 30 | 20 | 20 | 10 | 20 | 20 | 25 | 20 to 25 |
| Weaners | 1 to 2 | 3 | 3 | 2 to 3 | 1 | n.a. | n.a. | n.a. | 5 |
| Sows | 0 | 1 | 1 | 1 | n.a. | n.a. | n.a. | n.a. | n.a. |
| **Animal weights (kg):** | | | | | | | | | |
| Birth weight | .05 | .05 | .1 | .1 | n.a. | n.a. | n.a. | n.a. | n.a. |
| 3 months | 5 | 6 | 10 | 11 | n.a. | n.a. | n.a. | n.a. | n.a. |
| 6 months | 10 | 12 | 20 | 30 | n.a. | n.a. | n.a. | n.a. | n.a. |
| 7 months | 0 | n.a. | n.a. | n.a. | 100 | n.a. | n.a. | n.a. | n.a. |
| 8 months | 0 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| 10 months | 40 to 50 | 24 | 40 | 90 | n.a. | n.a. | 100 | 90 | n.a. |
| 12 months | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| 18 months | 45 | 50 | 80 to 100 | 130 | n.a. | 35 | n.a. | n.a. | 150 |
| 2 years | 55 | 60 | 120 | 140 | n.a. | 45 | n.a. | n.a. | n.a. |

(continued)

Appendix table 3.52: (Continued)

| | Wamenen forest pigs Irian Jaya | NTT Livestock Dev. Project [a] unimproved | Improved | Ambon commercial unit [b] | Medan commercial unit [b] | Traditional Batak N. Sumatra [b] | Semi-improved Aceh [b] | Bandung commercial Unit [b] | Malang commercial Unit [b] |
|---|---|---|---|---|---|---|---|---|---|
| **Age at sale:** | | | | | | | | | |
| Weaners (months) | 11 to 12 | 3 to 6 | 3 to 6 | 3 | n.a. | n.a. | n.a. | n.a. | n.a. |
| Surplus boars (years) | 2 | 1 to 2 | 1 to 2 | 1 to 2 | n.a. | n.a. | n.a. | n.a. | n.a. |
| Cull Sows (years) | n.a. | 4 | 4 | 4 | n.a. | n.a. | n.a. | n.a. | n.a. |
| Cull boars (years) | n.a. | 4 | 4 | 4 | n.a. | n.a. | n.a. | n.a. | n.a. |
| Fattened pigs (months) | n.a. | n.a. | n.a. | 10 | 7 | 18 | 10. | 8 | 18 |
| **Offtake rate:** | | | | | | | | | |
| Piglets weaned /sow/year | 5 to 7 | 6 to 7 | 5 to 12 | 13 to 16 | 16.5 | 5 | 11 to 14 | 16.5 | 15 |
| Kg. meat /sow/year | 110 to 160 | 80 to 90 | 120 to 200 | 700 to 860 | 990 | 88 | 660 to 840 | 890 | 900 |
| Dressing % | N/A | 52 | 60 | 60 | 60 | 50 | 60 | 60 | 60 |

Sources: [a] ACIL (1983)
[b] Team Interviews on the field
[c] NA represents not available or negligible quantity.

APPENDIX 4

TABLES FOR CHAPTER IV:

FEED RESOURCE BASE IN THE AGRICULTURAL SECTOR

Appendix table 4.1: Area harvested ('000 ha), production ('0000 t) and yield (100 kg/ha) of food crops, 1978 - 1982

| Crop | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| Rice - wetland | | | | | |
| Area harvested | 7,698 | 7,675 | 7,824 | 8,191 | 7,823 |
| Production | 24,172 | 24,731 | 27,993 | 30,989 | 31,776 |
| Yield | 31.40 | 32.22 | 35.78 | 37.83 | 40.36 |
| Rice - dryland | | | | | |
| Area harvested | 1,230 | 1,128 | 1,181 | 1,191 | 1,116 |
| Production | 1,599 | 1,551 | 1,659 | 1,785 | 1,808 |
| Yield | 13.00 | 13.74 | 14.05 | 14.00 | 16.20 |
| Maize | | | | | |
| Area harvested | 3,025 | 2,594 | 2,735 | 2,955 | 2,061 |
| Production | 4,029 | 3,606 | 3,934 | 4,509 | 3,235 |
| Yield | 13.32 | 13.90 | 14.60 | 15.26 | 15.69 |
| Cassava | | | | | |
| Area harvested | 1,383 | 1,439 | 1,413 | 1,386 | 1,324 |
| Production | 12,902 | 13,750 | 13,774 | 13,301 | 12,988 |
| Yield | 93 | 96 | 98 | 96 | 98 |
| Soybeans | | | | | |
| Area harvested | 733 | 785 | 732 | 810 | 608 |
| Production | 617 | 680 | 653 | 704 | 521 |
| Yield | 8.41 | 8.67 | 8.91 | 8.69 | 8.58 |
| Peanuts | | | | | |
| Area harvested | 506 | 473 | 506 | 508 | 461 |
| Production | 446 | 424 | 470 | 475 | 437 |
| Yield | 8.80 | 8.97 | 9.28 | 9.34 | 9.47 |
| Sweet potatoes | | | | | |
| Area harvested | 301 | 287 | 276 | 274 | 220 |
| Production | 2,029 | 2,194 | 2,078 | 2,094 | 1,676 |
| Yield | 69 | 76 | 76 | 76 | 76 |

Source: Biro Pusat Statistiks (1983).

Appendix table 4.2. Food crops production in Indonesia, 1983

| Crop | Production ('000 tons) | Harvested ('000 ha) | Yield (tons/ha) |
|---|---|---|---|
| Milled rice | 23,961 | 9,102 | 2.63 |
| - wetland | 22,582 | 7,941 | 2.84 |
| - dryland | 1,378 | 1,162 | 1.19 |
| Maize [a] | 5,095 | 3,018 | 1.69 |
| Soybean [a] | 568 | 633 | 0.90 |
| Peanut [a] | 476 | 484 | 0.98 |
| Mungbean [a] | 169 | 272 | 0.63 |
| Cassava [b] | 11,651 | 1,185 | 9.83 |
| Sweet potato [b] | 2,044 | 261 | 7.83 |

Source: Directorate General of Food Crops (1984)
a/ Dry grain
b/ Fresh root

Appendix table 4.3: Area harvested, yield per hectare and total annual production for food crops, Indonesia, 1974-1976 and 1982-1984

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| **Cereals:** | | | | | |
| Area harvested | ('000 ha) | 10,949 | 11,059 | 12,129 | 12,208 |
| Yield | ( kg/ha) | 2,338 | 3,330 | 3,326 | 3,400 |
| Production, | ('000 t) | 25,598 | 36,824 | 40,337 | 41,505 |
| **Rice (paddy)** | | | | | |
| Area harvested | ('000 ha) | 8,458 | 8,988 | 9,102 | 9,700 |
| Yield | ( kg/ha) | 2,685 | 3,736 | 3,871 | 3,866 |
| Production | ('000 t) | 22,705 | 33,584 | 35,237 | 37,500 |
| **Maize** | | | | | |
| Area harvested | ('000 ha) | 2,396 | 2,061 | 3,018 | 2,500 |
| Yield | ( kg/ha) | 1,181 | 1,569 | 1,688 | 1,600 |
| Production | ('000 t) | 2,829 | 3,235 | 5,095 | 4,000 |
| **Sorghum** | | | | | |
| Area harvested | ('000 ha) | 13,000 | 5,000 | 5,000 | 4,000 |
| Yield | ( kg/ha) | 600 | 600 | 600 | 625 |
| Production | ('000 t) | 8,000 | 3,000 | 3,000 | 3,000 |
| **Roots & Tubers** | | | | | |
| Area harvested | ('000 ha) | 1,897 | 1,628 | 1,588 | 1,769 |
| Yield | ( kg/ha) | 8,360 | 9,312 | 9,293 | 9,339 |
| Production | ('000 t) | 15,861 | 15,164 | 14,756 | 16,521 |
| **Sweet Potatoes** | | | | | |
| Area harvested | ('000 ha) | 315 | 220 | 261 | 268 |
| Yield | ( kg/ha) | 7,708 | 7,629 | 7,839 | 7,649 |
| Production | ('000 t) | 2,428 | 1,676 | 2,044 | 2,050 |

(continued)

Appendix table 4.3: (Continued)

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| **Cassava** | | | | | |
| Area harvested | ('000 ha) | 1,424 | 1,324 | 1,242 | 1,420 |
| Yield | ( kg/ha) | 8,840 | 9,812 | 9,845 | 9,859 |
| Production | ('000 t) | 12,589 | 12,988 | 12,229 | 14,000 |
| **Potatoes** | | | | | |
| Area harvested | ('000 ha) | 27 | 25 | 23 | 26 |
| Yield | ( kg/ha) | 7,095 | 8,000 | 7,533 | 7,538 |
| Production | ('000 t) | 188 | 200 | 173 | 196 |
| **Legumes and Pulses** | | | | | |
| Area harvested | ('000 ha) | 297 | 345 | 363 | 348 |
| Yield | ( kg/ha) | 1,026 | 875 | 832 | 860 |
| Production | ('000 t) | 304 | 302 | 302 | 299 |
| **Beans, dry** | | | | | |
| Area harvested | ('000 ha) | 288 | 336 | 355 | 340 |
| Yield | ( kg/ha) | 1,039 | 884 | 839 | 868 |
| Production | ('000 t) | 300 | 297 | 298 | 295 |
| **Soybeans** | | | | | |
| Area harvested | ('000 ha) | 717 | 608 | 633 | 707 |
| Yield | ( kg/ha) | 789 | 858 | 898 | 870 |
| Production | ('000 t) | 566 | 521 | 568 | 615 |
| **Groundnuts in shell** | | | | | |
| Area harvested | ('000 ha) | 433 | 461 | 484 | 507 |
| Yield | ( kg/ha) | 1,331 | 1,578 | 1,640 | 1,617 |
| Production | ('000 t) | 576 | 728 | 793 | 820 |

(continued)

Appendix table 4.3: (continued)

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| <u>Copra</u> | | | | | |
| Area harvested | ('000 ha) | na | na | na | na |
| Yield | ( kg/ha) | na | na | na | na |
| Production | ('000 t) | 981 | 1,200 | 1,070 | 800 |
| <u>Coconuts</u> | | | | | |
| Area harvested | ('000 ha) | na[b/] | na | na | na |
| Yield | ( kg/ha) | na | na | na | na |
| Production | ('000 t) | 9,294 | 11,700 | 11,000 | 9,600 |
| <u>Sesame</u> | | | | | |
| Area harvested | ('000 ha) | 22 | 30 | 25 | 30 |
| Yield | ( kg/ha) | 318 | 300 | 320 | 300 |
| Production | ('000 t) | 7 | 9 | 8 | 9 |
| <u>Seed cotton</u> | | | | | |
| Area harvested | ('000 ha) | 10 | 31 | 36 | 30 |
| Yield | ( kg/ha) | 499 | 673 | 745 | 588 |
| Production | ('000 t) | 5 | 21 | 27 | 18 |
| <u>Palm Kernels</u> | | | | | |
| Area harvested | ('000 ha) | na | na | na | na |
| Yield | ( kg/ha) | na | na | na | na |
| Production | ('000 t) | 79,933 | 151,222 | 155,298 | 220,000 |
| <u>Palm Oil</u> | | | | | |
| Area harvested | ('000 ha) | na | na | na | na |
| Yield | ( kg/ha) | na | na | na | na |
| Production | ('000 t) | 308,793 | 824,004 | 902,546 | 1,000,000 |

(continued)

Appendix table 4.3: (continued)

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| **Cabbages** | | | | | |
| Area harvested | ('000 ha) | 22 | 28 | 31 | 30 |
| Yield | ( kg/ha) | 11,080 | 11,246 | 10,656 | 10,667 |
| Production | ('000 t) | 243 | 316 | 325 | 320 |
| **Tomatoes** | | | | | |
| Area harvested | ('000 ha) | 14 | 22 | 24 | 23 |
| Yield | ( kg/ha) | 4,676 | 4,690 | 4,979 | 5,000 |
| Production | ('000 t) | 63 | 103 | 117 | 115 |
| **Cucumbers** | | | | | |
| Area harvested | ('000 ha) | 26 | 25 | 25 | 26 |
| Yield | ( kg/ha) | 6,327 | 5,782 | 6,760 | 6,667 |
| Production | ('000 t) | 164 | 145 | 169 | 170 |
| **Sugarcane** | | | | | |
| Area harvested | ('000 ha) | 104 | 255 | 275 | 278 |
| Yield | ( kg/ha) | 130,312 | 85,467 | 88,984 | 84,345 |
| Production | ('000 t) | 13,513 | 21,794 | 24,470 | 23,726 |
| **Coffee, green** | | | | | |
| Area harvested | ('000 ha) | 302 | 616 | 539 | 548 |
| Yield | ( kg/ha) | 566 | 514 | 437 | 600 |
| Production | ('000 t) | 171 | 265 | 236 | 329 |
| **Cocoa beans** | | | | | |
| Area harvested | ('000 ha) | 8 | 24 | 25 | 29 |
| Yield | ( kg/ha) | 449 | 610 | 608 | 552 |
| Production | ('000 t) | 4 | 15 | 15 | 16 |

(continued)

Appendix table 4.3: (continued)

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| **Tea** | | | | | |
| Area harvested | ('000 ha) | 83 | 86 | 96 | 96 |
| Yield | ( kg/ha) | 955 | 1,066 | 935 | 1,193 |
| Production | ('000 t) | 80 | 92 | 90 | 115 |
| **Eggplant** | | | | | |
| Area harvested | ('000 ha) | 33 | 33 | 33 | 33 |
| Yield | ( kg/ha) | 3,282 | 3,714 | 4,000 | 4,000 |
| Production | ('000 t) | 107 | 123 | 130 | 130 |
| **Chillies** | | | | | |
| Area harvested | ('000 ha) | 105 | 100 | 100 | 102 |
| Yield | ( kg/ha) | 2,454 | 2,000 | 2,000 | 2,010 |
| Production | ('000 t) | 257 | 200 | 200 | 205 |
| **Onions, dry** | | | | | |
| Area harvested | ('000 ha) | 40 | 46 | 49 | 50 |
| Yield | ( kg/ha) | 4,128 | 3,365 | 4,286 | 4,280 |
| Production | ('000 t) | 166 | 156 | 210 | 214 |
| **Green beans** | | | | | |
| Area harvested | ('000 ha) | 7 | 11 | 11 | 11 |
| Yield | ( kg/ha) | 3,845 | 3,810 | 3,810 | 3,805 |
| Production | ('000 t) | 26 | 40 | 40 | 43 |
| **Carrots** | | | | | |
| Area harvested | ('000 ha) | 3 | 6 | 6 | 7 |
| Yield | ( kg/ha) | 8,535 | 7,795 | 7,813 | 8,000 |
| Production | ('000 t) | 23 | 50 | 50 | 52 |

(continued)

Appendix table 4.3: (continued)

| | | 1974-76 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|
| **Tobacco leaves** | | | | | |
| Area Harvested | ('000 ha) | 182 | 210 | 215 | 216 |
| Yield | ( kg/ha) | 452 | 530 | 604 | 545 |
| Production | ('000 t) | 82 | 111 | 130 | 118 |
| **Oranges** | | | | | |
| Area harvested | ('000 ha) | n.a. | n.a. | n.a. | n.a. |
| Yield | ( kg/ha) | n.a. | n.a. | n.a. | n.a. |
| Production | ('000 t) | 138 | 343 | 390 | 380 |
| **Raw Sugar** | | | | | |
| Area harvested | ('000 ha) | n.a. | n.a. | n.a. | n.a. |
| Yield | ( kg/ha) | n.a. | n.a. | n.a. | n.a. |
| Production | ('000 t) | 1,037 | 1,629 | 1,643 | 1,675 |
| **Pineapple** | | | | | |
| Area harvested | ('000 ha) | n.a. | n.a. | n.a. | n.a. |
| Yield | ( kg/ha) | n.a. | n.a. | n.a. | n.a. |
| Production | ('000 t) | 118 | 297 | 230 | 299 |
| **Banana** | | | | | |
| Area harvested | ('000 ha) | n.a. | n.a. | n.a. | n.a. |
| Yield | ( kg/ha) | n.a. | n.a. | n.a. | n.a. |
| Production | ('000 t) | 1,719 | 2,033 | 1,900 | 2,000 |
| **Natural Rubber** | | | | | |
| Area harvested | ('000 ha) | n.a. | n.a. | n.a. | n.a. |
| Yield | ( kg/ha) | n.a. | n.a. | n.a. | n.a. |
| Production | ('000 t) | 976 | 861 | 994 | 1,150 |

Source: FAO (1985a). Production Yearbooks (various issues)
b/ na: data not available

Appendix table 4.4: Land utilization, by province, Indonesia, 1983

| Province | Total | Irrigated land | Garden/ bare land | Estates | Forests | Grassland | Swamps | Shifting cult. | Others [a] |
|---|---|---|---|---|---|---|---|---|---|
| W. Java | 4,457 | 1,209 | 702 | 358 | 928 | 68 | 383 | 238 | 584 |
| Cent. Java | 3,168 | 1,014 | 781 | 73 | 535 | 4 | 3 | 5 | 147 |
| Yogya | 312 | 66 | 106 | 2 | 19 | - | - | - | 312 |
| E. Java | 4,176 | 1,190 | 1,061 | 171 | 187 | 6 | 5 | 21 | 285 |
| Bali | 562 | 99 | 156 | 110 | 120 | 2 | - | - | 112 |
| NTB | 1,594 | 187 | 147 | 45 | 875 | 120 | 2 | 28 | 170 |
| NTT | 4,423 | 70 | 241 | 152 | 911 | 785 | 6 | 266 | 1,950 |
| Aceh | 6,181 | 272 | 313 | 363 | 3,680 | 155 | 133 | 104 | 762 |
| N. Sumatra | 7,052 | 450 | 454 | 624 | 3,472 | 357 | 230 | 234 | 1,402 |
| W. Sumatra | 4,209 | 209 | 194 | 178 | 2,381 | 48 | 42 | 70 | 2,381 |
| S. Sumatra | 10,925 | 308 | 223 | 796 | 3,068 | 147 | 2,337 | 142 | 12,110 |
| Lampung | 3,162 | 146 | 294 | 219 | 918 | 140 | 141 | 210 | 1,015 |
| Bengkulu | 1,895 | 66 | 55 | 40 | 595 | 10 | 76 | 33 | 617 |
| Jambi | 4,849 | 146 | 175 | 563 | 2,924 | 54 | 120 | 68 | 555 |
| Riau | 7,578 | 130 | 200 | 825 | 4,339 | 5 | 570 | 55 | 1,173 |
| W. Kalimantan | 13,897 | 234 | 192 | 286 | 6,799 | 34 | 1,180 | 183 | 4,987 |
| S. Kalimantan | 2,287 | 313 | 134 | 134 | 731 | 54 | 326 | 59 | 445 |
| E. Kalimantan | 15,172 | 197 | 34 | 648 | 12,210 | 68 | 259 | 93 | 1,343 |
| C. Kalimantan | 15,342 | 94 | 127 | 550 | 10,665 | 148 | 771 | 112 | 1,293 |
| N. Sulawesi | 2,298 | 43 | 109 | 286 | 1,201 | 88 | 15 | 101 | 399 |
| Cent. Sulawesi | 4,619 | 41 | 53 | 116 | 2,962 | 85 | 55 | 57 | 501 |
| S.E. Sulawesi | 4,522 | 16 | 73 | 34 | 2,650 | 125 | 24 | 56 | 1,214 |
| S. Sulawesi | 7,285 | 545 | 579 | 296 | 2,728 | 359 | 110 | 346 | 2,184 |

Source: Biro Pusat Statistiks (1984)
[b] Others include ponds, canals, and other land not classified.



557

Appendix table 4.5: Yields of agricultural residues (dry matter basis) in relation to consumable product yields for four eco-systems on Java, Madura and Bali

| Crop | Wet lowlands | Wet highlands | Dry lowlands | Dry highlands | Weighted average |
|---|---|---|---|---|---|
| Rice (IR) | | | | | |
| Grain yield (t/ha) | 4.53 | 4.85 | 4.96 | 5.68 | 4.91 |
| Straw (t/ha) | 3.82 | 3.92 | 3.69 | 4.28 | 3.86 |
| Straw as % of grain | 84.3 | 80.1 | 74.3 | 75.3 | 78.6 |
| Rice (upland) | | | | | |
| Grain yield (t/ha) | - | 2.34 | 2.53 | 1.24 | 2.04 |
| Straw (t/ha) | - | 3.52 | 2.48 | 1.83 | 2.76 |
| Straw as % of grain | - | 150.4 | 102.1 | 148.8 | 135.3 |
| Rice (local) | | | | | |
| Grain yield (t/ha) | 3.51 | 3.80 | 5.15 | 4.55 | 4.16 |
| Straw (t/ha) | 3.42 | 6.86 | 6.64 | 6.08 | 5.97 |
| Straw as % of grain | 97.4 | 180.5 | 128.9 | 133.6 | 143.5 |
| Corn | | | | | |
| Grain (t/ha) | 1.51 | 3.96 | 1.76 | 2.46 | 2.28 |
| Stover (t/ha)[a/] | 0.90 | 1.10 | 0.65 | 0.81 | 0.86 |
| Stover as % of grain | 59.6 | 27.8 | 36.9 | 32.9 | 37.7 |
| Sorghum | | | | | |
| Grain (t/ha) | 1.37 | 0.95 | 1.46 | - | 1.31 |
| Stover (t/ha) | 3.11 | 2.15 | 2.44 | - | 2.62 |
| Stover as % of grain | 227.0 | 226.3 | 167.1 | - | 200.0 |
| Peanut | | | | | |
| Grain (t/ha) | 1.53 | 1.15 | 1.19 | 1.61 | 1.37 |
| Vines (t/ha) | 1.45 | 4.86 | 2.19 | 2.37 | 2.14 |
| Vines as % of grain | 94.8 | 422.6 | 184.0 | 147.2 | 156.2 |

(Continued)

Appendix table 4.5. (Continued)

| Crop | Wet lowlands | Wet highlands | Dry lowlands | Dry highlands | Weighted average |
|---|---|---|---|---|---|
| Soybean | | | | | |
| Grain (t/ha) | 0.83 | - | 0.65 | - | 0.72 |
| Vines (t/ha) | 1.54 | - | 1.62 | - | 1.59 |
| Vines as % of grain | 185.5 | - | 2.49 | - | 2.21 |
| Sweet potato | | | | | |
| Tuber (t/ha)[b] | 15.50 | 24.96 | 16.36 | 24.04 | 20.05 |
| Vines (t/ha) | 1.56 | 1.61 | 2.29 | 1.27 | 1.81 |
| Vines as % of tubers | 10.2 | 4.5 | 14.0 | 5.3 | 9.0 |
| Cassava | | | | | |
| Tubers (t/ha) [b] | 25.56 | 35.14 | 23.79 | 26.81 | 26.95 |
| Tops (t/ha) | 0.63 | 1.12 | 0.65 | 1.83 | 0.92 |
| Residue as % of tubers | 2.5 | 3.2 | 2.7 | 6.8 | 3.4 |
| Sugar cane | | | | | |
| Sugar cane (t/ha) | 75.54 | - | 83.16 | - | 81.84 |
| Cane tops (t/ha) | 3.21 | - | 3.95 | - | 3.80 |
| Tops as % of cane | 4.2 | - | 4.7 | - | 4.6 |

Source: DBPP/FPGM (1983)
a/ Part of the plant actually used, excluding bottom part of the stem
b/ Fresh weigh basis

Appendix table 4.6. Estimated annual dry matter production of agricultural residues on Java, Madura and Bali

| Residue | Area planted | Estimated DM yield | |
|---|---|---|---|
| | | per ha [a] | Total |
| | (ha) | (tons) | ('000 tons) |
| Paddy rice straw | 4,813,391 | 3.86 | 18,580 |
| Upland rice straw | 256,994 | 2.76 | 704 |
| Corn stover | 1,913,260 | 0.86 | 645 |
| Sorghum stover | 36,350 | 2.62 | 95 |
| Cassava tops | 1,009,414 | 0.92 | 928 |
| Sweet potato vines | 130,713 | 1.81 | 237 |
| Peanut vines | 377,127 | 2.14 | 807 |
| Soybean vines | 620,246 | 1.59 | 986 |
| Sugar cane tops | 182,037 | 3.80 | 692 |
| Total DM from crop by-products | | | 24,675 |

Source: DBPP/FPGM, 1983

[a] Based on coefficients from appendix table 4.5



560

Appendix table 4.7: Estimated percent TDN and in vitro dry matter (IVDMD) and organic matter (IVOMD) digestibilities for agricultural residues on Java, Madura and Bali [a]

| Residue | TDN [b/c] | IVDMD [b] | IVOMD [b] |
|---|---|---|---|
| | (% of DM) | | |
| Paddy rice straw | 43.4 | 39.2 | 37.1 |
| Upland rice straw | | - | - |
| Corn stover [e] | 51.1 | 49.2 | 44.7 |
| Sorghum stover | 49.4 | 40.5 | 38.0 |
| Peanut vines | 56.1 | 52.9 | 48.5 |
| Soybean vines | 51.2 | 49.0 | 44.3 |
| Sweet potato vines | 57.3 | 60.0 | 53.4 |
| Cassava tops | 60.3 | 49.1 | 44.6 |
| Sugar cane tops | 54.0 | 51.4 | 42.7 |

Source: DBPP/FPGM, 1983

a/ Weighted average of samples from four ecosystems: wet lowlands, wet highlands, dry lowlands and dry highlands

b/ TDN = Total digestible nutrients; IVDMD = In vitro dry matter digestibility; IVDOM = In vitro organic matter digestibility

c/ Derived from regression equations relating TDN to chemical composition by L.E. Harris, Utah State University

d/ Part of plant actually used, excluding bottom of stem

Appendix table 4.8: Critical mineral levels and mineral composition of crop by-products fed to small ruminants in Garut, West Java (dry matter basis)

| Sample date | Description: Common name | Description: Bahasa Indonesia | Ca | P | Mg | K | Na | S | Fe | Cu | Zn | Mn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | | | | | | (ppm) | | | |
| Critical levels [a]: | | | 0.30 | 0.25 | 0.20 | 0.60 | 0.06 | - | 30 | 10 | 30 | 20 |
| Sept | Papaya leaves | Daun papaya | 2.50 | 0.40 | 1.20 | 3.06 | 0.04 | 0.69 | 640 | 11 | 40 | 98 |
| Sept | Cassava leaves | Daun singkong | 1.47 | 0.30 | 0.33 | 2.12 | 0.04 | 0.50 | 570 | 12 | 38 | 140 |
| June | Peanut vines | Jerami kacang tanah | - | - | 0.88 | - | - | - | 310 | 20 | 34 | 117 |
| Oct | Cassava leaves | Daun singkong | 1.95 | 0.60 | 0.77 | 1.91 | 0.03 | 0.41 | 330 | 18 | 160 | 140 |
| Nov | Potato vines | Daun kentang | 2.42 | 0.32 | 1.02 | 3.80 | 0.04 | 0.40 | 2370 | 61 | 45 | 270 |
| Oct | Bean vines | Daun kec. merah | - | - | 1.70 | - | - | - | 1470 | 20 | 37 | 81 |
| July | Cassava leaves | Daun singkong | - | - | 0.69 | - | - | - | 2030 | 25 | 48 | 141 |
| Aug | Cassava leaves | Daun singkong | - | - | 0.74 | - | - | - | 1300 | 15 | 76 | 119 |
| Jan | Sw. pot. vines | Daun ubi jalar | - | - | 0.56 | - | - | - | 1160 | 30 | 50 | 72 |
| Dec | Corn leaves | Daun jagung | - | - | 0.56 | - | - | - | 1010 | 7 | 23 | 61 |
| Dec | Corn stover | Jerami jagung | 0.50 | 0.31 | 0.27 | 2.71 | 0.02 | 0.18 | 330 | 12 | 24 | 36 |
| Nov | Corn leaves | Daun jagung | - | - | 0.82 | - | - | - | 1770 | 10 | 39 | 67 |
| Dec | Corn leaves | Daun jagung | - | - | 0.48 | - | - | - | 1270 | 7 | 8 | 115 |
| Jan | Peanut vines | Jerami kacang tanah | 1.43 | 0.27 | 0.61 | 2.64 | 0.03 | 0.21 | 1370 | 12 | 39 | 70 |
| Jan | Corn leaves | Daun jagung | 0.40 | 0.44 | 0.35 | 2.83 | 0.02 | 0.18 | 650 | 11 | 42 | 51 |
| Jan | Corn leaves | Daun jagung | 0.77 | 0.24 | 0.47 | 1.56 | 0.04 | 0.30 | 260 | 15 | 25 | 53 |
| Jan | Peanut vines | Jerami kac. | - | - | 0.48 | - | - | - | 420 | 41 | 24 | 352 |
| Jan | Peanut vines | Jerami kacang tanah | 0.90 | 0.31 | 0.49 | 3.10 | 0.11 | 0.26 | 2680 | 12 | 40 | 210 |

Source: Prabowo, et. al. (1984)

[a] Critical levels as per McDowell and Conrad, 1977



562

Appendix table 4.9: Estimated production (tons per ha) of total protein (TP), total digestible nutrients (TDN), digestible dry matter (DDM) and digestible organic matter (DOM) on Java, Madura and Bali [a]

| Residue | Estimated total yield | Total protein | TDN | DDM | DOM |
|---|---|---|---|---|---|
| | (tons per ha) | | | | |
| Paddy rice straw | 18,580.0 | 838.0 | 8,069.3 | 7,283.4 | 6,885.8 |
| Upland rice straw [b] | 703.9 | 31.8 | 305.7 | 275.9 | 280.9 |
| Corn stover [c] | 1,645.4 | 122.4 | 359.3 | 809.4 | 735.8 |
| Sorghum stover | 95.2 | 4.2 | 47.0 | 38.5 | 36.2 |
| Peanut vines | 928.7 | 189.4 | 559.7 | 456.2 | 414.5 |
| Soybean vines | 236.6 | 26.7 | 135.6 | 141.9 | 126.3 |
| Sweet potato vines | 807.0 | 89.4 | 452.8 | 426.6 | 391.4 |
| Cassava tops | 986.2 | 104.1 | 505.2 | 483.1 | 436.6 |
| Sugar cane tops | 691.7 | 38.9 | 373.7 | 355.4 | 295.2 |
| Total | 24,674.7 | 1,444.9 | 10,808.4 | 10,270.5 | 9,582.5 |

Source: DBPP/FPGM (1983)

[a] Values for CP, TDN, DDM and DOM derived from estimated yield times coefficients from appendix tables 4.8 and 4.9.

[b] Values for coefficients for CP, TDN, DDM and DOM of upland rice straw assumed same as those for paddy rice

[c] Part of plant actually used, excluding bottom of stem

Appendix table 4.10: Use of agricultural residues in livestock diets in four ecosystems of Java, Madura and Bali

| Location | Grass | Rice straw | Corn stover | Cassava tops | Sugar cane tops | Peanut vines | Sweet potato vines |
|---|---|---|---|---|---|---|---|
| | (% of diet, as fed basis) | | | | | | |
| Wet lowlands | | | | | | | |
| Bogor | 52.4 | 23.8 | 4.8 | - | - | 9.5 | 9.5 |
| Tasikmalaya | 57.5 | 32.0 | 1.8 | - | - | - | 8.8 |
| Kebumen | 57.5 | 25.5 | 4.3 | - | - | - | 12.8 |
| Kulon Progo | 25.0 | 12.5 | 12.5 | - | - | - | 50.0 |
| Mojokerto | 50.0 | - | - | - | - | - | - |
| Jember | 56.9 | 6.2 | 6.2 | - | - | 21.5 | - |
| Wet highlands | | | | | | | |
| Sukabumi | 64.8 | 20.4 | 20.4 | - | - | 3.7 | 3.7 |
| Temanggung | 54.5 | 0.1 | 0.1 | - | - | - | 9.1 |
| Salatiga | 36.5 | 9.5 | 9.5 | - | - | 12.2 | 16.2 |
| Malang | 62.5 | - | - | - | - | - | 37.5 |
| Dry lowlands | | | | | | | |
| Cirebon | 71.9 | 5.3 | 7.0 | - | - | 4.9 | 15.8 |
| Karawang | 73.2 | 9.8 | 4.9 | - | - | 4.9 | 7.3 |
| Demak | 65.0 | 5.0 | 5.0 | 5.0 | - | - | 20.0 |
| Wonogiri | 39.7 | 22.2 | 9.5 | - | | 19.0 | 9.5 |
| Klaten | 41.0 | 34.6 | 5.1 | 3.8 | 6.4 | 3.8 | 5.1 |
| Pasuran | 50.0 | - | 25.0 | - | - | 25.0 | - |
| Pamekasan | 80.0 | 20.0 | - | - | - | - | - |
| Dry highlands | | | | | | | |
| Sumedang | 61.5 | 15.4 | - | - | - | 5.1 | 18.0 |
| Lumajang | 75.0 | - | - | - | - | - | 25.0 |
| Banyuwangi | 44.4 | 22.2 | 11.1 | - | - | 11.1 | 11.1 |
| Average | 56.0 | 20.8 | 9.1 | 4.4 | 6.4 | 11.0 | 16.2 |

Source: DBPP/FPGM (1983)

Appendix table 4.11: Botanical composition of sheep rations in Sukawargi village and frequency of use for additional feeds

| Feedstuff | Percent in ration | % of farmers using feedstuff: Sukawargi | Wanaraja [a] |
|---|---|---|---|
| Native grass | 68.9 | 100 | 100 |
| Caliandra | 0.6 | 6 | - |
| Leucaena | 4.5 | 77 | 1 |
| Sesbania | 0.6 | 9 | - |
| Cassava leaves | 1.8 | 31 | 22 |
| Corn tops | 3.9 | 34 | 70 |
| Banana leaves | 3.1 | 37 | - |
| Jack fruit leaves | 0.3 | 17 | 10 |
| Cabbage leaves | 5.9 | 49 | - |
| Potato leaves | 6.7 | 80 | 3 |
| Pumpkin leaves | 0.1 | 3 | - |
| Other crop by-products | 3.6 | 31 | 13 [b] |

Source: Mathius and Van Eys (1983)
[a] From Sabrani, et al. (1981)
[b] Exclusively rice straw

Appendix table 4.12: Source and recovery of some agro-industrial by-products

| Parent material | By-product | Recovery (%) |
|---|---|---|
| Energy sources: | | |
| Cassava tuber | Cassava refuse | 40 - 50 |
| | Cassava pomace | 60 - 70 |
| Pineapple | Pineapple bran | 4 |
| | Pineapple waste | 70 |
| Rice | Rice bran | 10 |
| | Rice polishings | 3 |
| | Broken rice | 1 - 17 |
| Sugar cane | Molasses | 3 |
| Sago starch | Sago refuse | 19 |
| Banana | Banana fruit waste | 30 |
| Soybean | Soybean sludge waste | 10 - 15 |
| Plant protein sources: | | |
| Cotton | Cottonseed meal | 47 |
| Kapok | Copra meal | 50 - 55 |
| Rubber seed | Rubber seed meal | 45 - 55 |
| Oil palm | Palm oil cake | 22 |
| Soybean | Soybean meal | 50 - 55 |

Source: Nitis (1981)

Appendix table 4.13: Production of agro-industrial by-products, fresh weight basis (tons) for 8 provinces in Indonesia

| | North Sumatra | Lampung | DKI Jakart | West Java | Central Java | DI Yogyakarta | East Java | Bali |
|---|---|---|---|---|---|---|---|---|
| Major by-products: | | | | | | | | |
| Rice bran (rough) | 221,999 | 105,882 | 5,957 | 889,631 | 690,662 | 66,427 | 853,202 | 88,905 |
| Rice bran (fine) | 183,471 | 87,506 | 4,924 | 735,231 | 577,406 | 54,898 | 419,128 | 73,476 |
| Copra meal | 1,753 | 7,485 | 7,203 | 3,506 | 6,436 | 1,801 | 5,052 | 4,546 |
| Palm kernel cake | 64,058 | | | 2,300 | | | | |
| Palm oil refinery waste | 722,256 | | | 29,052 | | | | |
| Palm fruit fiber | 476,543 | | | 19,168 | | | | |
| Bagasse | 1,468 | 248,864 | | 335,964 | 3,580 | 89,746 | 4,423,343 | |
| Molasses | 229 | 38,885 | | 52,494 | 559 | 14,023 | 691,147 | |
| Cassava starch waste | | 10,934 | | 33,877 | 1,131 | 17,412 | 17,412 | |
| Wheat bran | | | 79,339 | | | | | |
| Ampas tahu/tempe | 575 | 1,688 | 62 | 312 | 369 | 1,118 | 177 | 74 |
| Minor by-products: | | | | | | | | |
| Ampas kelapa | 45,198 | 9,095 | | | | 4,857 | | 5 |
| Ampas kecap | 149 | 179 | 404 | | 184 | 66 | 43 | 23 |
| Coffee waste | 3,984 | 26,714 | | 2,116 | 3,186 | 36 | 13,914 | 1,711 |
| Cacao pod "skin" | 5,152 | | | 642 | | | 17,203 | |
| Cacao seed "skins" | 1,088 | | | | | | 3,634 | |
| Rubber seed meal | 69,555 | 6,826 | | 15,011 | 5,536 | | 5,905 | 32 |
| Pineapple waste | 5,915 | | | | | | | |
| Kapok seed cake | 9 | | | | 8,324 | 109 | 8,234 | 51 |
| Ampas markisa | 2,130 | | | | | | | |
| Ampas sagu | | 2,314 | | | | | | |
| Ampas bir | | | 6,984 | 290 | | | | |
| Corn bran | | | | | | | | 51 |

Source: DBPP/FPIPB (1985)

Appendix table 4.14. Chemical composition of Indonesian agro-industrial by-products

| Crop by-product | Indonesian name | DM (%) | CF | CP | Ash | EE | NFE | TDN | Ca | P |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Chemical composition (% of DM) | | | | | | | |
| Corn | Jagung | | | | | | | | | |
| Corn bran | Dedak jagung | 87.5 | 2.7 | 11.0 | 4.0 | 5.5 | 63.9 | 69.4 | 0.06 | 0.69 |
| Corn distillers | Bungkil jagung | 88.1 | 8.9 | 21.9 | 11.1 | 5.3 | 53.1 | | 0.06 | 2.18 |
| Rice | Padi | | | | | | | | | |
| Rough bran | Dedak halus | 89.6 | 29.8 | 6.5 | 15.9 | 2.4 | 34.9 | | 0.14 | 0.62 |
| Rice bran | Dedak kasar | 88.2 | 15.9 | 9.8 | 12.3 | 4.8 | 45.8 | | 0.09 | 1.09 |
| Rice polishings | Bekatul | 88.2 | 8.2 | 11.4 | 10.0 | 7.0 | 52.0 | | 0.07 | 1.06 |
| Rice screenings | Menir | 89.0 | 4.1 | 7.3 | 3.0 | 1.7 | 72.8 | | 0.03 | 2.23 |
| Wheat | Gandum | | | | | | | | | |
| Wheat bran | Dedak gandum | 88.2 | 7.4 | 16.9 | 3.6 | 4.1 | 67.6 | 66.9 | 0.09 | 0.75 |
| Brewer's grains | Ampas bir | 23.7 | 14.6 | 28.3 | 5.8 | 9.8 | 34.9 | | 0.18 | 0.48 |
| Peanut | Kacang tanah | | | | | | | | | |
| Peanut meal | Bungkil kacang | 89.2 | 7.4 | 35.8 | 5.5 | 11.1 | | | | |
| Soybean | Kacang kedele | | | | | | | | | |
| Tempe | Tempe | | 5.6 | 52.7 | 7.3 | 24.1 | 10.3 | | 0.16 | 0.51 |
| Tempe waste | Ampas tempe | 15.7 | 50.8 | 11.6 | 2.6 | 2.1 | 32.9 | | 0.57 | 0.19 |
| Sweet soy sauce | Ampas kecap | 26.6 | 9.4 | 30.0 | 8.0 | 20.4 | 39.2 | 65.9 | | |
| Curd waste a/ | Ampas tahu | | 23.6 | 22.4 | 4.5 | 9.6 | 42.2 | | 0.59 | 0.36 |
| Cassava | Ubi kayu | | | | | | | | | |
| Peelings b/ | Kulit ubi kayu | | 13.9 | 4.9 | 9.2 | 1.0 | 70.8 | | | |
| Starch waste | Onggok | | 12.0 | 1.7 | 1.5 | 0.3 | 84.3 | | | |
| Tapioca waste | Ampas tapioca | | 19.2 | 4.9 | 5.6 | 1.0 | 69.3 | | | |
| Sugar | Gula | | | | | | | | | |
| Molasses | Tetes | 79.7 | | 1.6 | 4.4 | | 94.0 | 53.7 | | |
| Bagasse | Bagase | | 48.0 | 1.4 | 5.3 | 0.7 | 44.6 | 20.5 | | |

(continued)



568

Appendix table 4.14. (Continued)

| Crop by-product | Indonesian name | DM (%) | Chemical composition (% of DM) CF | CP | Ash | EE | NFE | TDN | Ca | P |
|---|---|---|---|---|---|---|---|---|---|---|
| Coconut | Kelapa | | | | | | | | | |
| Copra meal | Bungkil kelapa | 88.5 | 13.6 | 20.4 | 6.4 | 12.6 | 43.6 | 77.1 | 0.14 | 0.56 |
| Corn distillers | Bungkil jagung | 88.1 | 8.9 | 21.9 | 11.1 | 5.3 | 53.1 | | 0.06 | 2.18 |
| Rubber | Kulit | | | | | | | | | |
| Rubber seed meal | Bungkil biji kulit | 92.7 | 11.0 | 33.0 | 4.5 | 12.2 | 41.3 | | | |
| Rough bran | Dedak halus | 89.6 | 29.8 | 6.5 | 15.9 | 2.4 | 34.9 | | 0.14 | 0.62 |
| Cacao | Cokolat | 88.2 | 15.9 | 9.8 | 12.3 | 4.8 | 45.8 | | 0.09 | 1.09 |
| Pod "skins" | Kulit buah coklat | 93.5 | 40.1 | 8.0 | 11.6 | 1.3 | 38.5 | | 0.58 | 0.18 |
| Seed "skins" | Kulit biji coklat | 88.1 | 20.9 | 16.2 | 7.6 | 8.4 | 46.8 | | 0.34 | 0.39 |
| Coffee | Kopi | | | | | | | | | |
| Coffee skins | Kulit buah kopi | 90.8 | 29.7 | 10.0 | 8.8 | 2.2 | 49.3 | 75.6 | 0.20 | 0.13 |
| Oil palm | Kelapa sawit | 23.7 | 14.6 | 28.3 | 5.8 | 9.8 | 34.9 | | 0.18 | 0.48 |
| Palm kernel cake | Bungkil kelapa sawit | | | | | | | | | |
| Oil palm "fiber" | Serat kelapa sawit | 91.5 | 36.1 | 7 0 | 6.1 | 14.7 | 35.8 | | 0.48 | 01.8 |
| Peanut meal | Bungkii kacang | 89.2 | 7.4 | 35.8 | 5.5 | 11.1 | | | | |
| Kapok | Kapuk | | | | | | | | | |
| Kapok seed meal | Bungkil biji kapuk | 90.0 | 30.8 | 31.2 | 7.1 | 7.0 | 23.3 | 69.6 | 0.45 | 0.58 |
| Tempe | Tempe | | 5.6 | 52.7 | 7.3 | 24.1 | 10.3 | | 0.16 | 0.51 |
| Tempe waste | Ampas tempe | 15.7 | 50.8 | 11.6 | 2.6 | 2.1 | 32.9 | | 0.57 | 0.19 |
| Soysauce waste | Ampas kecap | 26.6 | 9.4 | 30.0 | 8.0 | 20.4 | 39.2 | 65.9 | | |
| Tahu waste | Ampas tahu | | 23.6 | 22.4 | 4.5 | 9.6 | 42.2 | | 0.59 | 0.36 |

Source: DBPP/FPIPB (1985)
a/ Average of 3 reported chemical analyses
b/ Average of 4 reported chemical analyses



269

Appendix table 4.15: Maximum inclusion levels of agro-industrial by-products in livestock rations

| Product | Poultry | Swine | Cattle |
|---|---|---|---|
| | ------ (% of ration dry matter) ------ | | |
| Rice bran | 40 | 60 | 40 |
| Maize bran | 40 | 60 | 40 |
| Molasses | 5 | 15 | 15 |
| Cassava pomace | 25 | 30 | 40 |
| Coffee pulp | 20 | 20 | n.a. a/ |
| Citrus pulp | 10 | n.a. | n.a. |
| Cocoa husk | n.a. | 35 | 30 |
| Copra meal | 40 | 50 | 60 |
| Peanut meal | n.a. | n.a. | n.a. |
| Palm kernel meal | 20 | 30 | n.a. |
| Kapok meal | 10 | 10 | n.a. |
| Rubber seeds | 5 | n.a. | n.a. |
| Bagasse | b/ | b/ | 40 |

Source: Lebdosoekojo and Reksohadiprodjo (1982)
a/ n.a. = information not available
b/ Material normally only used for ruminants

Appendix table 4.16. Indonesian imports of commodities with known or potential feeding value

| Commodity | 1981 | | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|---|---|
| | (tons) | ($ US) | (tons) | ($ US) | (tons) | ($ US) | (tons) | ($ US) |
| Maize | 1,857.5 | 667,438 | 76,465.9 | 13,162,168 | 27,636.5 | 5,086,831 | 54,250.6 | 9,529,790 |
| Sorghum | - | - | 21,396.0 | 1,719,525 | 22,000.8 | 2,916,306 | | |
| Other grains | 10,634.1 | 1,407,392 | 6,700.6 | 1,309,801 | 7,363.6 | 1,750,051 | 48.7 | 14,525 |
| Maize or rice bran | - | - | | | 5,258.1 | 2,471,340 | 7,290.6 | 3,544,673 |
| Soybean meal | 169,775.7 | 41,847,148 | 71,769.0 | 18,828,477 | 103,568.6 | 28,854,691 | 206,076.9 | 52,566,872 |
| Fish meal | 53,893.4 | 33,761,517 | 72,861.8 | 39,159,227 | 52,094.8 | 29,042,470 | 45,185.0 | 24,576,006 |
| Peanut meal | 100,000.0 | 12,075 | 9,840.3 | 1,255,145 | 9,003.0 | 969,303 | 11,248.1 | 1,564,549 |
| Sunflower cake | 887.3 | 88,509 | 11,886.6 | 2,447,765 | 25,103.0 | 5,240,552 | 4,221.5 | 834,732 |
| Other oilseed cakes | 699.9 | 158,041 | 500.0 | 57,598 | 5,054.2 | 1,348,090 | 54,832.2 | 11,919,415 |
| Meat and bone meal | 1,117.6 | 234,569 | 1,150.4 | 375,659 | 5,713.9 | 1,844,828 | 7,635.2 | 3,251,981 |
| Feed supplements | 148.2 | 196,699 | 850.4 | 606,243 | 1,638.7 | 1,149,485 | 1,969.5 | 2,101,859 |
| Milk replacer | 52.0 | 11,862 | 320.0 | 139,295 | 1,199.5 | 339,725 | 50.0 | 2,870 |
| Total | 339,065.6 | 78,373,175 | 273,741.0 | 79,060,903 | 26[illegible],714.7 | 81,013,752 | 392,808.3 | 109,907,272 |

Source: Biro Pusat Statistiks (1981, 1982, 1983, 1984)
Note: All figures for costs of imports based on C.I.F. Indonesian port of entry

Appendix table 4.17: Indonesian exports of commodities with known or potential feeding value

| Description | 1981 | | 1982 | | 1983 | | 1984 | |
|---|---|---|---|---|---|---|---|---|
| | (tons) | ($ US) | (tons) | ($ US) | (tons) | ($ US) | (tons) | ($ US) |
| Maize | 4,786.2 | 744,037 | 540.7 | 111,070 | 17,936.4 | 2,555,128 | 159,053.1 | 21,807,866 |
| Barley, sorghum, other grains | 14,509.5 | 653,170 | | | 1,403.2 | 208,768 | 1,016.0 | 102,549 |
| Flours of coconut, sago and cassava | 8,904.0 | 1,976,272 | 15.0 | 4,153 | 1,648.5 | 319,354 | 5,190.0 | 848,081 |
| Peanuts | 2,084.2 | 787,241 | 1,365.7 | 539,026 | 1,649.2 | 769,068 | 1,598.0 | 615,946 |
| Coconut products | | | | | | | | |
| Copra | | | | | 3,159.5 | 745,402 | 56.2 | 25,818 |
| Copra meal | 321,835.5 | 35,727,27 | 350,258.4 | 36,125,825 | 259,289.0 | 25,922,884 | 140,256.9 | 14,223,614 |
| Oil palm products | | | | | | | | |
| Palm kernels | 22,723.6 | 4,414,717 | 6,699.8 | 1,259,831 | 12,995.3 | 3,097,789 | 9,100.3 | 2,963,287 |
| Palm kernel cake | 45,510.0 | 3,358,631 | 56,125.9 | 3,492,748 | 88,727.6 | 6,475,773 | 80,542.5 | 6,444,973 |
| Cotton products | | | | | | | | |
| Cottonseed | 5,444.0 | 682,991 | 6,998.7 | 570,382 | 3,285.0 | 305,000 | 6,450.5 | 576,517 |
| Cottonseed cake | 2,000.0 | 152,000 | | | | | 1.0 | 115 |
| Kapok seeds | 1,420.0 | 234,696 | 2.0 | 800 | | | | |
| Molasses | 255,873.4 | 20,375,421 | 459,653.7 | 13,922,157 | 619,384.4 | 23,044,725 | 690,528.2 | 26,912,027 |
| Fish meal | 8,661.1 | 807,250 | | | 54.0 | 29,812 | | |
| Other fisheries meals | | | 437,756.0 | 19,755 | | | 2,517.1 | 113,526 |
| Brans | | | | | | | | |
| Rice bran meal | 92,895.8 | 5,814,541 | 30,183.0 | 1,890,035 | 72,756.8 | 5,540,688 | 30,110.8 | 2,229,111 |
| Rice bran flour | 121,340.6 | 9,913,735 | 43,393.0 | 2,807,366 | 142,257.9 | 9,673,265 | 190,407.1 | 12,990,298 |
| Maize bran | 8,661.4 | 807,250 | | | 748.0 | 69,089 | 400.1 | 43,667 |
| Other brans, groats and meals | 94,615.8 | 6,910,304 | 57,239.6 | 3,710,998 | 45,905.0 | 3,396,551 | 21,245.7 | 1,745,208 |
| Milling and sifting residues | 321,642.8 | 23,104,298 | 326,790.1 | 24,612,913 | 291,518.0 | 24,507,168 | | |
| Total | 1,332,907.9 | 116,463,830 | 1,777,221.6 | 89,067,059 | 1,271,200.1 | 82,153,296 | 1,630,791.5 | 11[illegible],149,771 |

Source: Biro Pusat Statistiks (1981, 1982, 1983, 1984)
Note: All prices computed F.O.B. Indonesian port of exit



572

Appendix table 4.18: Export of "further-processed" agro-industrial by-products from Indonesia, 1980-1983

| Feedstuff | 1980 | 1981 | 1982 | 1983 |
|---|---|---|---|---|
| | (tons) | | | |
| Copra pellets | 56,679 | 114,277 | 111,380 | 94,236 |
| Rice bran pellets | | | | |
| Polishings | 86,738 | 177,865 | 118,666 | 169,410 |
| Rough bran | 27,358 | 6,400 | 20,975 | 4,323 |
| Cassava pellets | 237,386 | 297,915 | 69,777 | 178,555 |
| Cassava chips | n.a. [a] | 22,199 | 9,849 | 4,028 |
| Tapioca waste pellets | n.a. | n.a. | 3,955 | 4,158 |

Source: Biro Pusat Statistiks (1980, 1981, 1982, 1983)
[a] n.a. = information not available

Appendix table 4.19: Projected use of ingredients for concentrates during Repelita IV 1984-1988, (000 t)

| Commodity | 1984 | 1985 | 1986 | 1987 | 1988 | Inc./yr |
|---|---|---|---|---|---|---|
| | | | | | | (%) |
| Corn | 725.9 | 792.0 | 866.5 | 950.7 | 1,046.5 | 9.6 |
| Copra cake | 296.8 | 329.7 | 368.0 | 423.4 | 525.4 | 78.0 |
| Rice bran | 1,330.0 | 1,434.2 | 1,547.4 | 1,687.2 | 1,891.1 | 42.1 |
| Corn bran | 223.0 | 241.0 | 260.9 | 286.4 | 325.6 | 9.9 |
| Soybean cake | 224.1 | 252.2 | 283.5 | 319.9 | 362.4 | 12.8 |
| Fish meal | 85.9 | 95.7 | 107.1 | 119.0 | 135.5 | 12.1 |
| Wheat pollards | 451.6 | 479.7 | 509.3 | 541.0 | 574.1 | 6.2 |
| Sago | 96.4 | 103.1 | 109.7 | 116.6 | 124.1 | 6.5 |
| Others | 276.2 | 299.3 | 323.8 | 354.0 | 398.1 | 9.6 |
| TOTAL | 3,710.3 | 4,226.9 | 4,376.3 | 4,797.6 | 5,381.8 | 9.7 |

Source: DGLS (1983)



574

Appendix table 4.20: Prices paid (Rp/kg) for feed ingredients (F.O.B. factory gate) by feedmills and private farmers on Java and Sumatra

| Location: | Jakarta | Bandung | Bandung | Bandung | Klaten | Surabaya | Malang | Medan | Bukit Tinggi | Padang |
|---|---|---|---|---|---|---|---|---|---|---|
| Feedmill capacity (t/day) | 400 | 90 | | 6 | CLUSA | 400 | | 175 | 20 | 10 |
| Other description: | | | Swine farmer | | | | Poultry breeder | | | |
| Ingredient: | | | | | | | | | | |
| Corn | | | | | | | | | | |
| Current | 150 | 160 | 210 | 175 | 175 | 160 | 165 | 130 | 145 | 135 |
| Low-high | 150-160 | 150-180 | n.a. a/ | 140-170 | n.a. | 150-170 | n.a. | 129-145 | 130-160 | n.a. |
| Soybean meal | | | | | | | | | | |
| Current | 260 | 310 | 320 | 325 | * b/ | 265 | n.a. | 278 | 290 | 310 |
| Low-high | n.a. | n.a. | n.a. | 300-330 | | 265-330 | 375-400 | n.a. | n.a. | n.a. |
| Fish meal | | | | | | | | | | |
| Current | 625 | 630 | 500 | 400 | * | 400 | 500 | 635 | 500 | 630 |
| Low-high | n.a. | n.a. | n.a. | 375-490 | | 400-635 | n.a. | n.a. | 375-500 | n.a. |
| Rice bran | | | | | | | | | | |
| Current | 50 | 45 | 40 | 40 | 45 | 50 | 60 | 100 | 45 | 40 |
| Low-high | 35-60 | 35-55 | n.a. | 35-65 | n.a. | 40-65 | n.a. | 50-100 | 40-80 | n.a. |
| Copra meal | | | | | | | | | | |
| Current | * | 110 | 100 | 90 | * | * | * | 100 | 105 | 110 |
| Low-high | | 90-130 | n.a. | 75-110 | | | | 80-125 | 105-110 | n.a. |
| Sorghum | | | | | | | | | | |
| Current | * | * | * | * | * | 135 | * | * | * | * |
| Low-high | | | | | | 110-135 | | | | |

(continued)



575

Appendix table 4.20: (Continued).

| Location: | Jakarta | Bandung | Bandung | Bandung | Klaten | Surabaya | Malang | Medan | Bukit Tinggi | Padang |
|---|---|---|---|---|---|---|---|---|---|---|
| Feedmill capacity (t/day) | 400 | 90 | | 6 | CLUSA | 400 | | 175 | 20 | 10 |
| Other description: | | | Swine farmer | | | | Poultry breeder | | | |
| Ingredient: | | | | | | | | | | |
| Wheat pollards | | | | | | | | | | |
| Current | 100 | * | 120 | * | * | 95 | * | * | * | * |
| Low-high | 100-110 | | n.a. | | | 95-120 | | | | |
| Bone meal | | | | | | | | | | |
| Current | * | 180 | * | 250 | * | 165 | * | * | * | * |
| Low - high | | 175-190 | | 225-250 | | 150-165 | | | | |
| Meat and bone meal | | | | | | | | | | |
| Current | n.a. | 180 | * | 250 | * | * | * | n.a. | 350 | 335 |
| Low - high | | n.a. | | n.a. | | | | | 250-350 | 330-340 |
| Limestone | | | | | | | | | | |
| Current | n.a. | n.a. | * | * | * | 25 | 30 | * | * | * |
| Low - high | | | | | | 25-35 | 27-30 | | | |
| Oyster shell | | | | | | | | | | |
| Current | n.a. | 35 | * | 26 | * | 25 | * | * | * | * |
| Low - high | | 30-55 | | n.a. | | 25-35 | | | | |
| Broken rice | | | | | | | | | | |
| Current | 120 | * | * | * | * | 120 | * | * | * | * |
| Low - high | 110-150 | | | | | 110-130 | | | | |
| Leucaena leaf meal | | | | | | | | | | |
| Current | n.a. | 100 | * | * | * | 70 | * | 135 | 120 | 110 |
| Low - high | | 100-135 | | | | 70-110 | | 125-140 | n.a. | n.a. |
| Cassava meal | | | | | | | | | | |
| Current | * | * | * | 75 | 50 | * | * | * | * | * |
| Low - high | | | | 60-90 | 40-70 | | | | | |

Source: Field visits by study team members
a/ n.a.= Prices not available at time of visit
b/ * Ingredient never has been or is not currently being used

Appendix table 4.21: Prices (Rp/kg) for commercial livestock and poultry feeds (F.O.B. factory)

| | Bandung | Bandung | Bandung | Semarang | Surabaya | Medan | Padang |
|---|---|---|---|---|---|---|---|
| Feedmill capacity (t/day): | 70 | 6 | 9 | 50 | 150 | 100 | 20 |
| Layer: | | | | | | | |
| Starter | 278 | 305 | 313 | 292 | 273 | 286 | 270 |
| Grower | 239 | 253 | 257 | 268 | 215 | 231 | 230 |
| Production | 249 | 280 | 269 | 255 | 236 | 210 | 235 |
| Concentrate | - | 390 | 414 | 435 | 345 | 377 | - |
| Broiler: | | | | | | | |
| Starter | 321 | 350 | 357 | 337 | 307 | 319 | 335 |
| Finisher | 307 | 320 | 327 | 310 | 284 | 301 | 270 |
| Concentrate | - | - | - | - | 449 | - | - |
| Dairy: | | | | | | | |
| Concentrate | - | 180 | - | 144 | - | - | 195 |
| Complete | - | 135 | - | 134 | - | - | - |
| Swine: | | | | | | | |
| Starter | - | - | - | 281 | - | 335 | - |
| Finisher | - | - | - | 179 | - | - | - |
| Concentrate | - | - | - | 411 | - | 460 | - |
| Duck: | | | | | | | |
| Starter | - | - | - | 185 | 230 | - | - |
| Production | - | - | - | 460 | 466 | [illegible] | - |
| Concentrate | - | - | - | - | - | | |

Source: Field visits by study team members



5?0

## APPENDIX 4A: FEED COMPOSITION TABLES AND FEED REQUIREMENTS FOR INDONESIAN LIVESTOCK

A.1 Appendix tables 4A.1 through 4A.4 present nutritional data derived from Kearl (1982) for selected feeds and grasses which are available for livestock feeding in Indonesia. Appendix table 4A.1 contains chemical composition data based on crude fiber and mineral analysis. While the crude fiber procedure for chemical analysis presents limitations in terms of relating results to nutritional value and actual animal performance, the data in appendix table 4A.1 does allow for comparison between feedstuffs within the same class (protein supplements, forages, etc.).

A.2 Data in appendix table 4A.2 is for metabolizable energy, total digestible nutrients (TDN) and digestible protein. For most feedstuffs where laboratory values were not available, metabolizable energy, TDN and digestible protein was calculated by a regression equation from other reported chemical values. Values for metabolizable energy and TDN for goats and buffalo are taken as those for sheep and cattle, respectively. As with chemical composition (appendix table 4A.1), energy and protein values for the various feedstuffs are most useful in ranking feeds and designing rations to be field-tested. Under actual feeding conditions, variations in composition, processing procedure, maturity, etc. of feed constituents reduces the reliability of table values as predictors of animal performance. Adjustments in feeding formulations should be made based on further laboratory data and analysis of production responses.

A.3 Appendix table 4A.3 presents a listing of feedstuffs which might be available in Indonesia for the feeding of swine. For commercial pig feeding systems where high rates of reproduction and growth are essential to profitability, special consideration in the formulation of swine rations must be given to content of amino acids normally found to be limiting to performance such as lysine and the sulfur amino acids methionine and cysteine.

A.4 A detergent fiber analysis of improved tropical grasses in Puerto Rico is presented in appendix table 4A.4. These are similar to grasses available to small farmers in Indonesia. As is evident from the data in the table, increased maturity from 3 to 9 weeks post-harvest results in decreased forage quality as measured by a decrease in vitro true digestibility of dry matter (IVTDDM), and increases neutral (NDF) and acid detergent fiber (ADF) and lignin. As mentioned previously, table values are only useful for comparisons among feeds or forages harvested under a common protocol and to show general trends in feeding value with maturity, changes in management and processing procedure, etc. Application of the detergent fiber analysis method to forages harvested in Indonesia would be expected to produce a different set of values with possible changes in ranking among forages for feeding quality.

A.5 Appendix tables 4A.5 through 4A.10 present nutritional requirements for cattle, buffalo, swine, sheep and goats as derived from Kearl and the National Research Council of the US National Academy of

Sciences (NRC). Requirements for cattle are based on NRC requirements for dairy cattle (NRC, 1971) and should serve for both beef and dairy production systems in Indonesia. For all species, except swine, it is suggested that for ambient temperatures above 30°C maintenance requirements should be increased by 10%. For cattle and buffalo, maintenance requirements during the first lactation should be increased 20% and 10% during the second to allow for additional needed growth to reach mature bodyweight.

Appendix table 4A.1: Chemical composition of feedstuffs with potential for use in Indonesia a/

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Arachis hypogaea - Peanut | | | | | | | | | |
| -aerial part, fresh | 2-03-638 | 26 | 1.9 | 48.2 | 26.3 | 8.6 | 15.0 | 1.30 | 0.19 |
| -hay, sun-cured | 1-03-619 | 85 | 2.2 | 39.9 | 28.9 | 11.6 | 17.3 | 1.23 | 0.15 |
| -pods | 1-08-028 | 90 | 1.4 | 39.3 | 46.7 | 4.1 | 8.5 | 0.31 | 0.06 |
| -pods with seeds | 5-03-653 | 92 | 10.8 | 48.2 | 9.2 | 6.6 | 25.1 | — | 0.35 |
| -seeds w/o coats-meal mechanically extracted | 5-03-649 | 90 | 7.9 | 30.8 | 5.9 | 8.1 | 47.3 | 0.22 | 0.68 |
| -stem, fresh | 2-15-445 | 51 | 2.3 | 41.5 | 42.3 | 7.7 | 6.2 | — | — |
| -straw | 1-30-121 | 88 | 1.0 | 29.5 | 53.5 | 8.7 | 7.4 | — | — |
| Artocarpus heterophyllus - Jackfruit | | | | | | | | | |
| -leaves, fresh | 2-27-195 | 32 | 3.1 | 48.9 | 22.5 | 11.7 | 13.8 | 1.46 | 0.15 |
| Bambusa spp. - Bamboo | | | | | | | | | |
| -browse, sun-cured | 1-29-502 | 88 | 0.9 | 34.1 | 30.8 | 20.6 | 13.7 | 0.22 | 0.15 |
| -leaves, sun-cured | 1-29-503 | 88 | 3.3 | 37.2 | 30.0 | 11.5 | 18.0 | 0.20 | 0.13 |
| Bambusa vulgaris - Bamboo, common | | | | | | | | | |
| -leaves, fresh | 2-29-388 | 38 | 2.5 | 36.3 | 30.2 | 14.5 | 16.5 | 0.21 | 0.14 |
| Brassica oleracea capitata - Cabbage | | | | | | | | | |
| -outside leaves, fresh | 2-01-047 | 4 | 3.3 | 37.2 | 19.6 | 19.7 | 20.4 | 1.10 | 0.71 |
| Cajanus cajan - Pigeon pea | | | | | | | | | |
| -aerial part, fresh | 2-03-715 | 33 | 3.6 | 54.6 | 22.0 | 5.4 | 14.4 | 1.11 | 0.51 |
| -hay, sun-cured | 1-09-743 | 90 | 2.5 | 49.2 | 29.7 | 9.3 | 9.3 | -- | -- |
| -leaves, sun-cured | 1-11-772 | 89 | 5.6 | 42.8 | 21.3 | 5.7 | 24.6 | 1.13 | 0.36 |
| -pods, with seeds sun-cured | 4-24-275 | 92 | 2.9 | 43.1 | 29.3 | 6.6 | 18.1 | -- | -- |
| Carica papaya - Papaya | | | | | | | | | |
| -browse, fresh | 2-29-435 | 23 | 7.0 | 39.6 | 27.2 | 9.5 | 16.7 | 1.39 | 0.62 |
| -leaves, fresh | 2-29-434 | 18 | 6.2 | 41.1 | 19.8 | 10.9 | 22.0 | 0.87 | 0.51 |
| Ceiba pentandra - Kapok | | | | | | | | | |
| -seeds | 5-27-968 | 86 | 14.2 | 23.4 | 28.0 | 7.1 | 27.4 | — | -- |

(continued)



580

Appendix table 4A.1: (Continued)

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Centrosema pubescens - Butterfly peas, pubescens | | | | | | | | | |
| -aerial part, fresh | 2-11-459 | 23 | 4.3 | 38.6 | 32.2 | 8.9 | 16.0 | 1.03 | 0.29 |
| Cereals | | | | | | | | | |
| -brewer's grains, dehydrated | 5-02-141 | 90 | 5.7 | 49.9 | 16.5 | 4.1 | 23.7 | 0.26 | 0.60 |
| -distiller's soluables, dehydrated | 5-02-147 | 89 | 2.5 | 51.5 | 6.1 | 10.3 | 29.7 | 0.20 | 0.83 |
| Cocos nucifera - Coconut | | | | | | | | | |
| -kernels with coats, manually extracted | 5-21-283 | 89 | 15.7 | 45.3 | 10.7 | 6.9 | 21.5 | 0.07 | 0.64 |
| -kernels with coats, mechanicall extracted caked | 5-30-143 | 89 | 10.2 | 51.5 | 13.2 | 6.2 | 19.0 | 0.27 | 0.54 |
| -kernels with coats, waste caked | 5-29-668 | 90 | 29.7 | 31.1 | 14.0 | 5.3 | 20.0 | 0.59 | 0.10 |
| Coffea supp. - Coffee | | | | | | | | | |
| -hulls | 1-01-577 | 88 | 1.1 | 31.4 | 58.7 | 3.0 | 5.8 | 0.37 | 0.08 |
| Colocasia esculenta - Dasheen | | | | | | | | | |
| -leaves, fresh | 2-29-412 | 10 | 5.2 | 40.4 | 16.9 | 13.0 | 24.5 | 1.10 | 0.03 |
| -tubers, fresh | 4-10-463 | 26 | 2.0 | 84.1 | 3.6 | 4.5 | 5.7 | 0.14 | 0.25 |
| Dioscorea alata - Yam, winged | | | | | | | | | |
| -tubers, fresh | 4-10-493 | 25 | 0.8 | 78.4 | 4.7 | 5.0 | 11.0 | 0.17 | 0.17 |
| Dolichos lablab - Dolichos, hyacinth | | | | | | | | | |
| -aerial part, fresh | 2-09-703 | 17 | 2.2 | 28.0 | 35.9 | 12.7 | 21.2 | 0.66 | 1.11 |
| Eichhornia crassipes - Water hyacinth, common | | | | | | | | | |
| -aerial part, fresh | 2-29-445 | 8 | 2.9 | 44.0 | 20.9 | 15.4 | 16.7 | 1.72 | 0.68 |
| -whole, dehydrated | 1-29-619 | 92 | 2.5 | 46.1 | 25.1 | 14.9 | 11.4 | 1.67 | 0.49 |
| -whole, silage | 3-29-656 | 9 | 2.7 | 44.4 | 23.2 | 21.5 | 8.2 | -- | -- |
| Fish | | | | | | | | | |
| -meal, mechanically extracted | 5-01-977 | 87 | 6.3 | 4.6 | 2.3 | 27.5 | 59.3 | 7.68 | 3.36 |

(continued)

Appendix table 4A.1: (Continued)

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Glycine max - Soybean | | | | | | | | | |
| -aerial part, fresh | 2-04-574 | 28 | 2.1 | 44.5 | 20.8 | 9.6 | 23.0 | 1.08 | 0.29 |
| -seeds | 5-04-610 | 89 | 19.2 | 33.4 | 6.3 | 5.3 | 25.9 | 0.12 | 0.43 |
| -seeds, meal mechanically extracted | 5-04-600 | 87 | 6.7 | 34.5 | 5.7 | 6.6 | 46.5 | 0.55 | 0.66 |
| -seeds, mechanically extracted caked | 5-30-145 | 85 | 10.4 | 33.1 | 5.6 | 6.7 | 44.2 | -- | -- |
| -soysauce process residue, wet | 5-06-738 | 67 | 9.0 | 39.4 | 12.3 | 25.1 | 14.2 | 0.38 | 0.20 |
| Gossypium spp. - Cotton | | | | | | | | | |
| -hulls | 1-01-599 | 91 | 2.7 | 49.3 | 40.7 | 3.2 | 4.1 | 0.14 | 0.08 |
| -seeds | 5-01-614 | 91 | 23.0 | 28.9 | 24.8 | 4.8 | 18.6 | 0.22 | 0.31 |
| -seed cake, mechanically extracted | 5-01-623 | 92 | 2.3 | 26.5 | 9.9 | 7.2 | 46.2 | 0.19 | 1.09 |
| Hevea brasiliensis - Rubber tree | | | | | | | | | |
| -kernels with coats, meal mechanially extracted | 4-12-011 | 89 | 10.9 | 40.5 | 24.2 | 3.7 | 20.8 | 0.22 | 0.43 |
| Ipomoea batatas - Sweet potato | | | | | | | | | |
| -aerial part fresh | 2-04-784 | 14 | 2.7 | 51.7 | 17.4 | 12.4 | 15.7 | 0.91 | 0.54 |
| -leaves, fresh | 2-29-395 | 20 | 2.1 | 49.1 | 16.7 | 12.3 | 19.9 | 1.99 | 0.05 |
| -tubers, fresh | 4-04-788 | 28 | 1.1 | 85.8 | 3.0 | 4.3 | 5.8 | 0.12 | 0.16 |
| -tubers, meal | 4-03-536 | 91 | 1.3 | 89.4 | 3.4 | 3.1 | 2.9 | 0.15 | 0.21 |
| Leucaena glauca - Lead tree, "lamtoro" | | | | | | | | | |
| -browse, fresh | 2-02-495 | 27 | 4.9 | 42.3 | 16.5 | 7.7 | 28.6 | 0.98 | 0.27 |
| -hay, sun-cured | 1-02-492 | 92 | 7.1 | 51.4 | 6.2 | 9.6 | 25.7 | 2.88 | 0.18 |
| -leaves, fresh | 2-29-421 | 31 | 5.6 | 45.6 | 16.2 | 8.8 | 23.8 | 1.21 | 0.25 |
| -leaves, fresh immature | 2-29-420 | 23 | 2.2 | 50.4 | 13.5 | 5.4 | 28.5 | 1.04 | 0.17 |
| -leaves, sun-cured | 1-20-730 | 92 | 6.2 | 43.1 | 12.6 | 9.1 | 29.1 | 2.22 | 0.30 |
| Mangifera indica - Mango, common | | | | | | | | | |
| -leaves, fresh | 2-27-211 | 40 | 3.5 | 53.5 | 24.5 | 8.5 | 10.0 | 1.35 | 0.11 |

(continued)



582

Appendix table 4A.1: (Continued)

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Manihot esculenta - Cassava, common | | | | | | | | | |
| -aerial part, fresh | 2-09-627 | 21 | 7.1 | 41.5 | 15.7 | 8.4 | 27.3 | 1.30 | 0.56 |
| -leaves, fresh | 2-01-153 | 22 | 4.0 | 49.7 | 14.8 | 6.6 | 24.9 | 0.81 | 0.20 |
| -leaves, sun-cured | 1-13-552 | 90 | 5.9 | 44.2 | 17.3 | 7.9 | 24.7 | 1.50 | 0.42 |
| -peelings, dehydrated | 4-11-937 | 87 | 2.9 | 83.3 | 4.8 | 4.1 | 4.9 | 0.10 | -- |
| -starch process residue, dehydrated | 4-11-947 | 88 | 0.6 | 80.9 | 6.6 | 9.5 | 2.5 | 0.26 | 0.08 |
| -tubers, fresh | 4-09-599 | 41 | 0.7 | 91.4 | 3.5 | 2.2 | 2.1 | 0.13 | 0.05 |
| -tubers, meal | 4-09-598 | 90 | 0.8 | 89.9 | 3.3 | 3.4 | 2.6 | 0.16 | 0.20 |
| -tubers without peelings, meal | 4-13-553 | 89 | 0.7 | 92.5 | 2.7 | 1.8 | 2.3 | 0.14 | 0.05 |
| Mucuna spp. - Velvet bean | | | | | | | | | |
| -hay, sun-cured | 1-05-080 | 85 | 3.9 | 46.0 | 9.0 | 4.3 | 36.8 | 0.18 | 0.48 |
| Musa paradisiaca sapientum - Banana, common | | | | | | | | | |
| -aerial part, fresh | 2-10-544 | 18 | 1.0 | 59.5 | 22.0 | 12.0 | 5.5 | -- | -- |
| -stems, fresh | 2-11-906 | 5 | 2.2 | 51.7 | 25.6 | 17.3 | 3.2 | 0.89 | 0.23 |
| Musa spp. - Banana | | | | | | | | | |
| -leaves, fresh | 2-09-902 | 24 | 6.0 | 38.6 | 28.8 | 9.3 | 17.3 | 0.64 | 0.31 |
| -stems, fresh | 2-11-910 | 5 | 2.6 | 65.1 | 19.1 | 10.1 | 3.2 | -- | -- |
| Oryza sativa - Rice | | | | | | | | | |
| -bran with germs | 4-03-928 | 90 | 9.8 | 48.4 | 15.1 | 13.3 | 13.5 | 0.16 | 0.81 |
| -grain | 4-03-939 | 90 | 1.1 | 86.5 | 1.9 | 1.8 | 8.8 | 0.06 | 0.81 |
| -groats | 4-03-936 | 89 | 4.6 | 73.8 | 5.9 | 5.1 | 10.6 | 0.13 | 0.43 |
| -mill run | 1-03-941 | 88 | 1.4 | 68.4 | 15.3 | 8.0 | 6.9 | 0.05 | 0.31 |
| -polishings | 4-03-943 | 90 | 17.2 | 54.8 | 4.3 | 10.3 | 13.4 | 0.09 | 1.16 |
| -straw | 1-03-925 | 90 | 1.4 | 42.0 | 35.1 | 17.0 | 4.5 | 0.21 | 0.08 |
| Pennisetum purpureum - Napier grass, "rumput gadja" | | | | | | | | | |
| -aerial part, fresh, 43 to 56 days growth | 2-10-076 | 18 | 1.9 | 42.4 | 33.5 | 13.4 | 8.8 | 0.42 | 0.54 |
| -aerial part, fresh, 57 to 70 days growth | 2-10-255 | 18 | 1.4 | 42.2 | 35.2 | 14.2 | 7.0 | 0.08 | 0.06 |

(continued)

Appendix table 4A.1: (Continued)

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Phaseolus aureus - Bean, mung | | | | | | | | | |
| -aerial part, fresh | 2-00-169 | 24 | 1.7 | 46.2 | 29.8 | 10.2 | 12.0 | -- | -- |
| -pods, sun-cured | 1-23-068 | 87 | 1.3 | 57.5 | 20.9 | 9.4 | 11.0 | 0.64 | 0.61 |
| -seeds | 5-08-185 | 89 | 1.7 | 66.4 | 4.3 | 4.1 | 23.5 | 0.19 | 0.34 |
| Poultry | | | | | | | | | |
| -feathers, meal | 5-29-674 | 91 | 6.1 | 5.5 | 1.0 | 8.4 | 79.1 | 0.26 | 0.20 |
| Saccharum officinarum - Sugarcane | | | | | | | | | |
| -aerial part, fresh | 2-04-689 | 24 | 2.2 | 52.0 | 33.3 | 7.4 | 5.1 | 0.31 | 0.42 |
| -bagasse, dehydrated | 1-04-686 | 95 | 1.3 | 48.6 | 43.1 | 3.9 | 3.0 | 0.16 | 0.17 |
| -bagasse, wet | 2-09-909 | 78 | 0.8 | 78.4 | 10.2 | 7.1 | 3.5 | 0.35 | 0.27 |
| -leaves, fresh | 2-04-691 | 24 | 3.2 | 46.3 | 36.3 | 8.0 | 6.3 | 0.32 | 0.23 |
| -molasses | 4-13-251 | 76 | 4.1 | 84.3 | -- | 9.3 | 2.2 | 0.94 | 0.11 |
| -top of aerial part, dehydrated | 1-13-565 | 93 | 1.9 | 47.5 | 34.8 | 10.6 | 5.2 | -- | -- |
| -top of aerial part, fresh | 2-13-568 | 31 | 1.7 | 50.4 | 33.9 | 7.6 | 6.4 | -- | -- |
| Sesbania grandiflora - Wistaria tree, scarlet | | | | | | | | | |
| -leaves, fresh | 2-21-087 | 18 | 4.4 | 46.9 | 12.9 | 9.3 | 26.5 | 1.48 | 0.34 |
| Setaria sphacelata - Millet, golden | | | | | | | | | |
| -aerial part, fresh | 2-11-528 | 18 | 2.6 | 46.3 | 35.8 | 7.9 | 7.4 | -- | -- |
| Sorghum bicolor - Sorghum | | | | | | | | | |
| -aerial part with heads, sun-cured | 1-04-302 | 85 | 1.7 | 49.9 | 34.2 | 8.0 | 6.2 | 0.39 | 0.19 |
| -grain | 4-04-383 | 87 | 2.9 | 81.7 | 2.6 | 2.2 | 10.5 | 0.09 | 0.34 |
| Triticum aestivum - Wheat | | | | | | | | | |
| -bran | 4-05-190 | 89 | 4.1 | 63.9 | 9.9 | 5.8 | 16.3 | 0.15 | 0.92 |
| -germs, ground | 5-05-218 | 87 | 7.4 | 59.2 | 4.7 | 4.8 | 23.9 | 0.03 | 0.88 |

(Continued)

Appendix table 4A.1: (Continued)

| International feed name | International number | DM (%) | EE | NFE | CF | Ash | Total protein | Ca | P |
|---|---|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | | | |
| Vigna sinensis - Cowpea, common | | | | | | | | | |
| -aerial part, fresh | 2-01-655 | 11 | 2.1 | 44.7 | 23.2 | 12.9 | 17.1 | 2.26 | 0.38 |
| -hay, sun-cured | 1-01-645 | 88 | 1.8 | 38.8 | 33.0 | 11.8 | 14.7 | 1.53 | 0.66 |
| -leaves, fresh | 2-01-656 | 13 | 2.9 | 30.4 | 30.0 | 12.4 | 24.3 | 1.48 | 0.55 |
| -seeds | 5-01-661 | 78 | 2.1 | 60.0 | 5.7 | 5.9 | 26.3 | 0.36 | 0.42 |
| Zea mays - Maize | | | | | | | | | |
| -aerial part, fresh | 2-02-799 | 18 | 1.8 | 52.0 | 28.8 | 8.6 | 8.8 | 0.49 | 0.24 |
| -aerial part, fresh, dough stage | 2-02-803 | 27 | 2.5 | 54.1 | 29.6 | 8.7 | 5.1 | 0.20 | 0.36 |
| -husks, sun-cured | 1-02-785 | 88 | 1.5 | 56.5 | 23.2 | 10.7 | 8.1 | 0.18 | 0.15 |
| -stems, sun-cured | 1-02-795 | 89 | 1.6 | 48.2 | 37.9 | 7.4 | 5.0 | 0.29 | 0.16 |
| -aerial part, w/o ears, w/o husks | 2-02-809 | 23 | 1.8 | 59.9 | 26.4 | 6.2 | 5.7 | 0.62 | 0.09 |
| Zea mays indentata - Maize, dent white | | | | | | | | | |
| -grain | 4-02-928 | 87 | 3.5 | 81.6 | 2.8 | 2.1 | 10.0 | 0.06 | 0.31 |
| Zea mays indenta - Maize, dent yellow | | | | | | | | | |
| -grain | 4-02-935 | 88 | 4.4 | 80.9 | 3.0 | 1.9 | 9.8 | 0.07 | 0.34 |

Source: Kearl (1982)

a/ DM : dry matter; EE : ether extract; NFE : nitrogen-free extract; CF : crude fiber; Ca : calcium; P : phosphorous

Appendix table 4A.2: Digestible protein and energy values of feedstuffs of potential use for livestock feeding in Indonesia (dry matter basis) [a/]

| International feed name | International number | Digestible protein: sheep | goat | cattle | buffalo | Metabolizable energy: sheep/ goats | cattle/ buffalo | Total digestible nutrients: sheep/ goats | cattle/ buffalo |
|---|---|---|---|---|---|---|---|---|---|
| | | ------ (% of DM) ------ | | | | --- (Mcal/kg) --- | | --- (g/kg) --- | |
| Arachis hypogaea - Peanut | | | | | | | | | |
| -aerial part, fresh | 2-03-638 | 11.0 | 10.6 | 10.6 | 10.6 | 2.53 | 2.42 | 67.0 | 64.0 |
| -hay, sun-cured | 1-03-619 | 12.1 | 12.7 | 11.9 | 11.9 | 2.08 | 2.02 | 57.0 | 55.0 |
| -pods | 1-08-028 | 4.2 | 4.5 | 4.3 | 4.3 | 0.62 | 0.62 | 24.0 | 24.0 |
| -pods with seeds | 5-03-653 | 17.2 | 17.2 | -- | -- | 3.45 | 3.30 | 88.0 | 84.0 |
| -seeds w/o coats -meal, mechanically extracted | 5-03-649 | 47.6 | 47.6 | 47.1 | 47.1 | 3.36 | 2.93 | 85.0 | 81.0 |
| -stems, fresh | 2-15-445 | 2.8 | 2.8 | 3.1 | 3.1 | 2.00 | 2.35 | 55.0 | 53.0 |
| -straw | 1-30-121 | 3.2 | 1.0 | 3.3 | 3.3 | 2.17 | 1.45 | 59.0 | 43.0 |
| Artocarpus heterophyllus - Jackfruit | | | | | | | | | |
| -leaves, fresh | 2-27-195 | 9.8 | 9.4 | 9.6 | 9.6 | 2.37 | 1.48 | 63.0 | 43.0 |
| Bambusa supp. - Bamboo | | | | | | | | | |
| -browse, sun-cured | 1-29-502 | 8.8 | 9.3 | 8.8 | 8.8 | 1.65 | 1.50 | 47.0 | 44.0 |
| -leaves, sun-cured | 1-29-503 | 12.7 | 13.3 | 12.5 | 12.5 | 2.10 | 2.10 | 57.0 | 57.0 |
| Bambusa vulgaris - Bamboo, common | | | | | | | | | |
| -leaves, fresh | 2-29-388 | 12.4 | 12.0 | 11.9 | 11.9 | 2.26 | 2.08 | 61.0 | 57.0 |
| Brassica oleracea capitata - Cabbage | | | | | | | | | |
| -outside leaves, fresh | 2-01-047 | 16.0 | 15.5 | 15.2 | 15.2 | 2.33 | 2.18 | 62.0 | 59.0 |
| Cajanus cajan - Pigeon pea | | | | | | | | | |
| -aerial part, fresh | 2-03-715 | 10.4 | 10.0 | 10.1 | 10.1 | 2.57 | 2.67 | 68.0 | 70.0 |
| -hay, sun-cured | 1-09-743 | 4.9 | 5.2 | 5.0 | 5.0 | 1.96 | 1.98 | 54.0 | 55.0 |
| -leaves, sun-cured | 1-11-772 | 18.6 | 19.5 | 18.2 | 18.2 | 2.59 | 2.74 | 68.0 | 72.0 |
| -pods, with seeds, sun-cured | 4-24-275 | 12.8 | 13.4 | 12.6 | 12.6 | 2.28 | 2.26 | 61.0 | 61.0 |

(continued)

Appendix table 4A.2 : (Continued)

| International feed name | International number | Digestible protein: sheep | goat | cattle | buffalo (% of DM) | Metabolizable energy: sheep/ goats | cattle/ buffalo (Mcal/kg) | Total digestible nutrients: sheep/ goats | cattle/ buffalo (g/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Carica papaya - Papaya | | | | | | | | | |
| -browse, fresh | 2-29-435 | 12.5 | 12.1 | 12.0 | 12.0 | 2.17 | 2.43 | 59.0 | 65.0 |
| -leaves, fresh | 2-29-434 | 17.5 | 17.1 | 16.6 | 16.6 | 2.45 | 2.31 | 65.0 | 62.0 |
| Ceiba pentandra - Kapok | | | | | | | | | |
| -seeds | 5-27-968 | -- | -- | -- | -- | 2.69 | 2.49 | 71.0 | 66.0 |
| Centrosema pubescens - Butterfly pea, pubescens | | | | | | | | | |
| -aerial part, fresh | 2-11-459 | 11.9 | 11.5 | 11.5 | 11.5 | 2.27 | 2.30 | 61.0 | 62.0 |
| Cereals | | | | | | | | | |
| -brewer's grains, dehydrated | 5-02-141 | 21.7 | 21.7 | 22.0 | 22.0 | 3.10 | 2.75 | 80.0 | 72.0 |
| -distiller's solubles dehydrated | 5-02-147 | -- | -- | -- | -- | 3.07 | 3.05 | 79.0 | 78.0 |
| Cocos nucifera - Coconut | | | | | | | | | |
| -kernels with coats, manually extracted | 5-21-203 | -- | -- | -- | -- | 3.54 | 3.42 | 90.0 | 87.0 |
| -kernels with coats, mechanically extracted caked | 5-30-143 | 14.7 | 14.7 | 13.5 | 13.5 | 2.85 | 3.30 | 74.0 | 91.0 |
| -kernels with coats, waste, caked | 5-29-668 | -- | -- | -- | -- | 3.97 | 2.87 | 99.0 | 79.0 |
| Coffea spp. - Coffee | | | | | | | | | |
| -hulls | 1-01-577 | 1.8 | 2.0 | 2.0 | 2.0 | 1.43 | 1.55 | 51.0 | 45.0 |
| Colocasia esculenta - Dasheen | | | | | | | | | |
| -leaves, fresh | 2-29-412 | 19.8 | 19.4 | 18.7 | 18.7 | 2.57 | 1.94 | 68.0 | 54.0 |
| -tubers, fresh | 4-10-463 | 2.5 | 2.5 | 1.3 | 1.3 | 3.38 | 3.06 | 86.0 | 79.0 |
| Dioscorea alata - Yam, winged | | | | | | | | | |
| -tubers, fresh | 4-10-493 | 7.4 | 7.4 | 6.2 | 6.2 | 3.24 | 2.93 | 83.0 | 76.0 |
| Dolichos lablab - Dolichos, hyacinth | | | | | | | | | |
| -aerial part, fresh | 2-09-703 | 16.7 | 16.3 | 15.9 | 15.9 | 2.37 | 2.11 | 63.0 | 57.0 |

(continued)

Appendix table 4A.2 : (Continued)

| International feed name | International number | Digestible protein: sheep (% of DM) | goat | cattle | buffalo | Metabolizable energy: sheep/goats (Mcal/kg) | cattle/buffalo | Total digestible nutrients: sheep/goats (g/kg) | cattle/buffalo |
|---|---|---|---|---|---|---|---|---|---|
| **Eichhornia crassipes - Waterhyacinth, common** | | | | | | | | | |
| -aerial part, fresh | 2-29-445 | 12.6 | 12.2 | 12.1 | 12.1 | 2.37 | 2.27 | 63.0 | 61.0 |
| -whole, dehydrated | 1-29-619 | 6.8 | 7.2 | 6.8 | 6.8 | 1.87 | 1.88 | 52.0 | 52.0 |
| -whole, silage | 3-29-656 | 3.7 | 3.7 | 3.7 | 3.7 | 2.00 | 1.72 | 55.00 | 49.0 |
| **Fish** | | | | | | | | | |
| -meal, mechanically extracted | 5-01-977 | 58.9 | 58.9 | 59.2 | 59.2 | 2.25 | 3.11 | 61.0 | 86.0 |
| **Glycine max. - Soybean** | | | | | | | | | |
| -aerial part, fresh | 2-04-574 | 18.4 | 18.0 | 17.4 | 17.4 | 2.80 | 2.65 | 73.0 | 70.0 |
| -seeds | 5-04-600 | 37.4 | 37.4 | 37.6 | 37.6 | 3.92 | 3.69 | 98.0 | 97.0 |
| -seeds, meal mechanically extracted | 5-04-610 | 40.8 | 40.8 | 40.5 | 40.5 | 3.41 | 3.39 | 87.0 | 86.0 |
| -seeds, mechanically extracted caked | 5-30-145 | -- | -- | -- | -- | 3.54 | [illegible] | 90.0 | 90.0 |
| -soysauce process residue, wet | 5-06-738 | 10.2 | 10.2 | 9.0 | 9.0 | 2.15 | 2.01 | 58.0 | 69.0 |
| **Gossypium spp. - Cotton** | | | | | | | | | |
| -hulls | 1-01-599 | 0.3 | 0.4 | 0.5 | 0.5 | 1.82 | 1.95 | 51.0 | 54.0 |
| -seeds | 5-01-614 | -- | -- | 13.0 | 13.0 | 3.20 | 3.05 | 82.0 | 78.0 |
| -seed cakes, mechanically extracted | 5-01-623 | -- | -- | -- | -- | 2.71 | 2.56 | 75.0 | 70.9 |
| **Hevea brasiliensis - Rubbertree** | | | | | | | | | |
| -kernels with coats, meal mechanically extracted | 4-12-011 | 16.3 | 16.5 | 15.1 | 15.1 | 2.67 | 2.72 | 70.0 | 71.0 |
| **Ipomoea batatas - Sweet potatoes** | | | | | | | | | |
| -aerial part, fresh | 2-04-784 | 11.7 | 11.2 | 11.3 | 11.3 | 2.51 | 2.48 | 67.0 | 64.0 |
| -leaves, fresh | 2-29-395 | 15.5 | 15.1 | 14.8 | 14.8 | 2.69 | 2.57 | 70.0 | 68.0 |
| -tubers, fresh | 4-04-788 | 2.5 | 2.5 | 1.3 | 1.3 | 3.41 | 3.05 | 87.0 | 79.0 |
| -tubers, meal | 4-08-536 | -0.1 | -0.1 | -1.3 | -1.3 | 3.47 | 3.10 | 88.0 | 80.0 |

(continued)



586

Appendix Table 4A.2: (Continued)

| International feed name | International number | Digestible protein sheep | goat | cattle | buffalo | Metabolizable energy sheep/goats | cattle/buffalo | Total digestible nutrients sheep/goats | cattle/buffalo |
|---|---|---|---|---|---|---|---|---|---|
| | | ------ (% of DM) ------ | | | | --- (Mcal/kg) --- | | --- (g/kg) --- | |
| Leucaena glauca - Leadtree (also identified as *L. leucocephala*). | | | | | | | | | |
| -browse, fresh | 2-02-495 | 23.6 | 23.2 | 22.2 | 22.2 | 2.89 | 2.96 | 75.0 | 77.0 |
| -hay, sun-cured | 1-02-492 | 19.6 | 20.5 | 19.2 | 19.2 | 2.68 | 2.99 | 70.0 | 77.0 |
| -leaves, fresh | 2-29-421 | 19.2 | 18.8 | 18.1 | 18.1 | 2.68 | 2.01 | 70.0 | 71.0 |
| -leaves, fresh immature | 2-29-420 | 23.6 | 23.2 | 22.1 | 22.1 | 3.21 | 3.12 | 82.0 | 80.0 |
| -leaves, sun-cured | 1-20-730 | 22.6 | 23.7 | 22.1 | 22.1 | 2.69 | 2.89 | 71.0 | 75.0 |
| Mangifera indica - Mango, common | | | | | | | | | |
| -leaves, fresh | 2-27-211 | 6.3 | 5.9 | 6.4 | 6.4 | 1.07 | 0.70 | 30.0 | 26.0 |
| Manihot esculenta - Cassava, common | | | | | | | | | |
| -aerial part, fresh | 2-09-627 | 22.5 | 22.1 | 21.1 | 21.1 | 2.70 | 2.95 | 71.0 | 76.0 |
| -leaves, fresh | 2-01-153 | 20.2 | 19.8 | 19.0 | 9.0 | 2.26 | 2.20 | 60.0 | 59.0 |
| -leaves, sun cured | 1-13-552 | 18.7 | 19.6 | 18.3 | 18.3 | 1.81 | 2.03 | 51.0 | 56.0 |
| -peelings, dehydrated | 4-11-937 | 1.7 | 1.7 | 0.5 | 0.5 | 3.36 | 3.08 | 86.0 | 79.0 |
| -starch process residue, dehydrated | 4-11-947 | 1.5 | -0.5 | -1.7 | -1.7 | 2.75 | 2.88 | 72.0 | 75.0 |
| -tubers, fresh | 4-09-599 | -0.8 | -0.8 | -2.0 | -2.0 | 3.50 | 3.10 | 89.0 | 80.0 |
| -tubers, meal | 4-09-598 | -0.4 | -0.4 | -1.6 | -1.6 | 3.46 | 3.08 | 88.0 | 79.0 |
| -tubers w/o peelings, meal | 4-13-553 | -0.6 | -0.6 | -1.8 | -1.8 | 3.55 | 3.13 | 90.0 | 80.0 |
| Mucuna spp. - Velvetbean | | | | | | | | | |
| -hay, sun-cured | 1-05-080 | 29.6 | 30.9 | 28.8 | 28.8 | 3.07 | 3.09 | 79.0 | 79.0 |
| Musa paradisiaca sapientum - Banana, common | | | | | | | | | |
| -aerial part, fresh | 2-10-544 | 2.1 | 1.7 | 2.6 | 2.6 | 2.28 | 2.19 | 61.0 | 59.0 |
| -stems, fresh | 2-11-906 | -- | -0.4 | 0.6 | 0.6 | 1.89 | 1.83 | 53.0 | 51.0 |
| Musa supp. - Banana | | | | | | | | | |
| -leaves, fresh | 2-09-902 | 13.1 | 7.4 | 12.6 | 12.6 | 2.24 | 2.40 | 60.0 | 64.0 |
| -stems, fresh | 2-11-910 | -0.1 | -0.5 | 0.6 | 0.6 | 2.22 | 2.32 | 60.0 | 62.0 |

(continued)

Appendix table 4A.2 : (Continued)

| International feed name | International number | Digestible protein sheep | goat | cattle | buffalo | Metabolizable energy sheep/goats | cattle/buffalo | Total digestible nutrients sheep/goats | cattle/buffalo |
|---|---|---|---|---|---|---|---|---|---|
| | | ------ (% of DM) ------ | | | | --- (Mcal/kg) --- | | --- (g/kg) --- | |
| Oryza sativa - Rice | | | | | | | | | |
| -bran with germs | 4-03-928 | 9.6 | 9.6 | 8.4 | 8.4 | 2.46 | 2.61 | 65.0 | 67.0 |
| -grain | 4-03-939 | 5.3 | 5.3 | 4.1 | 4.1 | 3.53 | 3.09 | 89.0 | 80.0 |
| -groats | 4-03-936 | 7.0 | 7.0 | 5.8 | 5.8 | 3.24 | 3.03 | 83.0 | 78.0 |
| -mill run | 1-03-941 | 2.8 | 3.0 | 2.9 | 2.9 | 2.12 | 2.15 | 58.0 | 58.0 |
| -polishings | 4-03-943 | 9.5 | 9.5 | 8.3 | 8.3 | 3.24 | 3.38 | 83.0 | 86.0 |
| -straw | 1-03-925 | 1.7 | 0.7 | 0.2 | 0.2 | 1.49 | 1.63 | 41.3 | 45.2 |
| Penniseteum purpureum - Napier grass, "rameput gadjah" | | | | | | | | | |
| -aerial part, fresh, 43-56 days growth | 2-10-076 | 5.1 | 4.7 | 5.6 | 5.6 | 2.06 | 1.98 | 56.0 | 55.0 |
| -aerial part, fresh, 57-70 days growth | 2-10-255 | 3.5 | 3.1 | 4.5 | 4.5 | 1.99 | 1.69 | 55.0 | 48.0 |
| Phaseolus anerus - Bean, mung | | | | | | | | | |
| -aerial part, fresh | 2-00-619 | 8.2 | 7.7 | 8.1 | 8.1 | 2.34 | 2.20 | 63.0 | 60.0 |
| -pods, sun-cured | 1-23-068 | 6.4 | 6.8 | 6.4 | 6.4 | 2.10 | 2.07 | 57.0 | 57.0 |
| -seeds | 5-08-185 | 21.8 | 21.8 | -- | -- | 3.52 | 3.08 | 89.0 | 85.0 |
| Poultry | | | | | | | | | |
| -feathers | 5-29-674 | -- | -- | -- | -- | 3.41 | 3.71 | 87.0 | 93.0 |
| Saccharum officinarum - Sugarcane | | | | | | | | | |
| -aerial part, fresh | 2-04-689 | 1.8 | 1.4 | 2.3 | 2.3 | 2.15 | 2.13 | 58.0 | 58.0 |
| -bagasse, dehydrated | 1-04-686 | -0.7 | -0.6 | -0.4 | -0.4 | 1.83 | 1.76 | 51.0 | 50.0 |
| -bagasse, wet | 2-09-909 | 0.3 | -0.1 | 0.9 | 0.9 | 2.61 | 2.66 | 69.0 | 70.0 |
| -leaves, fresh | 2-04-691 | 2.9 | 2.4 | 3.3 | 3.3 | 2.04 | 2.06 | 56.0 | 73.0 |
| -molasses | 4-13-251 | -0.8 | -0.8 | -2.0 | -2.0 | 3.66 | 3.57 | 92.0 | 99.0 |
| -top of aerial part, dehydrated | 1-13-565 | 1.3 | 1.4 | 1.5 | 1.5 | 1.59 | 1.73 | 46.0 | 49.0 |
| -top of aerial part, fresh | 2-13-568 | 2.3 | 2.5 | 2.5 | 2.5 | 1.90 | 1.86 | 53.0 | 52.0 |
| -top of aerial part, silage | 3-08-528 | 0.1 | 0.1 | 0.1 | 0.1 | 2.17 | 1.96 | 59.0 | 54.0 |

(continued)

Appendix table 4A.2: (Continued)

| International feed name | International number | Digestible protein sheep | goat | cattle | buffalo | Metabolizable energy sheep/ goats | cattle/ buffalo | Total digestible nutrients sheep/ goats | cattle/ buffalo |
|---|---|---|---|---|---|---|---|---|---|
| | | ------ (% of DM) ------ | | | | --- (Mcal/kg) --- | | --- (g/kg) --- | |
| Sesbania grandiflora - Wistaria tree, scarlet | | | | | | | | | |
| -leaves, fresh | 2-21-087 | 21.7 | 21.3 | 20.4 | 20.4 | 2.31 | 2.19 | 61.0 | 59.0 |
| Setaria sphacelata - Millet, golden | | | | | | | | | |
| -aerial part, fresh | 2-11-528 | 3.9 | 3.4 | 4.2 | 4.2 | 2.12 | 2.09 | 58.0 | 57.0 |
| Sorghum bicolor - Sorghum | | | | | | | | | |
| -aerial part without heads, sun-cured | 1-04-302 | 2.0 | 2.3 | 2.3 | 2.3 | 2.06 | 1.84 | 56.0 | 51.0 |
| -grain | 4-04-383 | 6.9 | 6.9 | 5.7 | 5.7 | 3.49 | 3.21 | 88.0 | 89.0 |
| Triticum aestivum - Wheat | | | | | | | | | |
| -bran | 4-05-190 | 12.5 | 12.5 | 10.9 | 10.9 | 2.99 | 2.51 | 77.0 | 69.0 |
| -germs, ground | 5-05-218 | -- | -- | 25.9 | 25.9 | 3.65 | 3.41 | 92.0 | 87.0 |
| Vignia sinensis - Cowpea, common | | | | | | | | | |
| -aerial part, fresh | 2-01-655 | 13.1 | 12.5 | 12.5 | 12.5 | 2.24 | 2.33 | 62.0 | 63.0 |
| -hay, sun-cured | 1-01-645 | 9.7 | 10.2 | 9.6 | 9.6 | 1.92 | 1.87 | 53.0 | 52.0 |
| -leaves, fresh | 2-01-656 | 19.6 | 19.2 | 18.5 | 18.5 | 2.53 | 2.33 | 67.0 | 62.0 |
| -seeds | 5-01-661 | 21.5 | 21.1 | 20.3 | 20.3 | 3.27 | 3.24 | 84.0 | 83.0 |
| Zea mays - Maize | | | | | | | | | |
| -aerial part, fresh | 2-02-799 | 5.3 | 4.7 | 5.3 | 5.3 | 2.56 | 2.24 | 68.0 | 60.0 |
| -aerial part, fresh, dough stage | 2-02-803 | 3.2 | 3.0 | 3.0 | 3.0 | 2.28 | 2.11 | 61.0 | 57.0 |
| -husks, mature | 1-02-784 | -- | -- | 1.1 | 1.1 | 1.94 | 2.62 | 53.5 | 72.4 |
| -stems, sun-cured | 1-02-795 | 1.0 | 1.2 | 1.3 | 1.3 | 1.82 | 1.77 | 51.0 | 50.0 |
| -aerial part, w/o ears, w/o husks fresh | 2-02-809 | 2.3 | 1.9 | 2.8 | 2.8 | 2.03 | 2.12 | 56.1 | 58.5 |
| Zea mays indentata - Maize, dent white | | | | | | | | | |
| -grain | 4-02-928 | 6.4 | 6.4 | 5.2 | 5.2 | 3.50 | 3.14 | 89.0 | 81.0 |
| Zea mays indentata - Maize, dent yellow | | | | | | | | | |
| -grain | 4-02-935 | 6.2 | 6.2 | 5.0 | 5.0 | 3.51 | 3.17 | 89.0 | 81.0 |

Source: Kearl (1982)



591

Appendix table 4A.3: Average composition of some common feeds for swine available in Indonesia

| Feedstuff | DM [a/] (%) | ME (Mcal/kg) | TP | Avail. lysine | Methionine & Cysteine | Ca | Avail. P |
|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | |
| Cereals and by-products: | | | | | | | |
| Yellow maize | 89 | 3.39 | 9.0 | 0.26 | 0.26 | 0.02 | 0.20 |
| Maize germ meal | 93 | 2.80 | 20.2 | 0.91 | 0.63 | 0.05 | 0.45 |
| Wheat offal | 89 | 2.87 | 18.0 | 0.60 | 0.70 | 0.10 | 0.55 |
| Wheat bran | 89 | 2.29 | 16.0 | 0.49 | 0.47 | 0.14 | 0.72 |
| Sorghum | 89 | 3.18 | 11.0 | 0.27 | 0.36 | 0.04 | 0.15 |
| Rice | 89 | 2.99 | 8.0 | 0.32 | 0.28 | 0.04 | 0.16 |
| Rice bran [b/] | 39 | 2.29 | 13.5 | 0.50 | 0.40 | 0.06 | 1.20 |
| Seeds and by-products: | | | | | | | |
| Soybean meal [b/] | 89 | 2.99 | 45.0 | 2.90 | 1.40 | 0.30 | 0.40 |
| Groundnut meal [c/] | 92 | 2.92 | 45.0 | 2.20 | 0.60 | 0.20 | 0.40 |
| Coconut meal [b/] | 93 | 2.99 | 20.0 | 0.64 | 0.59 | 0.10 | 0.80 |
| Rubber seed meal [b/] | 91 | 3.11 | 28.0 | -- | -- | -- | -- |
| Palm kernel meal [b/] | 90 | 2.41 | 17.0 | 0.61 | 0.78 | -- | -- |
| Roots crops and other energy sources: | | | | | | | |
| Cassava (dried) [c/] | 87(32) | 3.23 | 1.7 | 0.04 | 0.01 | 0.26 | 0.32 |
| Sweet potatoes (dried) [c/] | 87(30) | 3.13 | 3.8 | 0.13 | 0.11 | 0.40 | 0.50 |
| Sago (dried) | 88 | 2.96 | 0.7 | -- | -- | 0.08 | 0.03 |
| Yam (dried) [c/] | 87(22) | 3.06 | 7.7 | 0.31 | 0.21 | 0.60 | 0.41 |
| Eddo (fresh) | 26 | 3.23 | 2.5 | -- | -- | 0.10 | 0.12 |
| Tannia (fresh) | 32 | 3.00 | 6.9 | -- | -- | -- | -- |
| Bananas (whole, green, fresh) | 10 | 3.14 | 1.0 | -- | -- | -- | -- |
| Molasses (final) | 76 | 3.11 | 3.2 | -- | -- | 1.20 | 0.50 |
| Breadfruit | 42 | -- | 1.0 | 0.05 | 0.02 | 0.02 | 0.03 |

(continued)

Appendix table 4A.3: (continued)

| Feedstuff | DM b/ (%) | ME (Mcal/kg) | TP | Avail. lysine | Methionine & Cysteine | Ca | Avail. P |
|---|---|---|---|---|---|---|---|
| | | | (% of DM) | | | | |
| Animal products: | | | | | | | |
| Fish meal | 91 | 2.61 | 65.0 | 5.70 | 2.50 | 4.50 | 2.90 |
| Shrimp meal | 92 | 2.01 | 42.0 | 2.00 | 1.50 | -- | -- |
| Meat | 94 | 2.94 | 55.0 | 2.40 | 1.10 | 7.10 | 3.40 |
| Meat and bone meal | 95 | 2.84 | 49.0 | 2.10 | 0.80 | 12.00 | 5.11 |
| Blood meal | 91 | 2.10 | 80.0 | 6.60 | 2.30 | 0.28 | 0.22 |
| Green feeds: | | | | | | | |
| Napier grass (2-3 weeks) | 24 | 1.58 | 17.1 | 0.42 | 0.33 | 0.20 | 0.08 |
| Pangola grass (2-3 weeks) | 28 | 2.57 | 13.6 | -- | -- | 0.36 | 0.25 |
| Sweet potato leaves | 21 | 1.81 | 12.4 | -- | -- | 0.76 | 0.67 |
| Banana leaves | 20 | 1.55 | 14.5 | 0.13 | 0.96 | 0.55 | 0.35 |
| Banana stems | 11 | 1.09 | -- | -- | -- | 0.45 | 0.18 |
| Cassava leaves | 28 | 2.00 | 25.0 | 0.43 | 0.19 | 0.14 | 0.03 |
| Water hyacinth | 17 | -- | 14.2 | 0.14 | 0.11 | -- | 0.16 |

Source: Clavijo and Maner (1974); Devendra and Fuller (1979) and NRC (1973).

a/ DM = Dry matter; ME = Metabolizable energy; TP = Total protein

b/ Extracted

c/ Figure in brackets are dry matter of fresh material

Appendix table 4A.4: *In vitro true digestibility of dry matter (IVTDDM) and chemical composition of five tropical grasses at various ages post-harvest in Puerto Rico*

| Grass species | Weeks post-harvest | IVTDDM[a] | NDF | ADF | Lignin | Cellulose | Hemi-cellulose | Silica | Ash | Ether extract | Total protein |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ( % of DM ) | | | | | | | | | |
| *Panicum maximum* ("Guinea") | | | | | | | | | | | |
| | 3 | 78.1 | 56.6 | 39.7 | 4.5 | 30.1 | 16.9 | 5.0 | 13.7 | 1.3 | 11.5 |
| | 6 | 68.3 | 68.7 | 47.2 | 7.5 | 35.5 | 21.5 | 3.9 | 10.9 | 1.3 | 7.6 |
| | 9 | 55.9 | 74.1 | 54.1 | 9.1 | 39.3 | 20.0 | 5.4 | 10.7 | 0.9 | 4.2 |
| *Digitaria decumbens* ("Pangola") | | | | | | | | | | | |
| | 3 | 71.5 | 69.4 | 42.8 | 5.7 | 32.4 | 26.6 | 2.7 | 11.5 | 1.5 | 12.7 |
| | 6 | 65.4 | 72.3 | 46.4 | 7.0 | 35.2 | 25.9 | 3.6 | 10.2 | 1.3 | 7.0 |
| | 9 | 63.7 | 68.4 | 42.9 | 6.6 | 31.4 | 25.5 | 4.9 | 10.5 | 1.4 | 6.2 |
| *Brachiaria ruziziensis* ("Congo") | | | | | | | | | | | |
| | 3 | 79.1 | 61.1 | 33.3 | 4.4 | 26.5 | 27.8 | 2.1 | 10.7 | 1.8 | 9.9 |
| | 6 | 70.3 | 66.1 | 39.3 | 6.0 | 29.7 | 27.8 | 2.9 | 10.1 | 1.7 | 5.4 |
| | 9 | 69.8 | 72.4 | 42.1 | 6.9 | 33.2 | 30.4 | 1.4 | 7.2 | 1.0 | 5.5 |
| *Penniseteum purpureum* ("Napier", "rumput gadja") | | | | | | | | | | | |
| | 3 | 85.7 | 53.0 | 33.3 | 3.1 | 24.2 | 19.7 | 4.4 | 15.7 | 1.8 | 14.4 |
| | 6 | 75.5 | 65.1 | 40.7 | 4.5 | 31.1 | 24.4 | 4.8 | 12.5 | 1.7 | 8.2 |
| | 9 | 64.0 | 74.0 | 47.5 | 8.2 | 35.7 | 26.5 | 4.1 | 5.3 | 1.6 | 9.9 |
| *Cynodon dactylon L.* ("Star grass") | | | | | | | | | | | |
| | 3 | 75.3 | 66.0 | 39.0 | 4.2 | 28.4 | 27.0 | 3.9 | 12.2 | 1.5 | 12.0 |
| | 6 | 64.3 | 72.0 | 44.9 | 7.1 | 34.1 | 27.3 | 3.6 | 10.0 | 0.8 | 6.3 |
| | 9 | 67.0 | 70.2 | 42.3 | 6.2 | 32.7 | 27.9 | 3.8 | 10.2 | 1.1 | 6.9 |

Source: Tessema (1972)

a/ IVTDDM : In vitro true digestibility of dry matter; NDF=neutral detergent fiber; ADF=acid detergent fiber



594

Appendix table 4A.5: <u>Daily nutrient requirements of (dairy) cattle</u>

| Body weight (kg) | Feed energy ME[a] (Mcal) | Feed energy TDN[a] (kg) | Total protein (g) | Calcium (g) | Phosphorous (g) |
|---|---|---|---|---|---|
| Maintenance of mature cows[b/c] | | | | | |
| 400 | 11.90 | 3.15 | 373 | 15 | 13 |
| 450 | 12.90 | 3.44 | 40[illegible] | 17 | 14 |
| 500 | 14.06 | 3.72 | 432 | 18 | 15 |
| 550 | 15.11 | 4.00 | 461 | 20 | 16 |
| Maintenance plus last two months of gestation of mature dry cows | | | | | |
| 450 | 16.90 | 4.47 | 763 | 29 | 20 |
| 500 | 18.29 | 4.84 | 821 | 31 | 22 |
| 550 | 19.65 | 5.20 | 877 | 34 | 24 |
| 600 | 20.97 | 5.55 | 931 | 37 | 26 |
| 650 | 22.27 | 5.90 | 984 | 39 | 28 |
| Milk production-nutrients per kg of different fat percentages | | | | | |
| fat (%) | | | | | |
| 2.5 | 0.99 | 0.260 | 72 | 2.40 | 1.65 |
| 3.0 | 1.07 | 0.282 | 77 | 2.50 | 1.70 |
| 3.5 | 1.16 | 0.304 | 82 | 2.60 | 1.75 |
| 4.0 | 1.24 | 0.326 | 87 | 2.70 | 1.80 |
| 4.5 | 1.31 | 0.344 | 92 | 2.80 | 1.85 |
| Body weight change during lactation-nutrients per kg weight change | | | | | |
| Weight loss | -8.25 | -2.17 | -320 | | |
| Weight gain | 8.55 | 2.26 | 500 | | |

(continued)



595

Appendix table 4A.5: (Continued)

Mature Zebu and Zebu-native crossbred cows and bullocks - working four hours per day (includes maintenance)[d]

| | | | | | |
|---|---|---|---|---|---|
| 300 | 11.1 | 3.1 | 460 | 10 | 10 |
| 350 | 12.9 | 3.6 | 515 | 12 | 12 |
| 400 | 14.4 | 5.1 | 573 | 13 | 13 |
| 450 | 15.8 | 4.4 | 623 | 14 | 14 |

Source: NRC (1978)

[a] ME = Metabolizable energy; TDN - Total digestible nutrients

[b] To allow for growth of young lactating cows, increase the maintenance allowance for all nutrients by 20% during the first lactation and 10% during the second lactation.

[c] Maintenance requirements should be increased 10% for ambient temperatures above 30oC.

Appendix table 4A.6: Daily nutrient requirements for liveweight gain of growing cattle

| Body weight (kg) | Gain (or loss) (kg) | Dry matter: Intake (kg) | Dry matter: % of live wt | Energy: ME[a] (Mcal) | Energy: TDN[a] (kg) | Protein: Total (g) | Protein: Dig. (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|---|---|---|---|
| Steers[b/c] | | | | | | | | | |
| Maintenance and growth | | | | | | | | | |
| 100 | .0 | 2.2 | 2.2 | 3.76 | 1.0 | 167 | 90 | 5 | 5 |
| | .25 | 2.6 | 2.6 | 4.76 | 1.3 | 306 | 200 | 10 | 7 |
| | .50 | 3.0 | 3.0 | 5.82 | 1.6 | 379 | 254 | 15 | 9 |
| | .75 | 3.2 | 3.2 | 6.88 | 1.9 | 448 | 309 | 20 | 11 |
| | 1.00 | 3.3 | 3.3 | 7.94 | 2.2 | 541 | 363 | 25 | 15 |
| 150 | .0 | 3.0 | 2.0 | 5.10 | 1.4 | 231 | 123 | 6 | 6 |
| | .25 | 3.8 | 2.5 | 6.56 | 1.8 | 400 | 251 | 12 | 9 |
| | .50 | 4.2 | 2.8 | 8.02 | 2.2 | 474 | 305 | 16 | 10 |
| | .75 | 4.4 | 2.9 | 9.55 | 2.6 | 589 | 361 | 21 | 13 |
| | 1.00 | 4.5 | 3.0 | 10.93 | 3.0 | 607 | 414 | 27 | 16 |
| 200 | .0 | 3.7 | 1.9 | 6.30 | 1.8 | 285 | 152 | 6 | 6 |
| | .25 | 4.5 | 2.3 | 8.10 | 2.2 | 470 | 293 | 11 | 9 |
| | .50 | 5.2 | 2.6 | 9.90 | 2.8 | 554 | 348 | 16 | 12 |
| | .75 | 5.4 | 2.7 | 11.70 | 3.2 | 622 | 403 | 21 | 15 |
| | 1.00 | 5.6 | 2.8 | 13.51 | 3.7 | 690 | 457 | 27 | 17 |
| | 1.10 | 5.6 | 2.8 | 14.23 | 3.9 | 714 | 479 | 30 | 18 |
| 250 | .0 | 4.4 | 1.8 | 7.40 | 2.0 | 337 | 180 | 9 | 9 |
| | .25 | 5.3 | 2.1 | 9.52 | 2.6 | 534 | 329 | 12 | 10 |
| | .50 | 6.2 | 2.5 | 11.64 | 3.2 | 623 | 383 | 16 | 14 |
| | .75 | 6.4 | 2.6 | 13.78 | 3.8 | 693 | 438 | 21 | 17 |
| | 1.00 | 6.6 | 2.6 | 15.84 | 4.3 | 760 | 492 | 28 | 19 |
| | 1.10 | 6.6 | 2.6 | 16.68 | 4.6 | 782 | 514 | 30 | 20 |
| 300 | .0 | 5.0 | 1.7 | 8.50 | 2.4 | 385 | 206 | 10 | 10 |
| | .25 | 6.0 | 2.0 | 10.90 | 3.0 | 588 | 357 | 15 | 11 |
| | .50 | 7.0 | 2.3 | 13.40 | 3.7 | 679 | 411 | 19 | 14 |
| | .75 | 7.4 | 2.5 | 15.80 | 4.3 | 753 | 466 | 23 | 18 |
| | 1.00 | 7.5 | 2.5 | 18.23 | 5.0 | 819 | 520 | 28 | 21 |
| | 1.10 | 7.6 | 2.5 | 19.20 | 5.3 | 847 | 542 | 30 | 22 |
| 350 | .0 | 5.7 | 1.6 | 9.50 | 2.6 | 432 | 231 | 12 | 12 |
| | .25 | 6.8 | 1.9 | 12.22 | 3.3 | 635 | 378 | 16 | 14 |
| | .50 | 7.9 | 2.3 | 14.94 | 4.1 | 731 | 433 | 20 | 16 |
| | .75 | 8.3 | 2.4 | 17.66 | 4.8 | 806 | 487 | 25 | 18 |

(continued)

Appendix table 4A.6: (continued)

| Body weight (kg) | Gain (or loss) (kg) | Dry matter Intake (kg) | Dry matter % of live wt | Energy ME[a] (Mcal) | Energy TDN[a] (kg) | Protein Total (g) | Protein Dig. (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|---|---|---|---|
| Steers (continued) | | | | | | | | | |
| 350 | 1.00 | 8.5 | 2.4 | 20.38 | 5.6 | 874 | 542 | 30 | 21 |
| | 1.10 | 8.5 | 2.4 | 21.47 | 5.9 | 899 | 563 | 31 | 23 |
| | 1.20 | 8.5 | 2.4 | 22.56 | 6.2 | 923 | 585 | 32 | 24 |
| 400 | .0 | 6.2 | 1.6 | 10.60 | 2.9 | 478 | 256 | 13 | 13 |
| | .25 | 7.5 | 1.9 | 13.63 | 3.7 | 664 | 393 | 16 | 15 |
| | .50 | 8.7 | 2.2 | 16.66 | 4.6 | 772 | 447 | 21 | 18 |
| | .75 | 9.1 | 2.3 | 19.69 | 5.4 | 875 | 502 | 26 | 21 |
| | 1.00 | 9.3 | 2.3 | 22.74 | 6.2 | 913 | 556 | 31 | 24 |
| | 1.10 | 9.4 | 2.4 | 23.95 | 6.6 | 942 | 578 | 32 | 25 |
| | 1.20 | 9.4 | 2.4 | 25.16 | 7.0 | 967 | 600 | 33 | 25 |
| | 1.30 | 9.3 | 2.3 | 26.37 | 7.2 | 988 | 622 | 33 | 26 |
| Heifers [c] | | | | | | | | | |
| Maintenance and growth | | | | | | | | | |
| 100 | .0 | 2.4 | 2.4 | 3.81 | 1.1 | 178 | 93 | 4 | 4 |
| | .50 | 2.9 | 2.9 | 4.90 | 1.3 | 321 | 206 | 13 | 10 |
| | .75 | 3.1 | 3.1 | 5.99 | 1.7 | 391 | 262 | 14 | 11 |
| | 1.00 | 3.2 | 3.2 | 7.09 | 2.0 | 460 | 319 | 20 | 14 |
| 150 | .0 | 3.3 | 2.2 | 5.25 | 1.6 | 234 | 127 | 5 | 5 |
| | .25 | 4.0 | 2.7 | 6.76 | 1.9 | 414 | 258 | 13 | 11 |
| | .50 | 4.2 | 2.8 | 8.26 | 2.3 | 513 | 315 | 14 | 12 |
| | .75 | 4.4 | 2.9 | 9.76 | 2.7 | 552 | 368 | 19 | 15 |
| | 1.00 | 4.5 | 3.0 | 11.26 | 3.1 | 623 | 428 | 25 | 18 |
| 200 | .0 | 4.0 | 2.0 | 6.49 | 1.8 | 299 | 157 | 6 | 6 |
| | .25 | 4.9 | 2.4 | 8.34 | 2.3 | 492 | 302 | 10 | 10 |
| | .50 | 5.6 | 2.8 | 10.20 | 2.8 | 577 | 358 | 14 | 13 |
| | .75 | 5.5 | 2.7 | 12.05 | 3.3 | 639 | 415 | 19 | 16 |
| | 1.00 | 5.6 | 2.8 | 13.92 | 3.8 | 707 | 472 | 23 | 18 |
| 250 | .0 | 4.8 | 1.9 | 7.62 | 2.1 | 264 | 185 | 7 | 7 |
| | .25 | 5.8 | 2.3 | 9.81 | 2.7 | 486 | 340 | 12 | 12 |
| | .50 | 6.2 | 2.5 | 11.99 | 3.3 | 564 | 395 | 13 | 13 |
| | .75 | 6.5 | 2.6 | 14.19 | 3.9 | 644 | 451 | 18 | 15 |
| | 1.00 | 6.6 | 2.6 | 16.32 | 4.5 | 724 | 507 | 23 | 18 |
| | 1.10 | 6.6 | 2.6 | 17.18 | 4.8 | 757 | 530 | 25 | 20 |

(continued)



598

Appendix table 4A.6: (Continued)

| Body weight (kg) | Gain (or loss) (kg) | Dry matter: Intake (kg) | Dry matter: % of live wt | Energy: ME[a] (Mcal) | Energy: TDN[a] (kg) | Protein: Total (g) | Protein: Dig. (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|---|---|---|---|
| 300 | .0 | 5.5 | 1.8 | 8.76 | 2.4 | 303 | 212 | 9 | 9 |
| | .25 | 6.7 | 2.2 | 11.23 | 3.1 | 526 | 368 | 13 | 13 |
| | .50 | 7.1 | 2.4 | 13.80 | 3.8 | 604 | 423 | 14 | 14 |
| | .75 | 7.4 | 2.5 | 16.27 | 4.5 | 717 | 502 | 17 | 15 |
| | 1.00 | 7.6 | 2.5 | 18.78 | 5.2 | 764 | 535 | 21 | 18 |
| | 1.10 | 7.3 | 2.4 | 22.11 | 6.1 | 797 | 558 | 24 | 20 |
| 350 | .0 | 6.1 | 1.7 | 9.78 | 2.7 | 340 | 238 | 10 | 10 |
| | .25 | 7.4 | 2.1 | 12.59 | 3.5 | 557 | 390 | 15 | 15 |
| | .50 | 8.0 | 2.3 | 15.39 | 4.3 | 637 | 446 | 15 | 15 |
| | .75 | 8.3 | 2.4 | 18.19 | 5.0 | 717 | 502 | 15 | 15 |
| | 1.00 | 8.5 | 2.4 | 20.99 | 5.8 | 797 | 558 | 18 | 18 |
| | 1.10 | 8.5 | 2.4 | 22.11 | 6.1 | 829 | 580 | 20 | 19 |
| | 1.20 | 8.4 | 2.4 | 23.24 | 6.4 | 860 | 602 | 21 | 20 |
| 400 | .0 | 6.8 | 1.7 | 10.92 | 3.0 | 377 | 264 | 11 | 11 |
| | .25 | 8.3 | 2.1 | 14.04 | 3.9 | 579 | 405 | 15 | 15 |
| | .50 | 8.8 | 2.2 | 17.16 | 4.7 | 657 | 460 | 15 | 15 |
| | .75 | 9.2 | 2.3 | 20.28 | 5.6 | 739 | 517 | 16 | 16 |
| | 1.00 | 9.4 | 2.4 | 23.42 | 6.5 | 819 | 573 | 18 | 18 |
| | 1.10 | 9.4 | 2.4 | 24.67 | 6.8 | 850 | 595 | 19 | 19 |
| | 1.20 | 9.2 | 2.3 | 25.27 | 7.0 | 883 | 618 | 20 | 19 |

Source: Kearl (1982)

[a] ME = Metabolizable energy; TDN = Total digestible nutrients

[b] For bulls, due to their greater efficiency of conversion of feed to liveweight gain, reduce rquirements by 15% as per Dyer and O'Mary (1977).

[c] For ambient temperatures above 30°C increase requirements by 10%



599

Table 4A.7: Daily nutrient requirements of buffalo

| Body weight (kg) | Feed energy ME[a] (Mcal) | TDN[a] (kg) | Total protein (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|
| Maintenance of adult buffaloes [b/c] | | | | | |
| 350 | 10.1 | 2.8 | 423 | 27 | 21 |
| 400 | 11.2 | 3.1 | 469 | 30 | 23 |
| 450 | 12.2 | 3.4 | 512 | 31 | 24 |
| 500 | 13.2 | 3.6 | 553 | 33 | 25 |
| Mature cows in their last three months of gestation, including maintenance | | | | | |
| 400 | 15.2 | 4.2 | 644 | 23 | 18 |
| 450 | 16.2 | 4.5 | 720 | 26 | 20 |
| 500 | 17.2 | 4.8 | 776 | 29 | 22 |
| 550 | 18.2 | 5.0 | 832 | 31 | 24 |
| Milk production - nutrients per kg of different fat percentages | | | | | |
| fat (%) | | | | | |
| 4.0 | 1.23 | 0.34 | 87 | 2.7 | 2.0 |
| 5.0 | 1.40 | 0.38 | 98 | 2.9 | 2.2 |
| 6.0 | 1.57 | 0.43 | 108 | 3.1 | 2.4 |
| 7.0 | 1.74 | 0.48 | 118 | 3.3 | 2.6 |
| 8.0 | 1.91 | 0.53 | 128 | 3.5 | 2.8 |
| Working buffalo - moderate work (4 hrs/day)[d] | | | | | |
| 300 | 11.9 | 3.3 | 577 | 13 | 11 |
| 400 | 15.0 | 4.1 | 644 | 17 | 13 |
| 500 | 18.0 | 5.0 | 617 | 20 | 15 |
| Working buffalo - heavy work (8 hrs/day) [d] | | | | | |
| 300 | 14.8 | 4.1 | 623 | 13 | 11 |
| 400 | 18.9 | 5.2 | 715 | 17 | 13 |
| 500 | 22.8 | 6.3 | 699 | 20 | 15 |

Source: Kearl (1982)

[a] ME = Metabolizable energy; TDN = Total digestible nutrients

[b] Increase all nutrient requirements 20% during the first lactation and 10% during the second lactation to allow for growth.

(continued)



600

Appendix table 4A.7: (Continued)

c/ Maintenance requirements should be increased 10% for ambient temperatures above 30°C for non-working buffalo; 25% for working buffalo.

d/ Energy has been calculated using a value of 2.4 kcal ME/hr of work/kg of body weight plus the ME requirement for maintenance and growth. A safety factor of 10% has been added to the total protein requirement for growth and maintenance of working buffalo doing moderate work and 20% for heavy work.

Appendix table 4A.8: Daily nutritional requirements of swine

| Class | Body weight (kg) | Metabolizable energy (Mcal) | Total protein | Ca | P |
|---|---|---|---|---|---|
| | | | (g) | | |
| Breeding swine | | | | | |
| Bred gilts | 110-160 | 6.34 | 280 | 15.0 | 10.0 |
| Bred sows | 160-250 | 6.34 | 280 | 15.0 | 10.0 |
| Lactating gilts | 140-200 | 15.84 | 750 | 37.5 | 25.0 |
| Lactating sows | 200-250 | 17.42 | 825 | 41.2 | 27.5 |
| Young boars | 110-180 | 7.92 | 350 | 18.8 | 12.5 |
| Adult boars | 180-250 | 6.34 | 280 | 15.0 | 10.0 |
| Growing swine | | | | | |
| | 5-10 | 2.02 | 132 | 4.8 | 3.6 |
| | 10-20 | 4.20 | 225 | 8.1 | 6.3 |
| | 20-35 | 5.39 | 272 | 11.0 | 8.5 |
| | 35-60 | 7.92 | 350 | 12.5 | 10.0 |
| | 60-100 | 11.09 | 455 | 17.5 | 14.5 |

Source: NRC (1973)

Appendix table 4A.9: Daily nutrient requirements of sheep

| Body weight (kg) | Daily gain or loss (g) | Feed energy: ME[a] (Mcal) | Feed energy: TDN[a] (kg) | Total protein (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|---|
| **Ewes and Lambs** | | | | | | |
| Maintenance, growth, non-lactating and first 15 weeks of growth [b/c/d/e] | | | | | | |
| 10 | 0 | 0.52 | 0.14 | 26 | 2.2 | 1.5 |
| | 25 | 0.64 | 0.18 | 30 | 2.2 | 1.5 |
| | 50 | 0.76 | 0.21 | 35 | 2.3 | 1.5 |
| | 100 | 1.00 | 0.28 | 43 | 2.3 | 1.6 |
| 15 | 0 | 0.71 | 0.20 | 36 | 2.7 | 1.7 |
| | 25 | 0.87 | 0.24 | 42 | 2.7 | 1.7 |
| | 50 | 1.04 | 0.29 | 49 | 2.8 | 1.8 |
| | 100 | 1.37 | 0.38 | 58 | 2.9 | 1.9 |
| 20 | 0 | 0.88 | 0.24 | 44 | 3.2 | 2.1 |
| | 25 | 1.08 | 0.30 | 52 | 3.2 | 2.2 |
| | 50 | 1.29 | 0.36 | 59 | 3.3 | 2.3 |
| | 100 | 1.69 | 0.47 | 72 | 3.4 | 2.4 |
| 25 | 0 | 1.04 | 0.29 | 53 | 4.0 | 2.6 |
| | 25 | 1.28 | 0.36 | 61 | 4.1 | 2.7 |
| | 50 | 1.52 | 0.42 | 70 | 4.1 | 2.7 |
| | 100 | 2.00 | 0.55 | 85 | 4.2 | 2.8 |
| 30 | 0 | 1.19 | 0.33 | 27 | 4.4 | 3.0 |
| | 25 | 1.74 | 0.48 | 42 | 4.6 | 3.1 |
| | 50 | 2.29 | 0.63 | 55 | 4.8 | 3.2 |
| | 100 | 2.57 | 0.72 | 60 | 4.9 | 3.3 |
| Last six weeks of gestation or last eight weeks of lactation [b/c/d/e] | | | | | | |
| 20 | 100 | 2.31 | 0.64 | 103 | 3.9 | 3.7 |
| 30 | 125 | 3.42 | 0.94 | 148 | 3.9 | 3.7 |
| 40 | 100 | 3.90 | 1.08 | 174 | 4.0 | 3.8 |
| First eight weeks of lactation [c/d] | | | | | | |
| 20 | 5 | 2.34 | 0.55 | 105 | 9.5 | 6.9 |
| 30 | 5 | 2.99 | 0.75 | 143 | 9.8 | 7.1 |
| 40 | -10 | 3.37 | 0.93 | 176 | 10.4 | 7.4 |

(continued)

Appendix table 4.A.9: (Continued)

Rams, maintenance and growth [d/]

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | 120 | 2.59 | 0.72 | 113 | 5.9 | 3.2 |
| 40 | 110 | 3.07 | 0.85 | 137 | 6.3 | 3.5 |
| 50 | 100 | 3.48 | 0.96 | 159 | 6.8 | 3.8 |
| 60 | 100 | 3.99 | 1.10 | 181 | 7.2 | 4.0 |

Source: Table values of Kearl (1982) corrected as per NRC (1975) to reflect increased requirements for lactation in first eight weeks relative to late gestation and last eight weeks of lactation.

[a/] ME = Metabolizable energy; TDN = Total digestible nutrients

[b/] For young ewes in their first lactation, 10% should be added to nutritional requirements.

[c/] Maintenance requirements during last trimester were calculated at 171% of maintenance. For ewes suckling twins, add 15% to nutritional requirements for last eight weeks of lactation.

[d/] An additional 10% should be added to maintenance requirements where environmental temperatures exceed 30°C.

[e/] For flocks with a high reproductive rate (1.75 or more) where there is a high probability that ewes in late lactation are carrying twins, nutritional requirements during the last six weeks should be increased an additional 25%.

Appendix table 4A.10: Daily nutrient requirements of goats

| Body weight (kg) | Feed energy ME[a] (Mcal) | Feed energy TDN[a] (kg) | Total Protein (g) | Ca (g) | P (g) |
|---|---|---|---|---|---|
| Maintenance only (includes stable feeding conditions, minimal activity, and early pregnancy) [b] | | | | | |
| 10 | 0.57 | 159 | 22 | 1.0 | 0.7 |
| 20 | 0.96 | 267 | 38 | 1.0 | 0.7 |
| 30 | 1.30 | 362 | 51 | 2.0 | 1.4 |
| 40 | 1.61 | 448 | 63 | 2.0 | 1.4 |
| Maintenance plus low activity (=25% increment, intensive management, tropical range and early pregnancy) [b] | | | | | |
| 10 | 0.71 | 199 | 27 | 1.0 | 0.7 |
| 20 | 1.20 | 334 | 46 | 1.4 | 0.9 |
| 30 | 1.62 | 452 | 62 | 1.4 | 1.2 |
| 40 | 2.02 | 560 | 77 | 2.1 | 1.5 |
| Additional requirements for late pregnancy (for all goat sizes) | | | | | |
| | 1.42 | 397 | 82 | 2.0 | 1.4 |
| Additional requirements for growth-weight gain at 50 g per day (for all goat sizes) | | | | | |
| | 0.36 | 100 | 14 | 1.0 | 0.7 |
| Additional requirements for growth-weight gain at 100 g per day (for all goat sizes) | | | | | |
| | 0.72 | 200 | 28 | 1.0 | 0.7 |
| Additional requirements for milk production per kg at different fat percentages (including requirements for nursing single, twin, or triplet kids at the respective milk production levels) | | | | | |
| % Fat | | | | | |
| 3.0 | 1.21 | 337 | 64 | 2.0 | 1.4 |
| 3.5 | 1.23 | 342 | 68 | 2.0 | 1.4 |
| 4.0 | 1.25 | 346 | 72 | 3.0 | 2.1 |
| 4.5 | 1.26 | 351 | 77 | 3.0 | 2.1 |

Source: NRC (1981)

[a] ME = Metabolizable energy; TDN = Total digestible nutrients

[b] An additional 10% should be added to maintenance requirements when ambient temperatures exceed 30°C.



605

**APPENDIX 6**

**TABLES FOR CHAPTER VI:**

**SUPPORT SERVICES**

Appendix table 6.1 Budgeting and resources for livestock development during Repelita I, Repelita II, Repelita III and the first and second year of Repelita IV (millions of Rupiahs)

| Source | Repelita I | Repelita II | Repelita III | -----Repelita IV------ First Year (1984/1985) | Second Year (1985/1986) | Total allocations |
|---|---|---|---|---|---|---|
| Development budget | | | | | | |
| APBN National Budget | | | | | | |
| Program for livestock production development | 1,657.82 | 13,715.07 | 61,143.36 | 19,424.67 | 17,700.81 | 113,641.73 |
| Program for improvement development of statistic | - | 198.30 | 359.90 | 73.66 | 80.00 | 711.86 |
| Program improvement of efficiency of officials | 96.30 | 299.73 | 576.91 | 193.53 | 119.86 | 1,286.33 |
| Program improvement of physical infrastructure of GOI | 350.02 | 255.36 | 252.30 | - | - | 857.68 |
| Program education on agriculture and irrigation | 203.01 | 130.00 | - | - | - | 331.01 |
| Program research on agriculture and irrigation | 563.55 | - | - | - | - | 563.55 |
| Program participation of smallholders in livestock development | - | - | 475.00 | - | - | 475.00 |
| Program Village Development | - | - | 1,800.00 | - | - | 1,800.00 |
| Program Transmigration | - | 200.00 | 13,290.21 | 1,305.00 | 3,428.62 | 18,223.83 |
| Total APBN | 2,870.70 | 14,798.46 | 77,897.68 | 20,996.86 | 21,329.29 | 137,892.99 |
| APBD Provincial income and expenditure budget | - | - | 20,758.56 | - | - | 20,758.56 |
| Sub-Total | 2,870.70 | 14,798.46 | 98,656.24 | 20,996.86 | 21,329.29 | 158,651.56 |
| Routine budget | 716.00 | 3,351.00 | 13,059.00 | 3,680.00 | 5,207.00 | 26,013.00 |
| Domestic credit budget | 59.00 | 5,511.00 | 102,248.00 | - | - | 107,818.00 |
| Counter budget technical Assistance/project aid | - | - | 70,562.00 | 28,196.00 | 24,510.00 | 123,268.00 |
| Others | - | - | 49,938.00 | - | - | 49,938.00 |
| Total | 3,645.70 | 23,660.46 | 334,463.24 | 52,872.86 | 51,046.29 | 465,688.55 |

Source: DGLS internal budget documents, various years.

Appendix table 6.2: Output of dairy factories in Indonesia, 1981-84 [a]

| Factory number | Factory Name | Type of product | Units | 1981 | 1982 | 1983 | 1984 |
|---|---|---|---|---|---|---|---|
| 1. | PT Food Specialties Indonesia | SCM | cartons | 803,103 | 753,209 | 927,943 | 861,235 |
| | | Milk powder | tons | 9,916 | 9,414 | 10,036 | 9,541 |
| | | BMR | tons | - | - | 2,668 | 11,699 |
| | | BMP | tons | 1,495 | 1,837 | 2,293 | 1,699 |
| | | T Food | tons | 824 | 760 | 1,021 | 1,099 |
| | | Sterilized milk | tons | 779 | 1,036 | 1,227 | 776 |
| 2. | PT Friesche Vlag Indonesia | SCM | cartons | 1,002,624 | 1,165,192 | 1,359,602 | 1,119,476 |
| | | Milk powder | tons | 8,018 | 8,777 | 9,822 | 5,859 |
| 3. | PT Foremost | SCM | cartons | 1,527,308 | 1,507,160 | 1,535,507 | 1,447,676 |
| 4. | PT Indomilk | SCM | cartons | 1,423,711 | 1,430,820 | 1,453,620 | 1,246,428 |
| | | Milk powder | tons | - | - | 437 | 4 |
| | | Pasteurized Fresh | tons | 1,353 | 1,493 | 6,712 | 10,512 |
| | | Butter | tons | 559 | - | 400 | 330 |
| 5. | PT SARI HUSADA | Milk powder | tons | 741 | 207 | 368 | 1,055 |
| | | BMR | tons | 7,792 | 4,447 | 7,101 | 1,200 |
| | | BMP | tons | - | - | 139 | 377 |
| | | UHT | liters | - | - | 1,191,060 | 1,640,911 |
| 6. | PT Ultra Jaya | UHT | liters | 7,900,000 | 8,473,000 | 9,421,800 | 9,284,160 |
| 7. | PT Dafa | UHT | liters | - | - | 437,000 | 596,630 |
| | | Pasteurized | tons | - | - | - | - |
| | | Yoghurt | tons | - | - | - | - |

Source: DGLS (1985a)

[a] SCM = Sweetened condensed milk; BMR = baby milk replacer; BMP = Babi milk powder; UHT - Ultra-high temperature sterilized milk



608

Appendix Table 6.3: Buying, selling and handling costs at Cooperative/KUD

| | Production per day | Selling price | Buying price | Handling cost | Buying as % of selling price | Handling cost relative to selling |
|---|---|---|---|---|---|---|
| | (liters) | (Rp/litre) | (Rp/litre) | (Rp/litre) | (%) | (%) |
| Strata I a/ | 2,500 | 278.75 | 227 | 51.75 | 81.43 | 18.57 |
| UFP Kaliurang | 900 | 271 | 215 | 56 | 79.43 | 20.66 |
| Karangnongko | 1,100 | 284 | 228 | 56 | 80.28 | 19.72 |
| Karangploso | 1,200 | 280 | 225 | 55 | 80.36 | 19.64 |
| Kertajaya | 2,154 | 280 | 240 | 40 | 85.71 | 14.29 |
| Strata II | 2,500-10,000 | 301.65 | 237.95 | 63.71 | 78.88 | 21.12 |
| Cisurupan | 2,500 | 275 | 200 | 75 | 72.73 | 27.27 |
| Makmur | 2,900 | 338.69 | 260 | 78.69 | 76.72 | 23.28 |
| Bakti | 3,400 | 338.69 | 260 | 78.69 | 76.72 | 23.28 |
| Ungaran | 3,650 | 275.25 | 229 | 46.25 | 83.20 | 16.80 |
| Cikajang | 3,729 | 275 | 200 | 75 | 72.73 | 27.27 |
| Danamulya | 4,000 | 290 | 225 | 65 | 77.59 | 22.41 |
| Boyolali Kota | 4,350 | 275.25 | 227.5 | 47.75 | 82.65 | 17.35 |
| Cepogo | 5,250 | 275.25 | 224.5 | 50.75 | 81.56 | 18.44 |
| Marga Mulya | 6,000 | 300.25 | 243 | 57.25 | 80.93 | 19.07 |
| Bayongbong | 6,900 | 318.29 | 227 | 91.29 | 71.32 | 28.68 |
| K.P.S. | 7,136 | 328.69 | 265 | 63.69 | 80.57 | 19.43 |
| Koperda | 7,445 | 328.69 | 294.39 | 34.5 | 89.51 | 10.49 |
| Strata III 10,000-20,000 | | | | | | |
| K P S B U | 18,500 | 312.29 | 250 | 62.29 | 80.01 | 19.95 |
| Strata IV | )25,000 | 302.31 | 258.33 | 43.98 | 85.45 | 14.55 |
| Sae Pujon | 37,500 | 300.25 | 250 | 50.25 | 83.26 | 16.74 |
| Setia Kawan | 39,662 | 300.25 | 250 | 50.25 | 83.26 | 16.74 |
| XPPS/MT | 63,736 | 306.43 | 275 | 31.43 | 89.74 | 10.26 |
| Milk Treatment | 16,000-33,000 | 300.25 | 279.42 | 32.69 | 89.05 | 10.95 |
| Mt. Batu | 16,293 | 300.25 | 280 | 28.51 | 90.5 | 9.50 |
| Mt. Pandaan | 22,751 | 300.25 | 280 | 22.13 | 92.63 | 7.37 |
| Mt. Boyolali | 31,000 | 300.25 | 282.68 | 41.83 | 86.07 | 13.93 |
| Mt. Ujungberung | 33,000 | 300.25 | 275 | 39.1 | 86.98 | 13.02 |

Source:

a/ Based on standardized milk price and production capacity/KUD



609

Appendix Table 6.4: Itemization of milk handling cost at each Cooperative/KUD

| | UPP | Karang | | | | | |
|---|---|---|---|---|---|---|---|
| | Kaliurang | Nongko | Ploso | Kertajaya | Cisurupan | Makmur | Bhakti |
| Production (liters/day): | 900 | 1100 | 1200 | 2154 | 2500 | 2900 | 3400 |
| Administration and Organization | 24 | 11 | 16.9 | 9 | 28 | 19.5 | 17.5 |
| Administration | 2 | 0.5 | 1.41 | 2 | 3 | 3.5 | 3 |
| Wages/salary | 14 | 4 | 10 | 6 | 13 | 10 | 8 |
| Extension for members | 5 | 0.5 | 0.46 | 1 | 5 | - | 0.5 |
| Technical services | 1 | 0.5 | 1 | - | 7 | 4 | 3 |
| Contribution to GKSI | - | 1 | 2 | - | - | 2 | 1 |
| Social etc. | 2 | 0.5 | 1 | - | - | - | 1 |
| Retribution/to regional develop | - | 2 | 0.03 | - | - | - | 1 |
| Members contribution | - | 2 | 1 | - | - | - | - |
| Overhead | 15.5 | 13 | 18.8 | 13 | 24 | 52 | 52 |
| Processing/handling | - | - | - | 2 | - | 7 | 17 |
| Exploitation | 1 | 0.5 | 1.26 | - | - | 15 | 5 |
| Milk transport | 5 | 7.5 | 1.63 | 5 | 20 | 15 | 15 |
| Spoiled risk | 6 | - | 4.8 | 2 | 4 | 10 | 10 |
| Investment/equipment/building | 3.5 | 5 | 11.11 | 4 | - | 5 | 5 |
| Saving/Investment | 14 | 31 | 15.9 | 14 | 22 | 5 | 7 |
| Saving | 3 | 2 | 2.4 | 3 | 2 | - | 2 |
| Share/milk treatment | - | 3 | 3 | 3 | 3 | - | - |
| Government investment saving | 5 | - | - | - | 5 | - | - |
| Credit repayment/interest | 6 | 24 | 5.5 | 8 | 12 | 5 | 5 |
| Profit | 2.5 | 1 | 3.4 | 4 | 1 | 2.39 | 2.39 |
| Total Cost | 56 | 56 | 55 | 40 | 75 | 78.89 | 78.89 |

(continued)

Appendix Table 6.4: (Continued)

| Production (liters/day) | Ungaran | Cikajang | Dana Mulya | Boyolali Kota | Cepogo | Warga Mulya | Bayongbong |
|---|---|---|---|---|---|---|---|
| Administration and Organization | 11.25 | 13 | 16.85 | 20.25 | 19.25 | 22 | 25.29 |
| Administration | 0.5 | 0.5 | 0.25 | 1 | 1 | 1 | 2 |
| Wages/salary | 4.5 | 6.5 | 10 | 7 | 7 | 8 | 11 |
| Extension for members | 0.5 | 1 | 0.5 | 1.75 | 0.75 | 6 | 2 |
| Technical services | 0.25 | 1 | 2 | 2 | 3.5 | 4 | 5.29 |
| Contribution to GKSI | - | 1 | 1 | 3 | 1 | 3 | 3 |
| Social etc. | 0.5 | 1 | 0.1 | 0.5 | 1 | - | 1 |
| Retribution/to regional develop | 5 | - | - | 5 | 5 | - | - |
| Members contribution | - | 2 | 3 | - | - | - | 1 |
| Overhead | 18 | 45 | 18.25 | 9.5 | 12 | 18 | 38 |
| Processing/handling | 7.5 | 15 | 6 | - | - | 0 | 6 |
| Exploitation | 2.5 | 9.5 | 3.25 | - | - | 5 | 5 |
| Milk transport | 3.5 | 10 | 7 | 5.5 | 5 | 1 | 22 |
| Spoiled risk | 4.5 | 8 | 1 | 1 | 5 | 5 | 3 |
| Investment/equipment/building | - | 2.5 | 1 | 3 | 2 | 7 | 2 |
| Saving/Investment | 16 | 13 | 20 | 16 | 16 | 15.25 | 23 |
| Saving | 2 | 2 | 2 | 2 | 2 | - | 3 |
| Share/milk treatment | 3 | 2 | 3 | 3 | 3 | - | 5 |
| Government investment saving | 5 | 1 | - | 5 | 5 | 5 | 5 |
| Credit repayment/interest | 6 | 8 | 15 | 6 | - | 10.25 | 12 |
| Profit | 1 | 4 | 10 | 2 | 3.5 | 2 | 5 |
| Total cost | 46.25 | 75 | 65.1 | 47.75 | 50.75 | 57.25 | 91.29 |

(continued)

Appendix Table 6.4: (Continued)

| | KPS | Koperda | Mt. Batu | KPSBU | Mt. Fandan | Mt. Boyolali |
|---|---|---|---|---|---|---|
| Production (liter/day) | 7,136 | 7,445 | 16,293 | 18,500 | 22,751 | 31,000 |
| Administration and organization | 27.05 | 12.25 | 6.02 | 20 | 8.63 | 14.92 |
| Administration | 7.88 | 1.25 | 0.92 | 1 | 2.98 | 4.08 |
| Wages/salary | 9.76 | 9 | 5.1 | 10 | 5.65 | 5.84 |
| Extension for members | 1.5 | - | - | 5 | - | - |
| Technical services | 1.5 | - | - | 1 | - | - |
| Contribution to GKSI | 1 | 1 | - | 1 | - | - |
| Social etc. | 4.41 | - | - | 1 | - | - |
| Retribution to regional development | 1 | 1 | 1 | 1 | - | 5 |
| Members conribution | - | - | - | - | - | - |
| Overhead | 25.62 | 12.25 | 8.49 | 74.79 | 8.5 | 16.91 |
| Processing/handling | - | 1.75 | 2.47 | 2.25 | 5.49 | - |
| Exploitation | 2.49 | 2.5 | 2.93 | 3.4 | 3.01 | 2.91 |
| Milk transport | 5 | 6 | 3.09 | 17 | - | 14 |
| Spoilage risk | 10.45 | 2 | - | 2.5 | - | - |
| Investment/equipment/building | 7.68 | - | - | - | - | - |
| Saving/Investment | 12 | 10 | 14 | 16 | 5 | 10 |
| Saving | 2 | 5 | 2 | 2 | 2 | 2 |
| Share/milk treatment | - | - | 3 | 3 | 3 | 3 |
| Government investment | 5 | - | 5 | 5 | - | 5 |
| Credit repayment/interest | 5 | 5 | 4 | 12 | - | - |
| Profit | (0.78) | - | - | 1.5 | - | - |
| :al cost | 63.89 | 34.5 | 28.51 | 62.29 | 22.13 | 41.03 |

ırce: DGLS (1985a)



612

Appendix table 6.5: Female animal slaughter at selected slaughter houses 1983

| Provine | | Beef Cattle | Percent females | Buffalo | Percent females | Goat | Percent females | Sheep | Percent females | Pigs | Percent females |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Central Sulawesi | M | 8262 | | 163 | | 3532 | | - | - | 1750 | |
| | F | 3707 | 31 | 43 | 21 | 481 | 12 | | | 563 | 25 |
| South Sulawesi | M | 26292 | | 17965 | | 5718 | | 407 | | 16344 | |
| | F | 5573 | 18 | 3413 | 16 | 1507 | 21 | 196 | 33 | 6453 | 28 |
| Central Timor | M | 518 | | 52 | | - | - | - | - | 634 | |
| | F | 1290 | 71 | 26 | 33 | | | | | 176 | 22 |
| West Java | M | 82645 | | 32622 | | 25177 | | 53956 | | 28363 | |
| | F | 12406 | 13 | 9238 | 22 | 17839 | 41 | 42202 | 44 | 244 | -1 |
| West Sumatra | M | 21569 | | 11775 | | 18411 | | - | - | - | - |
| | F | 4636 | 18 | 2338 | 17 | 9218 | 33 | | | | |
| Jambi | M | 2779 | | 3341 | | 7102 | | 410 | | - | - |
| | F | 805 | 22 | 1117 | 25 | 2658 | 46 | 463 | 53 | | |
| Moluccas | M | 2305 | | 60 | - | 1024 | | - | - | 2236 | |
| | F | 747 | 33 | 34 | | 345 | 25 | | | 2133 | 49 |
| NTT | M | 9079 | | 793 | | 4605 | | - | - | 14334 | |
| | F | 2881 | 24 | 248 | 24 | 876 | 15 | | | 941 | 6 |
| NTB | M | 14677 | | 3334 | | - | - | - | - | - | - |
| | F | 1653 | 10 | 3902 | 54 | | | | | | |
| Municipal Slhouse Banda Aceh | M | 1645 | | - | - | - | - | - | - | - | - |
| | F | 5392 | 77 | | | | | | | | |

Source: Direktorat Bina Program (1984)



613

Appendix table 6.6: Export of livestock raw materials, 1984

| Commodity | Net weight (kg) | Value CIF (US $) |
|---|---|---|
| Duck feathers | 125,722 | 865,092 |
| Rawbones, horns | 2,167,265 | 238,287 |
| Cattle hides | 4,043,156 | 11,672,733 |
| Buffalo hides | 20,082 | 37,160 |
| Goat and kid skins | 2,678,616 | 14,053,221 |
| Buffalo leather | 2,104 | 2,610 |
| Calf leather | 1,173 | 15,140 |
| Sheep Skins | 603,280 | 4,052,576 |
| Sheep and lamb leather | 193,024 | 4,964,161 |
| Goat and Kid leather | 70,471 | 908,526 |
| Total | 9,905,457 | 36,814,808 |

Source : Biro Pusat Statistiks (1984)

Appendix table 6.7: Average carcass weight, dressing percentage and carcass prices at selected meat markets

| Location | Species | Average live weight (kg) | Average carcass weight (kg) | Dressing percent | Carcass price (Rp/kg) |
|---|---|---|---|---|---|
| Jakarta | Cattle | 350-400 | 190-210 | 49-51 | 2875 |
| | Buffalo | | | | 2800 |
| | Goats [a] | | | | |
| | Pig | | | | |
| Bandung | Cattle | 350-400 | 170-210 | 49-51 | 2700 |
| | Buffalo | 400-450 | 180-210 | 45-48 | 2700 |
| | Goats [a] | 20- 30 | 10- 12 | 45 | 2600 |
| | Pig | 80 | 50 | 65 | 1200 |
| Cilacap | Cattle | 300 | 140-160 | 48-50 | 2600 |
| | Goats [a] | 20- 30 | 10- 12 | 45 | 2600 |
| | Pigs | 80 | 50- 55 | 65 | |
| Yogjakarta | Cattle | 300-350 | 140-170 | 50 | 2550 |
| | Goats [a] | 20- 30 | 10- 14 | 45-48 | 2600 |
| | Pig | 80 | 50 | 65 | 1500 |
| Semarang | Cattle | 250-300 | 130-170 | 48 | 2600 |
| | Buffalo | 300-350 | 140-160 | 45 | 2500 |
| | Goats [a] | 20- 35 | 10- 15 | 45 | 2500 |
| | Pigs | 80- 85 | 55 | 65 | 1600 |
| Ampal | Cattle | 250-350 | 145 | 48-50 | 2600 |
| Paku | Cattle | 250-400 | 120-200 | 48-50 | 2500 |
| | Goats | 20- 25 | 10- 14 | 45-48 | [b] |
| Kendari | Cattle | 250-350 | 120-170 | 48-50 | 2400 |
| | Buffalo | 300 | 140 | 45 | 2400 |
| Jayapura | Cattle | 200-300 | 100-150 | 49-50 | [c] |
| Ambon | Cattle | 150-250 | 70-120 | 48 | [d] |
| | Pigs | 80 | 50 | 65 | 4500 |

Source: Based on market survey by study team members
[a] Includes goats and sheep
[b] Not sold in the market
[c] Deboned and sold 5000-6000
[d] Deboned and sold 3500-4500



615

Appendix table 6.8: Average meat prices at selected meat markets (Rp/Kg)

| Location | Boneless Beef I | Boneless Beef II | Boneless Beef III | Minced beef | Bones w/meat | Goat/ Sheep | Pork | Dressed Chicken | Dressed Broiler |
|---|---|---|---|---|---|---|---|---|---|
| Jakarta | 4600 | 3600 | 3400 | 4300 | - | 3700 | 3800 | 3000 | 2350 |
| Bandung | 3500 | 3200 | 3000 | 3400 | - | 3000 | 2500 | 1400 | - |
| Cilacap | - | 3500 | - | - | - | 3000 | - | - | 2500 |
| Jogyakarta | 3600 | 3400 | 2700 | 3500 | - | - | - | - | - |
| Semarang | 3000 | 2500 | 2000 | - | - | - | - | - | - |
| Kendari | - | 2400 | - | - | - | - | - | - | - |
| Jayapura | 6000 | 5600 | 5000 | - | 2500 | 6000 | 4000 | 2500 | - |
| Wamena | - | 5000 | - | - | 2000 | - | - | 4000 | 2750 |
| Sorong | 6000 | - | 5000 | - | - | - | - | - | - |
| Ambon | 5000 | - | 3500 | - | 500 | - | 4500 | 3500 | 3000 |
| Kalimantan | - | 3300 | - | - | - | - | 5000 | 4000 | 1500 |
| Guguk | - | 3500 | - | - | 1500 | - | - | - | - |
| Solok | - | 3500 | - | - | - | - | - | - | - |
| Padang | 3500 | 3000 | 2500 | - | 1500 | - | - | - | - |

Source: Based on a survey by study team members

Appendix table 6.9: Average prices for meat offal (Rp/Kg) at selected meat markets

| Location | Liver | Lung | Heart | Stomach | Intestine | Leg | Brain[a] | Tongue | Tail |
|---|---|---|---|---|---|---|---|---|---|
| Jakarta | 4300 | 3100 | - | 2400<br>3600 | 2100<br>3100 | - | 2500 | 3000 | 2900 |
| Bandung | 4000 | 3000 | - | 3500 | 3500 | - | 2000 | 2000 | 2000 |
| Jogyakarta | 5000 | 3800 | - | 2000 | - | - | - | - | - |
| Semarang | 3000 | - | 1000 | 1000 | 1000 | - | 2500 | 2500 | 1000 |
| Kendari | 5000 | 1500 | 5000 | - | - | - | 1500 | - | - |
| Jayapura | 10000 | 6000 | 3500 | 4500 | 4500 | - | 2300 | 600 | 4500 |
| Wamena | 5000 | 3000 | 3000 | 3000 | 3000 | - | - | - | - |
| Ambon | 3000 | 3000 | - | 1750 | 1750 | - | 2000 | 600 | 3000 |
| Kalimantan | 4000 | - | - | 1500 | 1000 | - | - | - | - |
| Guguk | 4500 | 2500 | 2500 | 2000 | 2000 | 1500 | - | 3000 | - |
| Padang | 4000 | 4000 | 5000 | - | - | 1500<br>4000 [b] | - | - | - |

Source: Based on survey by study team members.
[a] per piece
[b] buffalo

Appendix table 6.10: Farmers opinions about farm to market roads, by region

| Provincial groupings | Good | Fair | Bad | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 117 | 112 | 68 | 3 | 300 |
| South Sumatra | 127 | 101 | 168 | 4 | 400 |
| West Java | 26 | 52 | 22 | 0 | 100 |
| Central Java | 89 | 93 | 7 | 12 | 201 |
| East Java | 162 | 110 | 105 | 12 | 389 |
| Nusa Tenggara | 73 | 9 | 113 | 5 | 200 |
| Kalimantan | 23 | 162 | 110 | 105 | 400 |
| Sulawesi | 85 | 108 | 50 | 57 | 300 |
| Moluccas | 61 | 14 | 4 | 100 | 179 |
| Irian Jaya | 50 | 35 | 15 | 0 | 100 |
| Total | 813 | 796 | 662 | 298 | 2569 |

Source: ADB/DGLS (1985)

Appendix table 6.11: Farmers' opinion about electric supply, by region

| Provincial Groupings | Good | Fair | Bad | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 31 | 33 | 0 | 236 | 300 |
| South Sumatra | 8 | 20 | 7 | 365 | 400 |
| West Java | 31 | 14 | 0 | 55 | 100 |
| Central Java | 19 | 3 | 0 | 179 | 201 |
| East Java | 32 | 1 | 0 | 67 | 100 |
| Nusa Tenggara | 51 | 55 | 26 | 169 | 301 |
| Kalimantan | 19 | 45 | 2 | 333 | 399 |
| Sulawesi | 73 | 67 | 8 | 253 | 400 |
| Moluccas | 0 | 15 | 85 | 0 | 100 |
| Irian Jaya | 34 | 2 | 0 | 64 | 100 |
| TOTAL | 298 | 254 | 128 | 1721 | 2401 |

Source: ADB/DGLS (1985)

Table 6.12: Farmers' opinion about piped water supply, by region

| Provincial Groupings | Good | Fair | Bad | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 0 | 0 | 0 | 300 | 300 |
| South Sumatra | 0 | 0 | 0 | 400 | 400 |
| West Java | 0 | 0 | 0 | 78 | 78 |
| Central Java | 20 | 0 | 0 | 180 | 200 |
| East Java | 0 | 0 | 0 | 100 | 100 |
| Nusa Tenggara | 0 | 80 | 41 | 179 | 300 |
| Kalimantan | 20 | 90 | 25 | 265 | 400 |
| Sulawesi | 5 | 15 | 20 | 360 | 400 |
| Moluccas | 22 | 6 | 72 | 0 | 100 |
| Irian Jaya | 12 | 1 | 6 | 81 | 100 |
| TOTAL | 79 | 192 | 164 | 1943 | 2378 |

Source: ADB/DGLS (1985)

Table 6.13: Farmers' opinion about telephone system, by region

| Provincial groupings | Good | Fair | Bad | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 0 | 0 | 0 | 300 | 300 |
| South Sumatra | 0 | 0 | 0 | 400 | 400 |
| West Java | 0 | 0 | 0 | 100 | 100 |
| Central Java | 1 | 7 | 32 | 160 | 200 |
| East Java | 0 | 0 | 0 | 100 | 100 |
| Nusa Tenggara | 0 | 0 | 0 | 300 | 300 |
| Kalimantan | 0 | 0 | 27 | 373 | 400 |
| Sulawesi | 0 | 0 | 20 | 355 | 375 |
| Moluccas | 0 | 0 | 100 | 0 | 100 |
| Irian Jaya | 0 | 0 | 0 | 100 | 100 |
| TOTAL | 1 | 7 | 179 | 2188 | 2375 |

Source: ADB/DGLS (1985)

Appendix table 6.14: Farmers' opinion about distance from nearest school, by region

| Provincial Groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 0 | 55 | 245 | 300 |
| South Sumatra | 0 | 66 | 334 | 400 |
| West Java | 3 | 51 | 46 | 100 |
| Central Java | 0 | 123 | 77 | 200 |
| East Java | 0 | 1 | 99 | 100 |
| Nusa Tenggara | 4 | 84 | 212 | 300 |
| Kalimantan | 2 | 106 | 292 | 400 |
| Sulawesi | 12 | 40 | 348 | 400 |
| Moluccas | 16 | 84 | 0 | 100 |
| Irian Jaya | 0 | 16 | 84 | 100 |
| TOTAL | 37 | 626 | 1737 | 2400 |

Source: ADB/DGLS (1985)

Appendix table 6.15: Farmers' opinion about distance from nearest market town, by region

| Provincial groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 40 | 161 | 99 | 300 |
| South Sumatra | 145 | 188 | 67 | 400 |
| West Java | 6 | 86 | 8 | 100 |
| Central Java | 25 | 109 | 66 | 200 |
| East Java | 0 | 56 | 44 | 100 |
| Nusa Tenggara | 21 | 131 | 148 | 300 |
| Kalimantan | 181 | 162 | 37 | 380 |
| Sulawesi | 60 | 171 | 173 | 404 |
| Moluccas | 20 | 60 | 0 | 80 |
| Irian Jaya | 4 | 25 | 71 | 100 |
| TOTAL | 502 | 1149 | 713 | 2364 |

Source: ADB/DGLS (1985)

Appendix table 6.16: Farmers' opinion about distance from veterinary office, by region

| Provincial groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 0 | 39 | 61 | 100 |
| South Sumatra | 166 | 117 | 117 | 400 |
| West Java | 22 | 86 | 86 | 194 |
| Central Java | 11 | 63 | 26 | 100 |
| East Java | 66 | 118 | 116 | 300 |
| Nusa Tenggara | 81 | 187 | 132 | 400 |
| Kalimantan | 123 | 110 | 167 | 400 |
| Sulawesi | 46 | 54 | 0 | 100 |
| Moluucas | 4 | 1 | 95 | 100 |
| TOTAL | 519 | 775 | 800 | 2094 |

Source: ADB/DGLS (1985)

Appendix table 6.17: Farmers' opinion about distance from agricultural office, by region

| Provincial Groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 40 | 91 | 169 | 300 |
| South Sumatra | 200 | 180 | 20 | 400 |
| West Java | 44 | 51 | 5 | 100 |
| Central Java | 25 | 109 | 66 | 200 |
| East Java | 34 | 27 | 40 | 101 |
| Nusa Tenggara | 90 | 87 | 123 | 300 |
| Kalimantan | 201 | 147 | 52 | 400 |
| Sulawesi | 192 | 118 | 90 | 400 |
| Moluccas | 60 | 20 | 0 | 80 |
| Irian Jaya | 60 | 20 | 0 | 80 |
| | 4 | 16 | 80 | 100 |
| TOTAL | 950 | 866 | 645 | 2461 |

Source: ADB/DGLS (1985)

Appendix table 6.18: Farmers' opinion about distance from extension office, by region

| Provincial groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 60 | 103 | 137 | 300 |
| South Sumatra | 120 | 192 | 88 | 400 |
| West Java | 80 | 20 | 0 | 100 |
| Central Java | 50 | 84 | 66 | 200 |
| East Java | 22 | 55 | 22 | 99 |
| Nusa Tenggara | 89 | 83 | 128 | 300 |
| Kalimantan | 141 | 161 | 97 | 399 |
| Sulawesi | 159 | 90 | 150 | 399 |
| Moluccas | 27 | 73 | 0 | 100 |
| Irian Jaya | 5 | 1 | 94 | 100 |
| TOTAL | 753 | 862 | 782 | 2397 |

Source: ADB/DGLS (1985)

Appendix table 6.19: Farmers' opinion about distance from hospital, by region

| Provincial groupings | Very Far | Far | Near | Total |
|---|---|---|---|---|
| North Sumatra | 60 | 76 | 164 | 300 |
| South Sumatra | 27 | 193 | 180 | 400 |
| West Java | 22 | 56 | 22 | 100 |
| Central Java | 25 | 89 | 86 | 200 |
| East Java | 0 | 34 | 66 | 100 |
| Nusa Tenggara | 46 | 128 | 126 | 300 |
| Kalimantan | 40 | 204 | 156 | 400 |
| Sulawesi | 49 | 127 | 222 | 398 |
| Moluccas | 47 | 33 | 0 | 80 |
| Irian Jaya | 4 | 1 | 95 | 100 |
| TOTAL | 320 | 941 | 1117 | 2378 |

Source: ADB/DGLS (1985)

Appendix table 6.20: Farmers' opinion about livestock advice from family and neighbors, by region

| Provincial groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 140 | 79 | 1 | 60 | 280 |
| South Sumatra | 124 | 105 | 94 | 77 | 400 |
| West Java | 5 | 34 | 22 | 39 | 100 |
| Central Java | 126 | 49 | 18 | 7 | 200 |
| East Java | 78 | 11 | 7 | 5 | 101 |
| Nusa Tenggara | 108 | 191 | 40 | 11 | 350 |
| Kalimantan | 149 | 131 | 111 | 9 | 400 |
| Sulawesi | 181 | 108 | 86 | 25 | 400 |
| Moluccas | 40 | 0 | 0 | 0 | 40 |
| Irian Jaya | 62 | 11 | 7 | 20 | 100 |
| TOTAL | 1013 | 719 | 386 | 253 | 2371 |

Source: ADB/DGLS (1985)

Appendix table 6.21: Farmers' opinion about support from informal traders, by region

| Provincial groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 62 | 187 | 20 | 29 | 298 |
| South Sumatra | 60 | 125 | 141 | 74 | 400 |
| West Java | 0 | 13 | 34 | 53 | 100 |
| Central Java | 72 | 29 | 1 | 98 | 200 |
| East Java | 33 | 22 | 34 | 11 | 100 |
| Nusa Tenggara | 6 | 174 | 2 | 118 | 300 |
| Kalimantan | 104 | 160 | 74 | 119 | 457 |
| Sulawesi | 57 | 186 | 65 | 92 | 400 |
| Moluccas | 73 | 23 | 3 | 0 | 99 |
| Irian Jaya | 40 | 25 | 24 | 11 | 100 |
| TOTAL | 507 | 944 | 398 | 605 | 2454 |

Source: ADB/DGLS (1985)

Appendix table 6.22: Farmer's opinion about support from middlemen, by region

| Provincial groupings | Strong | Moderate | Weak | Total |
|---|---|---|---|---|
| North Sumatra | 91 | 20 | 29 | 140 |
| South Sumatra | 0 | 4 | 137 | 141 |
| West Java | 0 | 0 | 54 | 54 |
| Central Java | 6 | 20 | 0 | 26 |
| East Java | 0 | 1 | 25 | 26 |
| Nusa Tenggara | 22 | 49 | 65 | 136 |
| Kalimantan | 60 | 71 | 29 | 160 |
| Sulawesi | 0 | 37 | 55 | 92 |
| Moluccas | 4 | 16 | 80 | 100 |
| Irian Jaya | 0 | 1 | 26 | 27 |
| TOTAL | 183 | 219 | 500 | 902 |

Source: ADB/DGLS (1985)

Appendix table 6.23: Farmers' opinion about support from government stock farms, by region

| Provincial Groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 0 | 20 | 40 | 140 | 200 |
| South Sumatra | 0 | 0 | 20 | 380 | 400 |
| West Java | 0 | 0 | 0 | 100 | 100 |
| Central Java | 50 | 27 | 3 | 120 | 200 |
| East Java | 22 | 22 | 56 | 0 | 100 |
| Nusa Tenggara | 45 | 75 | 0 | 180 | 300 |
| Kalimantan | 0 | 20 | 20 | 360 | 400 |
| Sulawesi | 8 | 24 | 32 | 308 | 372 |
| Moluccas | 0 | 8 | 92 | 0 | 100 |
| Irian Jaya | 40 | 21 | 5 | 34 | 100 |
| TOTAL | 165 | 217 | 268 | 1622 | 2272 |

Source: ADB/DGLS (1985)

Appendix table 6.24: Farmers' opinion about support from agricultural research stations, schools, or universities, by region

| Provincial groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 0 | 40 | 0 | 260 | 300 |
| South Sumatra | 0 | 1 | 39 | 360 | 400 |
| West Java | 0 | 0 | 0 | 100 | 100 |
| Central Java | 0 | 69 | 6 | 125 | 200 |
| East Java | 22 | 0 | 0 | 78 | 100 |
| Nusa Tenggara | 20 | 63 | 6 | 211 | 300 |
| Kalimantan | 0 | 25 | 45 | 330 | 400 |
| Sulawesi | 30 | 36 | 49 | 285 | 400 |
| Moluccas | 27 | 23 | 50 | 0 | 100 |
| Irian Jaya | 40 | 23 | 3 | 34 | 100 |
| TOTAL | 139 | 280 | 198 | 1783 | 2400 |

Source: ADB/DGLS (1985)

Appendix table 6.25: Farmers' opinion about advice from veterinary and animal production institutions, by region

| Provincial Groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 43 | 94 | 30 | 103 | 270 |
| South Sumatra | 89 | 112 | 47 | 152 | 400 |
| West Java | 40 | 18 | 5 | 37 | 100 |
| Central Java | 80 | 73 | 3 | 51 | 207 |
| East Java | 44 | 11 | 1 | 44 | 100 |
| Nusa Tenggara | 94 | 123 | 75 | 8 | 300 |
| Kalimantan | 114 | 100 | 63 | 122 | 399 |
| Sulawesi | 80 | 164 | 61 | 95 | 400 |
| Moluccas | 51 | 2 | 20 | 0 | 73 |
| Irian Jaya | 63 | 14 | 3 | 20 | 100 |
| TOTAL | 698 | 711 | 308 | 632 | 2349 |

Source: ADB/DGLS (1985)

Appendix table 6.26: Farmers' opinion about support from cooperatives and marketing institutions, by region

| Provincial Groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 31 | 20 | 53 | 196 | 300 |
| South Sumatra | 1 | 35 | 154 | 210 | 400 |
| West Java | 15 | 23 | 13 | 49 | 100 |
| Central Java | 78 | 74 | 38 | 10 | 200 |
| East Java | 33 | 1 | 10 | 56 | 100 |
| Nusa Tenggara | 46 | 61 | 61 | 132 | 300 |
| Kalimantan | 33 | 94 | 76 | 197 | 400 |
| Sulawesi | 22 | 122 | 77 | 179 | 400 |
| Moluccas | 7 | 53 | 0 | 0 | 60 |
| Irian Jaya | 62 | 10 | 6 | 22 | 100 |
| TOTAL | 328 | 493 | 488 | 1051 | 2360 |

Source: ADB/DGLS (1985)

Appendix table 6.27: Farmers' opinion about support from extension agents, by region

| Provincial groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 121 | 146 | 27 | 6 | 300 |
| South Sumatra | 69 | 151 | 113 | 67 | 400 |
| West Java | 0 | 22 | 27 | 51 | 100 |
| Central Java | 92 | 100 | 2 | 6 | 200 |
| East Java | 67 | 22 | 11 | 0 | 100 |
| Nusa Tenggara | 121 | 81 | 81 | 21 | 304 |
| Kalimantan | 33 | 102 | 64 | 201 | 400 |
| Sulawesi | 96 | 204 | 57 | 43 | 400 |
| Moluccas | 60 | 0 | 0 | 0 | 60 |
| Irian Jaya | 61 | 31 | 8 | 0 | 100 |
| TOTAL | 720 | 859 | 390 | 395 | 2364 |

Source: ADB/DGLS (1985)

Appendix table 6.28: Farmers' opinion about support from banks, credit institutions, by region

| Provincial groupings | Strong | Moderate | Weak | None | Total |
|---|---|---|---|---|---|
| North Sumatra | 39 | 40 | 62 | 159 | 300 |
| South Sumatra | 0 | 20 | 102 | 278 | 400 |
| West Java | 1 | 15 | 20 | 64 | 100 |
| Central Java | 111 | 40 | 22 | 27 | 200 |
| East Java | 22 | 35 | 2 | 42 | 101 |
| Nusa Tenggara | 24 | 71 | 1 | 204 | 300 |
| Kalimantan | 20 | 61 | 30 | 289 | 400 |
| Sulawesi | 22 | 28 | 80 | 269 | 399 |
| Moluccas | 40 | 0 | 60 | 0 | 100 |
| Irian Jaya | 42 | 2 | 24 | 32 | 100 |
| TOTAL | 321 | 312 | 403 | 1364 | 2400 |

Source: ADB/DGLS (1985)

Appendix table 6.29: Farmers' preference of livestock species, by region

| Provincial groupings | Cattle | Buffalo | Goat | Sheep | Poultry | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 112 | 119 | 25 | 0 | 44 | 300 |
| South Sumatra | 201 | 108 | 68 | 0 | 23 | 400 |
| West Java | 55 | 9 | 31 | 0 | 5 | 100 |
| Central Java | 141 | 15 | 18 | 3 | 23 | 200 |
| East Java | 38 | 5 | 8 | 0 | 49 | 100 |
| Nusa Tenggara | 151 | 111 | 1 | 31 | 6 | 300 |
| Kalimantan | 295 | 43 | 50 | 1 | 11 | 400 |
| Sulawesi | 273 | 42 | 20 | 14 | 51 | 400 |
| Moluccas | 30 | 8 | 3 | 1 | 0 | 42 |
| Irian Jaya | 97 | 0 | 3 | 0 | 0 | 100 |
| TOTAL | 1393 | 460 | 227 | 50 | 212 | 2342 |

Source: ADB/DGLS (1985)



626

Appendix table 6.30: Farmers' preference for improved breeds, by region

| Provincial groupings | Cattle | Buffalo | Goat | Sheep | Poultry | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 146 | 97 | 25 | 0 | 32 | 300 |
| South Sumatra | 227 | 96 | 52 | 1 | 24 | 400 |
| West Java | 69 | 18 | 7 | 0 | 6 | 100 |
| Central Java | 140 | 29 | 12 | 2 | 16 | 199 |
| East Java | 37 | 0 | 11 | 0 | 52 | 100 |
| Nusa Tenggara | 107 | 171 | 3 | 12 | 7 | 300 |
| Kalimantan | 289 | 38 | 35 | 21 | 17 | 400 |
| Sulawesi | 259 | 20 | 0 | 13 | 8 | 300 |
| Moluccas | 33 | 0 | 2 | 2 | 100 | 137 |
| Irian Jaya | 100 | 0 | 0 | 0 | 0 | 100 |
| TOTAL | 1407 | 469 | 147 | 51 | 262 | 2336 |

Source: ADB/DGLS (1985)

Appendix table 6.31: Farmers' opinion about importance of price, by region

| Provincial Groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | TOTAL |
|---|---|---|---|---|---|
| North Sumatra | 145 | 155 | 0 | 0 | 300 |
| South Sumatra | 58 | 282 | 31 | 21 | 392 |
| West Java | 63 | 37 | 0 | 0 | 100 |
| Central Java | 28 | 129 | 9 | 27 | 193 |
| East Java | 65 | 15 | 20 | 0 | 100 |
| Nusa Tenggara | 65 | 116 | 42 | 1 | 224 |
| Kalimantan | 88 | 131 | 161 | 0 | 380 |
| Sulawesi | 187 | 120 | 57 | 35 | 399 |
| Moluccas | 60 | 40 | 0 | 0 | 100 |
| Irian Jaya | 70 | 5 | 0 | 25 | 100 |
| TOTAL | 829 | 1030 | 320 | 109 | 2288 |

Source: ADB/DGLS (1985)

Appendix table 6.32: Farmers' opinion about importance of better animal health services, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 226 | 74 | 0 | 0 | 0 | 300 |
| South Sumatra | 136 | 115 | 97 | 4 | 48 | 400 |
| West Java | 36 | 64 | 0 | 0 | 0 | 100 |
| Central Java | 109 | 84 | 1 | 0 | 6 | 200 |
| East Java | 41 | 50 | 9 | 0 | 0 | 100 |
| Nusa Tenggara | 154 | 54 | 92 | 0 | 0 | 300 |
| Kalimantan | 186 | 47 | 137 | 0 | 0 | 370 |
| Sulawesi | 224 | 80 | 71 | 0 | 25 | 400 |
| Moluccas | 100 | 0 | 0 | 0 | 0 | 100 |
| Irian Jaya | 79 | 16 | 15 | 0 | 0 | 110 |
| TOTAL | 1291 | 584 | 422 | 4 | 79 | 2380 |

Source: ADB/DGLS (1985)

Appendix table 6.33: Farmers' opinion about importance of better market facilities, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 151 | 89 | 40 | 0 | 20 | 300 |
| South Sumatra | 112 | 74 | 108 | 4 | 2 | 300 |
| West Java | 13 | 87 | 0 | 0 | 0 | 100 |
| Central Java | 106 | 86 | 5 | 0 | 3 | 200 |
| East Java | 53 | 37 | 10 | 0 | 0 | 100 |
| Nusa Tenggara | 163 | 78 | 59 | 0 | 0 | 300 |
| Kalimantan | 120 | 73 | 207 | 0 | 0 | 400 |
| Sulawesi | 68 | 214 | 97 | 21 | 0 | 400 |
| Moluccas | 60 | 0 | 0 | 0 | 100 | 160 |
| Irian Jaya | 95 | 5 | 0 | 0 | 0 | 100 |
| TOTAL | 941 | 743 | 526 | 25 | 125 | 2360 |

Source: ADB/DGLS (1985)

Appendix table 6.34: Farmers' opinion about importance of better training, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 70 | 186 | 43 | 1 | 0 | 300 |
| South Sumatra | 164 | 117 | 64 | 43 | 12 | 400 |
| West Java | 26 | 33 | 41 | 0 | 0 | 100 |
| Central Java | 18 | 81 | 96 | 0 | 5 | 200 |
| East Java | 32 | 68 | 0 | 0 | 0 | 100 |
| Nusa Tenggara | 58 | 102 | 114 | 26 | 0 | 300 |
| Kalimantan | 129 | 148 | 85 | 38 | 0 | 400 |
| Sulawesi | 149 | 138 | 58 | 35 | 0 | 380 |
| Moluccas | 40 | 20 | 0 | 0 | 0 | 60 |
| Irian Jaya | 35 | 37 | 14 | 14 | 0 | 100 |
| TOTAL | 721 | 930 | 515 | 157 | 17 | 2340 |

Source: ADB/DGLS (1985)

Appendix table 6.35: Farmers' opinion about importance of improved credit facilities, by region

| Provincial Groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 82 | 119 | 99 | 0 | 0 | 300 |
| South Sumatra | 195 | 111 | 76 | 9 | 9 | 400 |
| West Java | 0 | 44 | 56 | 0 | 0 | 100 |
| Central Java | 75 | 62 | 43 | 0 | 20 | 200 |
| East Java | 32 | 57 | 91 | 45 | 75 | 300 |
| Nusa Tenggara | 178 | 114 | 68 | 40 | 0 | 400 |
| Kalimantan | 30 | 182 | 109 | 66 | 12 | 399 |
| Sulawesi | 20 | 20 | 0 | 0 | 0 | 40 |
| Moluccas | 25 | 30 | 37 | 8 | 0 | 100 |
| TOTAL | 637 | 739 | 579 | 168 | 116 | 2239 |

Source: ADB/DGLS (1985)

Appendix table 6.36: Farmers' opinion about importance of more extension service, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 103 | 174 | 23 | 0 | 0 | 300 |
| South Sumatra | 195 | 138 | 51 | 0 | 16 | 400 |
| West Java | 28 | 32 | 40 | 0 | 0 | 100 |
| Central Java | 29 | 106 | 65 | 0 | 0 | 200 |
| East Java | 50 | 22 | 28 | 0 | 0 | 100 |
| Nusa Tenggara | 80 | 154 | 62 | 4 | 0 | 300 |
| Kalimantan | 114 | 116 | 70 | 0 | 0 | 300 |
| Sulawesi | 77 | 228 | 46 | 6 | 36 | 393 |
| Moluccas | 20 | 60 | 20 | 0 | 0 | 100 |
| Irian Jaya | 51 | 39 | 9 | 0 | 1 | 100 |
| TOTAL | 747 | 1069 | 414 | 10 | 53 | 2293 |

Source: ADB/DGLS (1985)

Appendix table 6.37: Farmers' opinion about importance of better feed availability, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 49 | 149 | 26 | 4 | 72 | 300 |
| South Sumatra | 142 | 48 | 133 | 28 | 49 | 400 |
| West Java | 11 | 33 | 56 | 0 | 0 | 100 |
| Central Java | 29 | 85 | 66 | 0 | 20 | 200 |
| East Java | 35 | 41 | 7 | 16 | 1 | 100 |
| Nusa Tenggara | 45 | 40 | 47 | 168 | 0 | 300 |
| Kalimantan | 43 | 162 | 155 | 0 | 40 | 400 |
| Sulawesi | 48 | 180 | 142 | 3 | 27 | 400 |
| Moluccas | 0 | 0 | 40 | 60 | 0 | 100 |
| Irian Jaya | 29 | 11 | 25 | 34 | 1 | 100 |
| TOTAL | 431 | 749 | 697 | 313 | 210 | 2400 |

Source: ADB/DGLS (1985)

Appendix table 6.38: Farmers' opinion about importance of quality improvement of feed, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 102 | 151 | 27 | 0 | 20 | 300 |
| South Sumatra | 100 | 154 | 102 | 24 | 20 | 400 |
| West Java | 6 | 38 | 56 | 0 | 0 | 100 |
| Central Java | 9 | 97 | 74 | 0 | 20 | 200 |
| East Java | 33 | 41 | 26 | 0 | 0 | 100 |
| Nusa Tenggara | 57 | 123 | 39 | 81 | 0 | 300 |
| Kalimantan | 68 | 142 | 110 | 49 | 31 | 400 |
| Sulawesi | 116 | 211 | 58 | 10 | 5 | 400 |
| Moluccas | 20 | 20 | 60 | 0 | 0 | 100 |
| Irian Jaya | 24 | 25 | 34 | 13 | 4 | 100 |
| TOTAL | 535 | 1002 | 586 | 177 | 100 | 2400 |

Source: ADB/DGLS (1985)

Appendix table 6.39: Farmers' opinion about importance of more market information, by region

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 24 | 210 | 44 | 0 | 22 | 300 |
| South Sumatra | 49 | 95 | 113 | 29 | 14 | 300 |
| West Java | 4 | 50 | 46 | 0 | 0 | 100 |
| Central Java | 4 | 95 | 57 | 16 | 28 | 200 |
| East Java | 46 | 24 | 30 | 0 | 0 | 100 |
| Nusa Tenggara | 20 | 140 | 68 | 72 | 0 | 300 |
| Kalimantan | 43 | 118 | 89 | 83 | 67 | 400 |
| Sulawesi | 12 | 114 | 157 | 46 | 71 | 400 |
| Moluccas | 0 | 80 | 20 | 0 | 0 | 100 |
| Irian Jaya | 3 | 27 | 7 | 29 | 34 | 100 |
| TOTAL | 205 | 953 | 631 | 275 | 236 | 2300 |

Source: ADB/DGLS (1985)

Appendix table 6.40: <u>Farmers' opinion about importance of roads, by region</u>

| Provincial groupings | Very Imp. | Imp. | Marg. Imp. | Not Imp. | Don't Care | TOTAL |
|---|---|---|---|---|---|---|
| North Sumatra | 158 | 76 | 35 | 0 | 31 | 300 |
| South Sumatra | 185 | 76 | 109 | 4 | 26 | 400 |
| West Java | 4 | 32 | 64 | 0 | 0 | 100 |
| Central Java | 34 | 107 | 12 | 25 | 22 | 200 |
| East Java | 33 | 35 | 32 | 0 | 0 | 100 |
| Nusa Tenggara | 133 | 72 | 90 | 5 | 0 | 300 |
| Kalimantan | 253 | 64 | 3 | 60 | 20 | 400 |
| Sulawesi | 133 | 166 | 61 | 34 | 6 | 400 |
| Moluccas | 56 | 4 | 0 | 40 | 0 | 100 |
| Irian Jaya | 10 | 36 | 4 | 25 | 25 | 100 |
| TOTAL | 999 | 668 | 410 | 193 | 130 | 2400 |

Source: ADB/DGLS (1985)

# Appendix 6A: Artificial Insemination and Forage and Livestock UPTs

The DGLS, through the Directorate of Livestock Production, is responsible for the Unit Pelaksana Teknis (UPT) for both the Artificial Insemination Units and the Forage and Livestock Station. The UPTs were established for the purposes of implementing technical innovations designed to improve production of livestock. Knowledge obtained in these UPTs will be channeled into the Extension Service for designing "production packets" for farmers. Two artificial insemination centers and nine forage and livestock UPTs have been established.

## A. Artificial Insemination Centers

Two bull studs are operated by the Directorate General for Livestock Services: at Lembang, north of Bandung in West Java, and at Singosari, north of Malang in East Java. The bull studs are administered by the Directorate for Livestock Production within the DGLS. The Lembang stud was opened in 1975 through a technical cooperation agreement with the Government of New Zealand. The Singosari stud was opened in 1982. Development of this center began in 1975 under a cooperative agreement between the Belgian government and the provincial government of East Java. The Government of Indonesia provided funding to complete the center between 1978 and 1982.

### 1. Selection and number of bulls

The April, 1985 report of the Lembang stud (Lembang Balai Inseminasi Buatan, 1985) lists an inventory of 29 bulls including 12 Holstein-Friesians (Table 6A.1). On visiting the center in July, the study team was informed that the stud inventory was 40 bulls; 37 Holstein-Friesians, 1 Ongole, 1 Murrah buffalo and 1 Polled Hereford. Apparently, the inventory of Holstein-Friesian bulls had been increased and the Brahmans and all Ongole bulls, except one, transferred to Singosari. The plan of the Livestock Production Directorate is for Lembang to produce Holstein-Friesian semen to service the dairy industry which is heavily concentrated in West and Central Java, and for the Singosari stud to maintain the inventory of *Bos indicus* and *B. Sundaicus* bulls for the provinces where these breeds predominate, especially Bali, NTB, NTT and parts of Kalimantan and Sulawesi.

The study team was informed that Holstein-Friesian bulls at Lembang were imported from, or donated by, New Zealand, Australia, West Germany and Israel. In addition, frozen semen from Holstein-Friesians and other *Bos taurus* breeds (Limousin, Hereford, Angus and Simmental) had been received in the past through importation or donation from several countries including New Zealand, Australia, the U.S., Japan and West Germany. Importation of semen is apparently now ended and what remaining semen from the exotic breeds, Limousin, Hereford, Angus and Simmental, is left will be used and not replenished. Holstein-Friesian semen used in the country will be produced at Lembang as well as Singosari.

The study team was told that most of the Holstein-Friesian bulls at Lembang were sons of progeny-tested bulls, but none, at the time, had daughter production records of their own. A new technical cooperation project with the Government of Japan, to be initiated in 1986, will develop a progeny testing system for Holstein Friesian bulls at Singosari.

The May, 1985 report of the Singosari Artificial Insemination Center (Singosari Balai Inseminasi Buatan, 1985) lists 36 bulls including 5 Holstein-Friesians (Table 6A.1). Presumably, the Holstein-Friesians will be maintained at Singosari to produce semen for East Java and the provinces serviced with beef breed frozen semen from the center. These Holstein-Friesian bulls were all imported from New Zealand and Australia. The Bali and Madura bulls were selected at livestock shows and tested for sperm

Appendix table 6A.1: 1984/1985 inventory of bulls, Lembang and Singosari bull studs

| Breeds | Lembang | Singosari |
|---|---|---|
| Holstein-Friesian | 12 | 5 |
| Ongole | 4 | 10 |
| Brahman | 8 | 11 |
| Bali | | 7 |
| Madura [a] | | 2 |
| Hereford | 2 | |
| Charbray | 1 | |
| Santa Gertrudis | | 1 |
| Murrah buffalo [b] | 2 | |
| Total | 29 | 36 |

Source: Singosari Balai Inseminasi Buatan (1985), Lembang Balai Inseminasi Buatan (1985)
[a] Singosari has 1 Madura cow
[b] Lembang also has 2 Murrah buffalo cows

count and libido before purchase. They have no progeny performance records. Brahman semen produced at Singosari is primarily used to breed Ongole cows in East Java, NTB and NTT in order to improve size for draft and meat production.

2. Production, distribution and use of frozen semen

Semen is collected and packaged in 1/4 c.c. french straws at the two bull studs using internationally-accepted procedures for dilution and freezing. The frozen semen is distributed directly to provincial livestock offices via overland and air transport. Table 6A.2 and 6A.3 present summary data for production and distribution of frozen semen for 1984-85 and 1985-1986 (projected) at Lembang and Singosari, respectively (Lembang Balai Inseminasi Buatan, 1985 and Singosari Balai Inseminasi Buatan, 1985).

Actual production of frozen semen at Lembang was 511,092 units, of which 45.4% was from Holstein-Friesian bulls, 32.4% from Brahmans and 19.3% from Ongoles. Holstein-Friesian bulls accounted for 36.6% of the frozen semen distributed while Brahman and Ongole semen represented 38.3% and 19.9%, respectively. Frozen semen from the 2 Hereford bulls maintained at the stud and imported Simmental and Limousin semen accounted for 13,755 units distributed in 1984-85. The Lembang annual report does not list the provinces receiving this semen but study team members saw crossbreds of Bali cows bred AI with Limousin, Hereford and Simmental bulls on Lombok island (NTB).

The projected production of semen for 1985-1986 at Lembang is 327,550 units, of which 37.9% will be from Holstein-Friesian bulls, 38.8% from Brahmans and 17.4% from Ongoles (Table 6A.2).

Appendix table 6A.2: 1984/1985 projected and actual production and distribution and projected 1984/1985 distribution of frozen semen, Lembang bull stud

| Breed | 1984/1985 Production: Projected | Actual | Distribution | 1985/1986 projected distribution |
|---|---|---|---|---|
| Ongole | 72,080 | 98,664 | 84,003 | 57,080 |
| Holstein-Fr. | 174,645 | 231,782 | 154,539 | 124,035 |
| Brahman | 144,070 | 165,388 | 161,440 | 126,935 |
| Murrah buffalo | 9,600 | 7,354 | 8,236 | 10,000 |
| Hereford | - | 7,904 | 9,203 | - |
| Simmental | - | - | 648 | - |
| Limousin | - | - | 3,924 | - |
| Carryover 1983/1984 | 99,605 | - | - | - |
| Total | 500,000 | 511,092 | 421,995 | 327,550 |

Source: Lembang Balai Inseminasi Buatan (1985)



635

Appendix table 6A.3: 1984/1985 projected and actual production and distribution and projected 1984/1985 distribution of frozen semen, Singosari bull stud

| | 1984/1985 | | | |
|---|---|---|---|---|
| | Production: | | | 1985/1986 projected distribution |
| Breed | Projected | Actual | Distribution | |
| Holstein-Fr. | 100,000 | 86,151 | 41,140 | 64,600 |
| Brahman | 130,000 | 71,163 | 66,180 | 116,650 |
| Ongole | 65,000 | 75,059 | 66,116 | 61,300 |
| Bali | 25,000 | 26,195 | 26,236 | 23,600 |
| Madura | 5,000 | 5,018 | 3,046 | 1,500 |
| Other [a] | - | - | 7,498 | - |
| Total | 325,000 | 263,586 | 210,710 | 267,650 |

Source: Singosari Balai Inseminasi Buatan (1985)
[a] This category includes semen from Limousin, Simmental and Hereford

The Singosari bull stud produced 263,586 units of frozen semen in 1984-85 and distributed 210,710 units. Brahman, Ongole and Bali bulls accounted fro 31.4%, 31,4% and 12.5% of the frozen semen distributed from the center, respectively. For 1985-86, distribution of Ongole and Bali frozen semen is projected to decrease slightly while distribution of Brahman semen will increase by 76.3% and Holstein-Friesian semen by 55.1%.

The distribution of frozen semen by province is presented in appendix table 6A.4. The Lembang center serviced primarily the western provinces of Indonesia including the island of Java. It also provided more frozen semen to East Java than the Singosari center presumably because of its greater production of Holstein-Friesian semen. Most of the frozen semen going to Kalimantan, Sulawesi and the eastern provinces (Bali, NTB and NTT) was supplied by Singosari where it is used on the Bali and Ongole populations of those islands.

3. Organization of artificial insemination services

Frozen semen is produced and distributed by the Lembang and Singosari bull studs and distributed directly to the provincial DGLS offices (provincial Dinas Peternakan). Each Dinas office with an artificial insemination program has an AI "unit" (UPTIB, Unit Pelaksana Teknis Inseminasi Buatan) led by a "supervisor" who has been trained in New Zealand or Australia. He supervises "instructors" at the kabupaten (district) level who receive 6 week training courses (3 weeks on artificial insemination, 3 on pregnancy diagnosis) in Indonesia. The instructor is attached to a "UWIB" (Unit Wilayah Inseminasi Buatan) at the kabupaten level.



636

Appendix table 6A.4: __1984/1985 distribution of frozen semen, by province, Lembang and Singosari bull studs__

| Province | Lembang | Singosari |
|---|---|---|
| Aceh | 8,515 | |
| N. Sumatra | 20,850 | |
| W. Sumatra | 17,621 | |
| Riau | 2,812 | |
| Jambi | 1,830 | |
| Bengkulu | 2,738 | |
| S. Sumatra | 6,181 | |
| Lampung | 26,124 | |
| W. Java | 95,905 | |
| DKI Jakarta | 4,011 | |
| Central Java | 87,688 | 63,271 |
| DI Yogyakarta | 30,060 | |
| East Java | 110,198 | 95,765 |
| Bali | 200 | 8,602 |
| NTB | | 4,244 |
| NTT | | 4,023 |
| W. Kalimantan | 1,000 | |
| S. Kalimantan | | 4,849 |
| E. Kalimantan | | 1,610 |
| N. Sulawesi | | 4,209 |
| C. Sulawesi | 6,272 [a] | 3,498 |
| S. Sulawesi | | 10,163 |
| Sub-total | 421,995 | 200,234 |
| Direktoral Jen. Pet. | -- | 10,476 |
| Total | 421,925 | 210,710 |

Source: Singosari Balai Inseminasi Buatan (1985), Lembang Balai Inseminasi Buatan (1985)

[a] Includes NTT

Inseminators work at the kecamaten (sub-district) level and also may be exclusively assigned to KUDs with milk production divisions. The program on Java calls for one inseminator to be assigned to an area with a population of 450 cows. The inseminator is attached to a "ULIB", or "Unit Lokasi Inseminasi Buatan". Assuming an average 2.5 inseminations per conception and one conception per year (ideally), each inseminator is expected to perform 1,000 breedings annually. The inseminator is supposed to be supplied with a motorbike and petrol, AI equipment and a 250 c.c thermos to carry straws between his office and the farm.

In addition to the supervisors, instructors and inseminators, the Dinas veterinarian in charge of the UPIBD has "assistant technicians for reproduction", or "ATRs", at the Kabupaten level. These technicians are specially-trained to handle routine reproductive problems which do not require the services of a veterinarian (difficult calvings, retained placentas, etc.) and to supervise pregnancy checking.

Farmers organized in groups, or "kelompoks", receive training in estrus detection. The kelompok chief reports to the inseminator when a cow requires breeding. In some parts of Java, especially for KUDs involved in milk production, a "card system" has been designed. Each farmer has 3 cards of different colors. A box is located in the desa which the inseminator, kelompok chief or other person checks once or twice daily. A red card signifies that a cow is sick, a yellow card that she has delivered a calf and a blue card that she requires breeding. A fourth card is used to record cow production, primarily the breed of cow, sex of calf, birth condition (abortion, stillbirth, normal, etc.), and the name and number of the bull used. The ATR is responsible for collecting this information, recording and collating it at the kabupaten office, and sending it on to the provincial dinas or Jakarta.

Culling of cows for low production, disease, injury or reproductive failure requires the inspection and permission of a dinas veterinarian.

4. Monitoring of fertility

In provinces with extensive AI programs, such as those on Java and certain parts of Sumatra, Bali and NTB, bull fertility is monitored through periodic pregnancy checking by instructors and ATRs attached to the UWIB at the kabupaten dinas or directly to the provincial dinas office. The provincial dinas forwards copies of pregnancy test results directly to both the DGLS office in Jakarta and to the bull stud from which it receives semen. At the stud, records are collated and summarized for individual bulls.

Conception rate (number of cows pregnant to first service by semen from a bull divided by the number of cows bred to the bull), and services per conception (total services by a bull divided by number of conceptions resulting) are the variables recorded. Not all cows bred AI are fertility checked.

Fertility monitoring results on bulls from Lembang and Singosari are presented in appendix tables 6A.5 (Lembang) and 6A.6 (Singosari).

Appendix table 6A.5: Fertility evaluations on bull studs at Lembang

| Breed | No. provinces using semen | No. cows checked | Conception rate [a] | Services per conception [b] |
|---|---|---|---|---|
| Ongole | 14 | 3,847 | 45.9 | 2.4 |
| Holstein-Friesian | 15 | 19,085 | 45.7 | 2.4 |
| Brahman | 17 | 5,267 | 47.5 | 2.3 |
| Murrah | 2 | 989 | 37.5 | 2.8 |

Source: Lembang Balai Inseminasi Buatan (1985)
[a] Conception rate = No. cows checked / No. cows pregnant to first service
[b] Services per conception = No. services / No. cows pregnant

Appendix table 6A.6: Fertility evaluation on bulls in the Singosari bull stud

| Breed | No. provinces using semen | No. cows checked | Conception rate [a] | Services per conception [b] |
|---|---|---|---|---|
| Ongole | 5 | 3,524 | 54.2 | 1.83 |
| Holstein-Fr. | 6 | 2,522 | 27.3 | 3.44 |
| Brahman | 8 | 3,888 | 52.6 | 2.02 |
| Bali | 7 | 2,858 | 68.0 | 1.48 |
| Madura | - | - | - | - |

Source: Singosari Balai Inseminasi Buatan (1985)
[a] Conception rate = No. cows checked / No. cows pregnant to first service
[b] Services per conception = No. services / No. cows pregnant

Pregnancy diagnosis was performed on 5,267 cows bred to Ongole, Holstein-Friesian and Brahman bulls and 989 buffalo cows bred to Murrahs from the Lembang stud.

Cattle breeds, conception rate and services per conception tended to be quite similar. The roughly 46% conception rate for these breeds is not unusually low considering the adverse conditions many of the inseminators have to operate under, problems in estrus detection (especially in Brahman and Ongole cows), and maintenance of semen viability from storage tank to farm. The lower reported conception rate for Murrah buffaloes, 37.5%, and higher number of services per conception, 2.8, is indicative of the difficulty in detecting estrus and the still undecided ideal time to breed buffalo cows once detected in heat.

The low figures for conception rate (27.3%) and high number of services per conception (3.44) for Holstein-Friesian bulls collected at Singosari is notable. Examination of the pregancy diagnosis records of individual bulls at the stud from the Singosari annual report (Singosari Balai Inseminasi Buatan, 1985) indicate 1,622 cows were bred with 2,794 units from two particular bulls (numbers 3802 and 3803), but resulted in only 783 pregancies to first breeding for a conception rate of 23.0 and 24.1 and number of services per conception of 3.6 and 3.8, respectively, for the two bulls. Four other Holstein-Friesian bulls had conception rates in the range of 30.5% to 36.8% . The "top" bull reported had a conception rate of only 44.6% after being bred to 166 cows. Fertility records such as these indicate a serious problem which appears to be breed related, given the more normal performance of the other breeds. Low fertility might also be traced to management of the semen at the provincial or kabupaten level given the tendency to use a single bull for one year in one kecamaten. The number of provinces reporting the use of these bulls was not indicated. Concentration of use of Singosari Holstein-Friesian semen in kecamatens with particular problems in getting cows bred (poor nutrition, poor insemination management, etc.) might also account for the low figures.

B. The Forage and Livestock Development Centers (UPT)

In partial fulfillment of the mandate to improve livestock production, the DGLS has established nine forage and livestock development centers. The primary purposes of these stations are the 1) breeding and multiplication of both large and small ruminants, swine, and poultry, whichever is needed in the surrounding region, and 2) forage seed or vegetative plant multiplications and distributions of improved grasses and legumes to farmers. Three UPT stations have specific mandates for improvement of purebred cattle: Baturraden for the *Bos taurus* dairy breed, the Friesians; Serading for the *Bibos sandaicus*, Bali Cattle; and Lili for the *Bos indicus*, Ongoles.

The livestock development program is designed to upgrade the type and quality of livestock used by farmers. This is to be accomplished by maintenance of genetic stocks through the selection of superior animals. As these superior genetic animals become available (the program is new), the females will be distributed to farmers while the males will be used in the A.I. centers. It was not clear to the study team what the exact system or systems of production-testing these UPT livestock units will be. What is needed is a production-testing scheme that is established and operated by an experienced Animal Geneticist or Animal Breeding Specialist who would use production-test data as part of a long-term genetic improvement program. However, it appears that neither the DGLS nor the AARD have personnel now in-country that are qualified to lead such programs. At this time, it appears that there are only two Animal Breeding Specialists who have a research degree, the Ph.D. in Animal Breeding, one at the Institute Pertanian Bogor (IPB) and one at the University of Gadjah Mada (UGM) in Yogyakarta. As Animal Nutrition and Feeding, Animal Reproduction, and Animal Genetics appear to the major constraints on animal production in Indonesia, it is time for these major units, DGLS, AARD, and the major Agricultural Universities, to cross old time bureaucratic barriers in order to bring together the best-trained people in Indonesia to work together to establish a long-term production-testing program with the goal of genetic improvement of indigenous as well as imported animals. Such units would also become superior places to study nutrition and reproductive physiology.

At each station, some hectares of land are being used to nurseries of grasses and legumes for the production of seeds and root stock for propagation of certain grasses, particularly Penniseteum purpureum (elephant grass, or "rumput gadjah"), Brachiaria decumbens and others. Details of grasses and legumes in each station are shown in table IV. In study team visits, it was found that many of these stations had active programs and that the surrounding farmers were using the improved plants with success.

In addition, the forages produced on the stations are used to provide feed for on-station livestock so as to obtain forage and animal yield data. For example, records at Baturraden revealed that elephant grass yielded up to 300 tons of fush material per hectare per year, equal to about 54 to 60 tons of dry matter. The yields of Setaria splendida (setaria) and Brachiaria decumbens were about 50% that of elephant grass. However, most stations have yield data on grasses/legumes grown in their ecological zone, important data since there is extreme variations from station to station.

Another important function of all stations is that of training extension workers, key farmers, and farmers in animal management, and the establishment and development of improved forages. Study team members found that the stations at Pleihari and Indrapuri were widely used for training farmers in transmigration areas in which the ADB Loan was being used for the distribution of large ruminants to transmigrants, who had no previous experiences in using draft animals or in the planting and management of improved forages.

# Appendix VI.B: The Extension Division of the AAETE and the Directorate Generals in the Ministry of Agriculture

The main purposes of the extension components, wherever found in the organizational structures, is to prepare information packets for farmer use that will improve the production of agricultural commodities and to improve the well being of farmers. The Agency for Agricultural Education, Training and Extension (AAETE) serves the four Directorate Generals of the production arms of the MOA to provide technical advice in extension methods for the preparation of training materials and distribution to organizations that can use these materials for training farmers. In order to prepare and distribute such information packets, the MOA has established organizations at national, provincial, regency or wilayah, and subdistrict levels.

## A. National Level

The AAETE has responsibility to advise and coordinate the information gathering activities within the four Directorate Generals, the AARD, and any other GOI or private source for transmission to professional groups, national or provincial, for preparation of training materials for use in training farmers.

## B. Provincial Level

The governor is responsible for all agricultural activities in the province and the head of Livestock Services, called Dinas Peternakan, and reports directly to the governor for all livestock activities. In keeping all agricultural activities at the kabupaten and kecamatan levels, the Governor makes sure that these are coordinated through Bappeda (regional development planning agency). Also, the BIMAS secretary at the provincial level reports to the Governor.

AAETE units at the provincial level include a Regional Training Center (RTC) and the Agricultural Information Center (AIC). The RTC serves as a training center for large bodies of Senior Field Extension Workers (PPM), Field Extension Workers (PPL), for officials only, not farmers. These are units that can handle larger groups than others that will be discussed. The key unit for preparation of technological information packets is the AIC, which reports to the AAETE. AIC is a technical unit that collects, processes and distributes information packets for use of extension personnel in training contact farmers who, in turn, train the farmers in their group. The AIC may receive information from any research unit, DGLS, MOA, universities, AARD, libraries, private industry, foreign governments, various GOI units outside of agriculture, and others. By use of its specialized units (publishing, audio visual, library and distribution) and special staff of subject matter specialists (SMS or PPS), the AIC is capable of preparing written materials, audio visual or other training materials.

At the provincial level, the head of AIC acts as the vice-secretary of the working team of the Extension Coordination Forum (FKPPI) which is lead by the representative of the MOA (KANWIL). The inspectors of the Agricultural Services, the BIMAS secretary, the head of AIC are members of the FKPPI, which meets regularly to formulate and discuss integrated activities to achieve more efficient success in extension.

C. Regency or Districts Level

Similar to the provincial level, each regency has its own Extension Coordination Forum (FKPP II) lead by one of the heads of the Agricultural Services, while the District Bimas Secretary serves as the secretary.

D. Subdistricts (Kecamatan) Level (Wilayah)

As the information flow gets nearer to its utilizers, the farmers, the organizations reflect a specific purpose. There is the subdistrict livestock service which has both the A.I. post and the Animal Health post, normally managed and supervised by the mantri hewan. For extension purposes outside of the animal health and AI services, the Center for Extension Services is the Balai Penyuluhan Pertanian (BPP) which is the extension center at the subdistrict level. It is the Center for the PPM and PPL and may have demonstration plots for improved forages, facilties for training farmers in the use of animals for plowing, pulling carts, trimming feet of cattle, vaccination of animals, rabbit raising etc. It is an important part of Extension at the Contact Farmer level.

At the BPP level are found most of the PPM as most are supervisors of PPL activities. In general, 1 PPM supervises 12 PPL's, while 1 PPL works closely with about 15 contact farmers (Kontak Tani), which in turn works closely with about 20 farmers in his group (KELOMPOK).

E. Example of One BPP in Action

The study team was able to visit for detailed study one AIC unit in Lembang, West Java. Since it is one of the oldest and largest AIC's in Indonesia, it represents one of the most developed and serves as the model for those that are younger. While on this visit, the study team was able to study one BPP that had responsibilities in all areas of production except fisheries. However, inland fishery units are developing in this area, thus they hope to fill this need as soon as possible by recruting a PPL with inland fisheries expertise. This BPP served two kecamatans and has one PPM as the head and supervisor; also, there was one PPM who served as the programmer. Therefore the BPP unit has 2 PPM's and 15 PPL's, which were divided as follows:

| | |
|---|---|
| Food crops | 10 PPL |
| Livestock | 2 PPL |
| Estate Crops | 2 PPL |
| Conservation | 1 PPL |
| Total | 15 PPL |

The unit has 160 kontak tani (KT), or key farmers, with each KT serving about 20 farmers. Therefore, the Extension Service in this BPP is in



647

contact with 3,200 farmers. Since there are 30,602 farmers in the two kecamatans, it is apparent that the extension workers are working directly with about 10% of the farmers, who, as key farmers, are actually representing their colleagues. These farmers are expected to disseminate the information to their neighbors, so that each PPL could cover approximately 1,600 farm families. But, as not all subdistricts have their own REC's and because of the limited number of PPL's, not all farmers could be covered by the existing REC's or extension workers.



Lui

APPENDIX 7:

TABLES FOR CHAPTER VII:

DESCRIPTION AND ANALYSIS OF SELECTED INDONESIAN FARMING SYSTEMS

Appendix table 7.1. Major farming systems in Indonesia

| Farming system base | Major Crops [a/] | Major Animals [b/] | Regions | Feed Source |
|---|---|---|---|---|
| A. Food crop based | | | | |
| 1. Irrigated | | | | |
| a. Lowland (intensive rice cultivation) | | | | |
| 1) Water - 12 months | Rice-rice-rice<br>Coconut<br>Mixed garden | Buffalo, chickens, small ruminants | Java, Bali<br>Lombok, Lampung | Cut-and-carry vegetation [c/], crop residues |
| 2) Water - 7-10 months | Rice-rice-secondary crops<br>Coconuts<br>Mixed garden<br>Sugarcane | Buffalo, cattle, small ruminants, chickens, ducks,<br>Swine | Java, Bali, Lombok, parts of Sulawesi, Sumatra, Kalimantan | Cut-and-carry, elephant grass, leucaena, sesbania, crop residues, sugarcane tops, grazing after crop harvest and non-cultivated areas |
| 3) Water 5-7 months | Rice-rice-secondary crops<br>Rice-secondary crops[a]<br>Mixed garden (fruit trees) | Cattle, small ruminants, chickens<br>Swine | Java, Bali, parts of Salawesi, Sumatra, Kalimantan, NTT, NTB | Cut-and-carry, use of public lands, crop residues, grazing after crop harvest and non-cultivated areas |
| 4) Mixed-crops | Rice-secondary crops<br>Mixed garden | Cattle, small ruminants, chickens<br>Swine | Parts of most islands | Cut-and-carry, use of public lands, crop residues, grazing after crop harvest and non-cultivated areas |
| 5) Intensive vegetables | Speciality crops such as onions, tomatoes, carrots, cabbage celery, cucumber beans, leafy vegetables, corn | Cattle, small ruminants, chickens | Java, Bali | Cut-and-carry, vegetable residues, grazing non-cultivated areas |
| 2. Rainfed | | | | |
| a. Lowland | | | | |
| 1) Mixed-crops | Rice-secondary crops<br>Mixed garden (tree crops) | Cattle, small ruminants, chickens<br>Swine | Parts of all islands | Cut-and-carry, use of public lands, crop residues |

(continued)

Appendix table 7.1. (Continued)

| Farming system base | Major crops [a] | Major livestock species [b] | Regions | Feed source |
|---|---|---|---|---|
| b. Upland | | | | |
| 1) Mixed-crops | Corn + other secondary crops (intermixed)<br>Mixed garden | Small ruminants, chickens<br>Swine | Parts of all islands | Cut-and-carry from public lands, crop residues, grazing after crop harvest and on communal lands |
| 2) Vegetable-based | Mixed vegetables (eg. peas, beans corn, vegetables | Chickens<br>Rabbits | Java, Bali<br>Parts of Sulawesi, Sumatra | Vegetable residues |
| 3) Coastal wetlands (tidal swamps) | Rice-secondary crops[a]<br>Mixed garden (tree crops) | Cattle, small ruminants, chickens | Parts of Kalimantan, Sumatra, Sulawesi | Cut-and-carry, crop residues, grazing non-cultivated areas |
| 4) Shifting agriculture | Maize, cassava other secondary crops<br>Vegetables | Chickens, goats, cattle (minor)<br>Swine | Sulawesi, Sumatra, Kalimantan, Irian Jaya, NTT | Grazing of native vegetation, crop residues |
| B. Estate-crop based | | | | |
| 1) Coconut | Rice-secondary crops[1]<br>Mixed garden | Cattle, small ruminants, chickens | Most all islands | Grazing under coconuts and non-cultivated areas, crop residues |
| 2) Rubber or palm oil | Legumes as cover crops<br>Rice-secondary crops<br>Mixed garden | Small ruminants (tethered)<br>Cattle (minor) (tethered)<br>Chickens | Java, Sulawesi, Sumatra, Kalimantan | Cut-and-carry legumes under trees, crop residues, grazing non-cultivated areas |
| 3) Spices, cashew, etc. | Corn and other secondary crops, upland rice,<br>Mixed garden | Small ruminants chickens<br>Chickens | Java, Bali, Sulawesi, Sumatra, Kalimantan Moluccas | Grazing and cut-and-carry native vegetation and legumes, rice bran, crop residues |

(continued)

Appendix table 7.1. (Continued)

| Farming system base | Major crops | Major animals | Regions | Feed source |
|---|---|---|---|---|
| C. Livestock based | | | | |
| 1) Beef fattening | Rice-secondary crops<br>Mixed garden<br>Fruit crops | Cattle (Holstein bull calves or ongole)<br>Bali, Brahman crosses<br>Chickens | Java<br>NTT | Cut-and-carry improved grasses (eg. elephant, setaria), leucaena, sesbania, banana stems, rice bran, crop residues |
| 2) Dairy | Maize, cassava<br>Mixed garden | Holsteins and their crosses | Java | Cut-and-carry native vegetation and improved grasses |
| 3) Swine | Rice, maize-cassava<br>Mixed garden (fruit trees) | Native and improved swine chickens | Bali,<br>Irian Jaya | House and crop residues, reject fruits, elephant grass, leucaena, seeds of native trees |
| 4) Chickens | Rice-secondary crops<br>Mixed garden | Layers and broilers | Java,<br>Sulawesi,<br>Kalimantan | Purchased feed |
| 5) Ducks | Rice-secondary crops<br>Mixed garden | Cattle, buffalo, small ruminants, ducks, chickens | Java and parts of most islands | Grain lost in harvest, vegetation along canals and waterways |
| 6) Small ruminants | Rice-secondary crops<br>Mixed garden | Small ruminants, cattle (some farms) chickens | Most all island island areas | Scavenging non-cultivated crop residues |
| 7) Ranching | Mixed garden (some farms) | Cattle, chickens | Sulawesi, parts of Kalimantan | Grazing improved and native pastures |

a/ Rice is the major crop in many systems but corn becomes prominent with less water. Secondary crops include corn, peanut, soybean, mung bean, pigeon peas, cowpeas, cassava, sweet potato; in addition some farmers grow cash crops as tobacco and cotton. Mixed garden is that around the house site for various vegetables, fruit and nut trees but may be extended to include spices, coffee, cacao, etc.
Sugarcane on small farms by allocation for one year.

b/ All farms of a given type may not have all animals; swine found on farms of non-Muslims.

c/ Cut-and-carry refers to daily cutting of native and naturalized grasses and other vegetation on rice bunds, terraces, non-cultivated areas, waterways, public lands, fodder trees, as well as improved grasses (such as elephant and setaria) and legumes (especially leucaena).

## Appendix 7.A: ADDITIONAL PROFILES OF SELECTED FARMING SYSTEMS

Additional insights into the diversity of Indonesian farming systems are provided by this appendix which summarizes field notes compiled by the consultants. These notes were checked against data from secondary sources and, where possible, with data from the ADB/DGLS survey. While these summary profiles should not be considered "representative" or "typical" farming systems, they can, nevertheless, serve as base models upon which additional field survey work can be designed and conducted. They can also assist in project design and project analysis exercises.

All figures are for mid-1985 and in Rupiahs, at that time valued at about Rp 1118 per $ US. Five general farming systems are described: Lowland based, partially irrigated uplands, rainfed upland, slash and burn (swidden) system and specialized poultry units. The locations for each of these are as follows:

Lowlands:

1. South Lampung
2. Central Lampung
3. Coastal Swamp Jambi

Partly irrigated upland:

1. Central Java
2. North Sumatra
3. West Sumatra
4. South Kalimantan
5. Central Kalimantan

Rainfed upland:

1. Aceh
2. Jambi
3. Jambi

Slash and burn system:

1. Central Kalimantan

Specialized poultry:

1. Chickens (broilers), Lampung
2. Nucleus Estate Poultry Schemes



8649

I. **Lowland:**

1. Mixed farming system in South Lampung Province, Sumatra, with draft cattle and village (ayam kampung) chickens

Family: Farmer, wife, daughter. Spontaneous transmigrant from East Java, Settled here in 1968.

Land: 3 ha total (2 ha dryland, 0.75 ha wet rice, 0.25 ha for household).

Cropping System:

Wet rice - one crop/year, 4 tons/ha with 300 kg urea and 100 kg TSP.
Plowing - 3 passes, 8 days/pass based on 6 a.m. - 11 a.m. work day.
Cost if hired - Rp 1500/day without food.
Harrowing - 3 passes, 5 days/pass.
Labor - Land preparation and weeding, Rp 50,000/ha.
Transplanting - 30 persons for 1/2 day, wage about Rp 750/person.
Harvest - 20 persons for 1/2 day, get 1/4 to 1/5 of yield plus meal, worth Rp 500.
Home consumption - 500 kg rough rice.
Market price - Rp 100/kg dried.
Corn - cassava intercrop. 2 ha dryland.
Corn - 2 tons/ha, Rp 125/kg, 350 kg urea and TSP mixes. Plow twice, 8 days/pass, 6-11 am.
Weeding - Uses animals, 5 days total.
Harvest - 15 people/ha for 1/2 day. 1/6 output as payment.
Cassava - sells in the field, 6 tons at 25/kg.

Manure - Get 750 kg/month from cow, bull and calf. Uses for compost.
Market price is Rp 5/kg fresh.

Livestock:

Cattle:

Received IFAD-sponsored Bali cow and bull in July 1984. First calf in July 1985. Feeds cut grass, Setaria, grazing plus salt. Bull used by other cattle recipients in the farmer group 5 times per month, payment in form of "jamu" (special medicine or tonic) for bull consisting of 3 eggs, soy sauce, coffee, salt, and garlic. Trained for plowing in one month, paired together. Bought plow for Rp 25,000, bought cart chassis for Rp 70,000. Cuts 40 kg setaria/day.

Chickens:

100 ayam kampung: The farmer sells 10 eggs/day at Rp 100/egg plus sells 5 month old chickens for Rp 1500/bird. Sells 10/month.

Gross output:

| | |
|---|---|
| Rice - 0.75 ha at 4 tons/ha @ 100,000/ton | 300,000 |
| Corn - 2 ha at 2 tons/ha @ 125,000/ton | 500,000 |
| Cassava - 6 tons @ Rp 25/kg | 150,000 |
| Cattle - (from system -7), 2 @ 200,000/yr* | 400,000 |
| Chickens - eggs | 365,000 |
| meat | 180,000 |
| | --------- |
| Total gross output: | 1,895,000 |
| Gross output/family member: | 631,667 |

Net cash income:

Sales:

| | |
|---|---|
| Rice - 3 tons x 75% yield = 2.25 tons less 0.50 home consumption =1.75 tons for sale | 175,000 |
| Corn - 4 tons x 85% yield = 3.4 tons | 425,000 |
| Cassava - 6 tons @ 25/kg | 150,000 |
| Livestock - (from above) | 945,000 |
| | --------- |
| Total sales: | 1,695,000 |

Costs:

| | |
|---|---|
| Fertilizer - urea + TSP, 350 kg @ 100/kg | 35,000 |
| Draft power - rice: 40 days @ 1500 | 60,000 |
| corn: 20 days @ 1500 | 30,000 |
| Manure - 750 kg/month x 12 month @ 5/kg [a] | 45,000 |
| rice - Land preparation + weeding | 50,000 |
| Transplanting-30 persons x 750 | 22,000 |
| Cassava - total cost of crop | 100,000 |
| | ------- |
| Total costs: | 342,500 |
| | ========= |
| Net cash income: | 1,352,500 |
| Net cash income/family member: | 450,833 |

[a] Note: The net income per cow/bull included their value for draft power and manure. Therefore, these were also included as costs to the farmer above to avoid double counting.

Strengths of system: Excellent gross value of output produced for a 3 ha farm with no tree crops. Good integration of cattle with crops, very good forage program, steady source of cash income from village chickens. A good model farm for dryland cropping systems that need draft animals.

Weaknesses of system: Chicken operation susceptible to N.D.outbreak.

Lowlands:

2. Crop-based lowland cropping system with draft cattle in Central Lampung, Sumatra

Family: Farmer, wife, 3 working children, 1 child in school.

Land: 2.5 ha, good quality soil on peneplains.

Cropping system: One ha irrigated rice, double cropped, 3 tons/ha/crop.
Fertilizer - 400 kg urea + 200 kg TSP/ha/crop. Four bottles insecticide @ Rp 1250/bottle.
Corn - Yields of 4 ton/ha on 0.25 ha.
Cassava and mung bean on small household plots only.
Black pepper - one ha, yield of one ton/ha, price of Rp 3500/kg.
Cloves - 100 trees, yield of 0.1 kg/tree, Rp 8000/kg.

Livestock: Received imported Brahman crossbred cow from Crash Program in 1981. One calf returned, second calf 4 months old. Calving interval of 1.5 to 2.0 years. Draft power - 12 days/ha for pair, paid Rp 2000/day for 4-hour day plus meal and cigarettes. Manure for upland crops. Feeding - Setaria on 0.25 h, cut once a week for supplemental feeding. Two kg rice bran/day when working. Maize stover. Use bulls and A.I. for breeding. Ayam kampung chickens - 25 raised for meat, Rp 1200/kg. Eggs are Rp 75/egg at farm level. Ducks - 15 Muscovy-type birds, produce 10 eggs/day @ Rp 100/egg farm gate. Sell culls for Rp 2500.

Representative farm budgets:

Gross output :

| | |
|---|---|
| Rice - 6 ton/year @ Rp 130,000/ton | 780,000 |
| Maize - 1 ton @ Rp 100,000/ton | 100,000 |
| Black pepper - 1 ton @ 3500/ton | 3,500,000 |
| Cloves - 10 kg @ Rp 8000/kg | 80,000 |
| Chickes - 50 birds/year @ Rp 1500/bird | 75,000 |
| Ducks - 3000 eggs/year @ Rp 100/egg | 300,000 |
| | ---------- |
| Total gross output: | 4,835,000 |
| Gross output/family member | 806,000 |

Net cash income :

Sales:

| | |
|---|---|
| Rice - four tons @ 130,000 | 520,000 |
| Maize - one ton @ 100,000 | 100,000 |
| Black pepper | 3,500,000 |
| Cloves | 80,000 |
| Poultry | 300,000 |
| | ---------- |
| Total sales: | 4,500,000 |



652

Costs:

| | |
|---|---|
| Fertilizer | 38,000 |
| Insecticide | 5,000 |
| Rice bran for cattle for 40 days | 7,000 |
| Total costs | 50,000 |
| Net cash income from farming | 4,000,000 |

Strengths of system: Good cash crop program based on pepper and cloves supplemented by rice and village poultry. Good forage program supplemented by maize stover and rice bran. Good Utilization of animals for draft power.

Weaknesses of system: Not typical to use as model for development programs because of high income from pepper. Also much better developed farm than typical cattle recipient and higher levels of government assistance involved than is normal.

3. Swamp area with mixed crop-livestock system in Jambi Province, Eastern Coastal Swamp Areas of Sumatra

Family: Eight persons including 6 children aged 7 months to 15 years. Lives in Nipah Panjang villaage, Batang Hari River, about 4 km from the sea.

Land: One ha including household. Farms are long strips of land extending back from drainage canals. Also rents 0.5 ha of land.

Cropping systems: All systems are coconut based with cropping underneath coconut of rice plus food crops. Typical crops include long beans, chilies, oranges, eggplant, and green maize. Land is not plowed. The grass is cut and used as mulch. The land is hoed before planting, requiring 2 persons for 1 month/ha. Weeding done twice, for a total of 10 days/ha. If field labor is contracted, the cost for land preparation is 44,000/ha, planting is 36,000/ha, and harvest is 1/6 of the harvest for laborers. One crop rice is planted per year yielding approximately 2 tons/ha. Home consumption of rice is 4 kg (milled) per day. The farmer sells 200 kg milled rice for 300/kg. The farmer harvest 300 oconuts per month which are sold at 40/nut. Other crops are for home consumption only.

Rented land : Same rice-coconut system. Rent is 100 kg dry rice. The farmer doesn't get the coconuts.

No fertilizer or manure is used on any crop.

Livestock: Three different farms all had basically the same cropping system, but all had different livestock.

1) Cattle only : One madura cow dropped December 1983 under APBD (regional budget) program. Three calves so far, one returned, another to be returned soon, the third still young. Breeding was by farmer group bull; service fee is 2 eggs for the bull. Feeding - tethered during the day, fed cut local grasses at night. No forage problem. Burns rice hulls and manure at night in shed to keep out mosquitos. Local 2-year-old cattle worth 300,000.

2) Cattle plus goats: One Madura cow received under APBN (national budget) scheme. Two calves born since December, 1983. A goat buck and doe were purchased in local market for 40,000. Now have one kid. Goats graze on tether plus fed cut grass. No manure is used. Farmer says he can handle a maximum of 5 goats. Kids sold at one year of age for 25,000.

3) Buffalo and meat goat unit - Pregnant buffalo purchased at 3 years of age for 285,000. Cow has had 2 calves, one died. Not used for plowing but for mixing mud for brick making. Manure used in paddy field. Feeding is by grazing local grasses only. Goats - 3 does, 1 buck, 3 kids. Native grasses only, tethered plus stall fed.

4) All farmers above have 5-10 ayam kampung chickens and/or ducks.

(continued)

Gross output from one ha farm:

| | |
|---|---|
| Rice - 2 tons @ 140,000/ton | 280,000 |
| Coconuts - 3600 nuts @ 40/nut | 144,000 |
| Village poultry - 60 eggs/yr @ 75/egg | 4,500 |
| Chickens - 5 birds/yr @ 2000/bird | 10,000 |
| Cattle or buffalo - 300,000 every 1.5 yrs | 200,000 |
| Goats - 2 to 3 sales/yr @ 25,000 | 65,000 |
| | ------- |
| Total gross output: | 701,000 |

Net cash income:

| | |
|---|---|
| Rice - Two tons less home consumption less harvesters' share = 200 kg milled rice @ 300 | 60,000 |
| Coconut & livestock revenue (as above) | 421,000 |
| Less: Land preparation & planting costs 80,000 | 80,000 |
| | ------- |
| Net cash income: | 401,000 |

Strengths of systems: Self-sufficiency in food reached without large effort, diet supplemented with fish. Livestock play the major role in farm cash income. Plenty of forages available.

Weaknesses of systems: Low productivity of crops, low coconut prices, very little integration of crops and livestock, low farm income, so most farmers work part-time on or off farm to supplement income. Poor quality forages, little contribution made by village poultry.



1057

II. Partially irrigated:

1. Crop-based system with mixed crop-livestock farm, Klepu, Central Java

Family: Husband, wife, 2 children.

Crops: 0.25 ha irrigated land, 2 crops of rice, 1 dryland crop. Four tons/ha/harvest of rice. Total output = 2 tons, 1 ton sold for 175/kg, one ton for home consumption and payment to workers.

Inputs: Land preparation by one pair cattle, 8 hrs/ha of 4 hour days, 1600 plus one meal/day. 120 kg/ha of Urea/crop plus 2 tons manure @ 10/kg (home supplied).

Planting: 60 man-days/ha, weeding - 6 days/ha, harvest and threshing for 1/6 of harvest.

Secondary crops : Mixed cropping producing 40 kg shelled peanuts, 750 kg fresh maize, 1000 kg sweet potatoes, cassava on dryland only.

Animals: Feed - rice straw, cut grass, cassava leaves, maize stover, sweet potatoe vines, leucaena. Two draft cattle, home use for 10 days, hire out for 20 days.

| | | |
|---|---|---|
| Household budget: | | |
| Sales: | | |
| Secondary food crop sales | | 120,000 |
| Rice: | | |
| Gross income, 2 tons @ 175,000 | | 350,000 |
| | | -------- |
| Total sales: | | 470,000 |
| Costs: | | |
| Urea | 15,000 | |
| Labor, 30 days @ 1000/day | 20,000 | |
| Harvest, 1/6 of 2 tons @ 175/kg | 58,330 | |
| | ------ | |
| Total expenses: | 93,330 | 93,330 |
| | | -------- |
| Net returns to household: | | 376,670 |
| Cash Income: | | |
| Rice sales | 175,000 | |
| Draft animal hire | 32,000 | |
| Secondary crop sales | 120,000 | |
| | ------- | |
| Total cash sales: | 327,000 | 327,000 |
| Costs: | | |
| Urea | 15,000 | |
| | ------ | |
| Total costs: | 15,000 | 15,000 |
| | | ======= |
| Net cash return: | | 312,000 |

Strengths: Self-sufficient unit, efficient use of crop by-products.

Weaknesses: Low levels of gross income and cash income per family member, need to work off-farm, very little cash income from livestock, high feed and labor requirements for animal maintenance.

2. Crop-based mixed system with buffalo, North Sumatra Highlands

Family: Farmer and wife, 3 children off in school.

Land: 0.6 ha, single crop paddy followed by fish pond.

Cropping system: Single crop rice with local variety, 5500 kg/ha. 50% home consumption, 50% for sale. 6 month crop, Rp. 182/kg for local paddy.

Land preparation: Two female buffalo at 25 days/ha, based on 3 hrs/day for plowing. Harrowing is 3 hrs/day for 8 days.

Fertilizer : 150 urea, 150 TSP, 300 Ammophos/ha/crop.

Livestock: One buffalo bull, two females. Feed on grazing areas near rice fields (no rice straw fed), rice stubble and cassava leaves. Farmer has 25 ducks, 50 village chickens. Buffalo manure to fruit trees, not paddy.

Consumption of animal products - Two chickens/year, one egg/week.

Gross output from 0.6 ha :

| | |
|---|---|
| Rice: 3300 kg @ 182/kg | 600,600 |
| Fish: ? no data | |
| Ducks: 500 eggs @ 80 | 40,000 |
| Chicken: Meat - 20/year @ 3000/bird | 60,000 |
| Eggs - 700 eggs @ 100 | 70,000 |
| | ------- |
| | 770,600 |

Net cash income:

| | |
|---|---|
| Rice sales | 300,000 |
| Livestock sales | |
| Duck | 40,000 |
| Chicken | 130,000 |
| One buffalo calf every two years | 60,000 |
| | -------- |
| Total sales: | 530,000 |

Cash expenses:

| | |
|---|---|
| Fertilizer | 45,000 |
| | ------ |

| | |
|---|---|
| Net cash income: | 485,000 |
| Net cash income per household member (excluding fishpond income) | 97,000 |

Strengths of system: Good integration of crops - livestock - fish farms, ability to carry large numbers of animals on small area, use of manure, draft power. Good market access.

Weaknesses of system : Low productivity of buffalo, native chickens, native ducks, system limited by one crop/year, lack of alternative crops for sale or household consumption, lack of recognition by farmers of potential role of forage crops or role of quick-growing forage crops sown into rice stubble.

3. <u>Mixed farming system with buffalo, Minangkabau Highlands, West Sumatra</u>

Family: Farmer, wife, 4 children.

Land: 2 ha, including 1 ha irrigated rice and 1 ha partially cleared mountain slope.

Cropping system:
Wet rice - 2 crops/year, 3 ton/ha/harvest. Fertilizer - 150 kg urea and 100 kg TSP/ha/crop.
Upland crops - bananas, coconuts, kapok, cassava. Sales only 50,000/yr.

Labor:

Land preparation - One buffalo, 20 days for initial plowing and harrowing. Eight days for second round. Buffalo works 6 hrs/day. Rate is 2500/day plus lunch.
Transplanting - 35 persons for 3 days,7 hrs/day. 4 kg rice/day plus lunch.
Weeding - 35 days, family labor.
Harvest - 20 people for one day. Lunch plus 15% of crop.

Rice price - 130/kg dried paddy. 4.5 tons sold per year less wage costs paid in rice

Family consumption: 1.5 tons per year.

Livestock: Water buffalo cow 4 years old, plus 9 month old calf.
Purchase price at 2 years old = Rp. 330,000. Borrows bull from neighbor. Will sell calf when mature for Rp. 450,000 for work.
Vaccinated once per year for hemorraghic septicemia.
Feeding - cut grass plus grazing fallow rice field only. Grass harvest requires 2 hrs/day of labor by children.

Village chickens - 25 birds used for sales of eggs and chickens. Sales of 20 eggs/month @ 80/egg plus 10 birds for meat twice a year @ 1800/bird.

Gross agricultural output:

| | |
|---|---|
| Rice - 6 tons @ 130,000/ton | 780,000 |
| Cash crop sales | 50,000 |
| Buffalo output from : | |
| draft power | 70,000 |
| manure, 15 kg/day @ 10/kg | 55,000 |
| sales of calf every two years | 225,000 |
| Chickens - eggs 20 per month @ 80 | 19,200 |
| meat 20 per year 1800/bird | 36,000 |
| Total gross agricultural output: | 1,235,200 |
| Gross output/family member: | 205,867 |

Net cash income:

| | | |
|---|---|---|
| Rice: 6 tons - 1.5 ton home consumption 420 kg rice for transplanting - 900 kg for harvest | 413,400 | |
| Cash crop sales: | 50,000 | |
| Livestock sales - buffalo | 225,000 | |
| chickens | 55,200 | |
| Total cash sales | 743,600 | 743,600 |
| Costs: | | |
| Fertilizer - 500 kg @ 100 | 50,000 | |
| Meals for workers | 62,500 | |
| Total costs: | 112,500 | 112,500 |
| Net cash income: | | 681,100 |
| Net cash income/family member: | | 113,516 |

Strengths of system: System is very stable because of good irrigation system, farmer-owned source of draft power, small but steady income from cash crops and village chickens. Farmer is introducing fish pond to further integrate crops and livestock, based on buffalo system requiring little outside input.

Weaknesses of system: Severe shortage of irrigated rice land, little room for income growth since rice yields are already quite high and feed resources for introducing additional livestock are not available. Upland plot too far away to integrate with rest of farm. Fish pond only way to increase income. Farm too small to absorb additional family members productively.

4. Mixed crop-livestock systems in transmigration area, Kolamkiri, South Kalimantan

Background:

South Kalimantan had 20,000 transmigrants in 1984; planned to settle 50,000 more during Repelita IV. Transmigration Department provides 2 ha of cleared land, 1 ha of which is ready for planting. An average of 0.8 ha is now being cultivated under existing scheme. Plan for groups of 5 farmers to share pair of draft animals. No community grazing lands are provided. Area has acid, poorly drained soils.

Family: Most families have farmer, wife, 1-2 children below working age. Very few households with more than 2 working age adults. Transmigrants are from Java.

Land: 0.25 ha for household, 0.75 ha cleared for food crop, 1.0 ha for food crops or tree crops. Average of 1.5 ha used for crops to date. Rice is flood-irrigated when river rises.

Cropping systems: One ha flood-irrigated rice, one crop of two tons/year, all for home consumption. 90 kg urea and 80 kg TSP/year. Rice straw burned. Farm price for rice is 100/kg.

Labor:

Land preparation: one ha requires 1.5 months for one person for land or contract price of Rp. 100,000.
Transplanting - 30 person-days
Harvest - 25 person-days
Weeding - 20 person-days.
Harvesters share: 1/3 of crops.

Upland crops - 0.5 ha crop used on average.
Cassava - corn - vegatables - peanuts - soybeans.
Cassava - 10 t/ha @ Rp. 25/kg on 0.25 ha.
Corn - peanut - soybean intercrop on 0.25 ha.
Corn - 1000 ears sold fresh @ Rp. 25/ear.
Peanuts - 250 kg sold @ Rp. 450/kg.
Soybeans - 200 kg sold @ Rp. 600/kg.
Vegatables - long bean, eggplant, chilies, for home consumption.

Household plot: bananas, coffee, cloves, cassava, forage plot.

Lime: Area required 4 tons lime for 2 ha, cost of Rp. 50/kg.

Livestock: Cattle received from either ADB program, Transmigration Department, Crash Program, or INPRES program. Bali or Ongole cattle preferred. About 10% of recipients use cattle for draft; main use is for manure on household plot and animals for sale. Cattle manure generally for tree crops, vegatables, forage plots. About 10% used manure for paddy crops if the field was near household. Farmers pair animals for plowing, rates are 4000/day for 5 hours. Feeding - Tethering, Imperata grass, cassava leaves, corn stover, peanut vines. Village chickens - average of 15 per household, all eggs hatched out since live chickens are much easier to get to market, price 1500/kg liveweight. High mortality in rainy season (Nov -January). Sales of 10 chickens/month at 2000/bird.

Gross output:

| | | |
|---|---|---|
| Rice - 2 tons @ 100,000/ton | 200,000 | |
| Cassava - 2.5 tons @ 25,000/ton | 62,500 | |
| Corn - 1000 ears @ 25/ear | 25,000 | |
| Peanuts - 250 kg @ 450/kg | 112,500 | |
| Soybeans - 200 kg @ 600/kg | 120,000 | |
| Other crops - no data available | | |
| Cattle - one calf every two years @ 200,000/calf | 100,000 | |
| Village chickens - 120/year @ 2000/bird | 240,000 | |
| | ------- | |
| Total gross output: | 860,000 | |
| Gross output/household member: | 215,000 | |

Net cash income:

| | | |
|---|---|---|
| Gross value - less value of rice crop: | 660,000 | 668,000 |
| Cash costs: | | |
| Fertilizer | 17,000 | |
| Lime - 200,000 every 4 years | 50,000 | |
| | ------ | |
| Total cash costs: | 67,000 | 67,000 |
| | | ======= |
| Net cash income: | | 593,000 |
| Net cash income/person | | 148,250 |

Strengths of system: Moderate levels of integration between crops and livestock, which should increase as land becomes better developed. Moderate potential for income generation as tree crops mature and livestock production problems are overcome. Good potential for village poultry systems to supplement income. Good potential for productive forage crops. Manure is very important.

Weaknesses of system: Poor soils, areas isolated from market so must concentrate on higher value cash crops, limited potential to use cattle for draft power because of the lack of plows, distances from households to fields, obstacles in fields, and thin layers of topsoil in some areas. Isolation has limited services for livestock; mortality rates high and reproduction rates low, particularly for imported cattle and Ettawa goats. Shortages of labor for fieldwork and for cutting grass for cattle. No community grazing lands.

5. Crop-based mixed crop-livestock systems in transmigration area: Pangkoh IV Block, Central Kalimantan

Family: Farmer, wife, no working-age children available for farm labor, average 4.6 people per household.

Land: Acid soils, thin topsoil with toxic subsoil (high Al concentration) close to surface. Standard farm is 2 ha, 0.25 for household tree crops, garden. Double-crop rice, wet season flooded rice, dry season upland rice on 0.5 ha of land; upland crops, fallow and grazing on 1.25 ha.

Cropping pattern:

| Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Land prep | plant | weed | Harvest | | land prep | | plant | weed | | Harvest | |
| HYV rice, flooded | | | | | Local rice, dryland | | | | | | |

Fertilization : 100 kg Urea and 50 kg TSP/ha on HYV rice only. No manure used, field too far from household, no carts for transport and all manure needed for household plots. Urea, TSP = 125/kg.

Paddy yields: HYV = 2.4 tons/ha, local = 2.0 tons/ha.

Production: about 2.2 tons/family, sales of 500 kg @ Rp. 150/kg dried.

Labor: Land preparation: 60,000/ha based on 40 man-days @ Rp. 1500/man-day plus 2 meals. Alternative is use of plowing services based on 1000/hr. for team and driver and 40 hrs/ha. Additional human labor needed to complete puddling.
Transplanting - 60,000/ha
Weeding - 35,000/ha
Harvest - 5 kg to owner : 1 kg to harvesters: total cost/ha based on 4.2 tons for 2 harvests is 700 kg worth 105,000 total.

Secondary crops: Mixed cropping system with maize, soybeans, peanuts, cassava, vegatables on raised bed ("surgen") system. Approximate yields and prices:

| | Yields/ha | Area/farm | Price/unit |
|---|---|---|---|
| Maize (fresh) | 6000 ears | 0.5 | 15-20/ear |
| Cassava | 20 tons | 0.2 | 25/kg |
| Soybeans | 800 kg | 0.2 | 500/kg |
| Peanuts | 400 kg | 0.1 | 400 (dry, in shell)/kg<br>800 (dry, shelled)/kg |

Tree crops: Coffee, coconuts, cloves, bananas, jackfruit, mangoes, etc.

Livestock: Village chickens: Sales of about 20 birds/year, eggs used for brooding, some sold @ Rp. 100/egg. Chickens sold for Rp. 1700/kg, average of 1.4 kg/bird. Dinas Peternakan vaccinates twice/year for Newcastle Disease.

Cattle: On area basis, have 120 Madura cattle for 700 families. Only 25 families use animals for draft, borrow neighbors cattle to make pairs. There are only 5 plows for 25 families. Feeding system based on semi-confinement with grazing and some stall feeding. Reproductive rates: about 30%/year, no cattle returned since cattle dropped by Dinas Peternakan in 1982.

Gross output:

| | |
|---|---|
| Rice, 2.2 tons @ 150,000/ton | 330,000 |
| Secondary food crops, average output | 240,000 |
| Tree crops, average sales | 50,000 |
| | ------- |
| Total gross output: | 620,000 |
| Gross income/family member: | 134,780 |

Expenses:

| | |
|---|---|
| Rice production costs, 2 crops | |
| Land preparation, 1 ha total | 60,000 |
| Transplanting, 1 ha total | 60,000 |
| Weeding, 1 ha total | 35,000 |
| Harvesting | 105,000 |
| Fertilizer | 37,500 |
| | ------- |
| Total rice production costs: | 297,500 |
| Net return to household: | 322,500 |

Net cash income:

| | | |
|---|---|---|
| Sales: | | |
| Net rice sales | 75,000 | |
| Secondary food crop sales | 240,000 | |
| Tree crop sales | 50,000 | |
| | ------- | |
| Total sales: | 365,000 | 365,000 |
| Costs: | | |
| Fertilizer | 37,500 | 37,500 |
| | | ======= |
| Net cash income/household: | | 327,500 |
| Net cash income/family member: | | 71,200 |

Strengths of system: Area had somewhat better than average soils for Kalimantan Transmigration regions, much better access to major market in Palangkaraya allows intensive fruit and vegatable cultivation.

Weaknesses of system: Weak integration of animals into system, very limited use of draft animals because of lack of plows, distances to fields, poor condition of fields for plowing. Little use of crop by-products because too far to haul them to household.

III Rainfed uplands:

1. Crop-based upland farming system with draft cattle, Kabupaten Lhok Seumawe, South Aceh

Family: Farmer, wife, son who works part-time on farm.

Land: 2 ha dryland, coconuts, soybean-corn intercrop under coconut trees. Also plots of elephant grass (1200 $m^2$), Mexico grass (1200 $m^2$).

Cropping system:

Coconuts: 100 trees of coconuts, 4 harvests/year, 12 nuts/tree/harvest. One coconut = 400 g fresh meat @ 100/kg = 1920/tree/year = 192,000/year income.

Maize-soybean intercrop : Soybean one crop/year at 1 ton/ha. Sold at 350/kg of grain.

Maize - Sells fresh ears, sells 3500 ears/ha from single crop @ Rp. 12/ear. Maize stover fed to cattle. No manure inputs, 100 kg urea + 50 kg TSP/ha/year.

Livestock: 2 Aceh cattle, females for draft and breeding, 15 days/ha for land preparation @ 2 hrs/day. Hire out for 1000 for 3 hrs. Manure - to coconuts and grass plots. Gets about 2 calves in 3 years per cow, feeds 5 kg rice bran/day during dry season and during work.

| | | |
|---|---|---|
| Gross output: | | |
| Coconuts | 192,000 | |
| Soybeans | 700,000 | |
| Maize | 84,000 | |
| Calf sales, 1 per year | 100,000 | |
| Draft power sales, 30 days | 90,000 | |
| | -------- | |
| Total gross output: | 1,166,000 | 1,166,000 |
| Gross output/family member: | 388,667 | |
| Cash costs: | | |
| Rice bran: 150 days @ 5 kg/day @ 60/kg | 45,000 | |
| Fertilizer | 20,000 | |
| | ------- | |
| Total cash costs | 65,000 | 65,000 |
| | | ========== |
| Net income: | | 1,101,000 |

Strengths of system: Good markets for cash crops and livestock, fertile soils, good integration of crop and livestock enterprises, well adapted forage grasses for supplemental feeding. Good support from Dinas Peternakan.

Weaknesses of system: No rice produced, high dependency on purchased food products, low copra prices, limited feed base for expanding livestock production.

2. <u>Specialized smallholder water buffalo system in Sungai Bengkel River Basin, Jambi</u>

Location: River Basin draining Jambi Province to the sea. Low population density, large grazing areas on river flood plains and in forest. Local inhabitants live along river, not transmigrants.

Family: Farmer, wife, 4 children, 1 of working age.

Land: 0.5 ha rainfed rice near river.

Cropping system: One rice crop/year of 1.4 tons/ha. No fertilizer, home consumption of 3 kg rice/day.

Labor (0.5 ha):

Land preparation - 15 days
Transplanting - 5 days
Weeding - 10 days
Harvest - 10 days by farmer and wife.

Livestock system: Four water buffalo, 2 adults and 2 calves. Sells calves at 3-4 years of age for meat when cash is needed. Calf carcass weight on slaughter; 100 kg. Carcass value 400,000. Buffalo manure is not used. The buffalo are used for draft power. Feeding - Free ranging system along rivers. The rice field is fenced to keep out the buffalo. Return to household at night. Night feeding of cut grass and crop by-products not common. Natural mating in the herds. Calving interval approximately 14 months.

Gross income:

| | |
|---|---|
| Rice: 700 kg @ 140/kg | 98,000 |
| Buffalo - 1 calf per year | 400,000 |
| Total gross income: | 498,000 |

Strengths of system: Very low input system to produce meat. Major source of income in this area. Few reproduction or feeding problems, low labor inputs for buffalo.

Weaknesses of system: Low crop productivity, low income, no cooperative use of labor. Slow growth rate of buffalo because of no night feeding and poor quality grasses along river banks. Potential for Buffalo Improvement Project based on more animals and a forage program.

2. Mixed Crop-Livestock system in IFAD Draft Cattle project area, Pamenang Transmigration area, Central Jambi Province

Location: Pamenang area, poor, sloping, highly erodable soils, about 1800 families to be resettled in area, including local farmers. Farmer started in 1980, received 1 Bali cow, October, 1984. Wild pigs and monkeys are major problems.

Family: Farmer, wife, son, daughter-in-law, baby. Farmer is transmigrant from Central Java.

Land: 3.5 ha available, 2 ha cleared so far. Household plot of 0.25 ha; 1.75 ha for coffee, cloves, fruit, vegatable and food crops. 1.25 ha still along edge of forest, cannot be opened due to wild animal problems.

Cropping system:

Household plot - Pineapple, cloves, bananas, papayas, corn.
- Pineapples - Sells 10,000 per year @ 25/fruit
- Bananas - 3000 bunches per year sold @ 300/bunch.
- Papayas - Harvest about 20 per day, fed to cow. Value @ 20/fruit.
- Cloves - 25 trees, no yield yet.
- Corn - Two harvests per year, 2000 fresh ears per harvest @ 15/ear
- Coffee, 300 trees, intercropped with dryland rice. Coffee yields 30 kg/harvest, 2 harvests/year, 1000/kg.

Rice - 300 kg/ha, all for home consumption, applies 10 kg/ha of urea, TSP, and KCl.

Labor use for rice production:

Exchange labor for planting: 15 man-days/ha
Weeding: 5 man-days/ha
Harvest: 1/6 crop to laborers

Livestock system:

One Bali cow, used for manure output only, not draft power. Feed - corn stover, cassava, setaria, natural grasses. Not grazed in fields.

Village chickens - 30 head, 2 eggs sold/day, 100/egg. Ten chickens sold per year, 1500/kg. Sales depend on household cash needs, no home consumption of chickens or eggs.

Typical household budget:

| | | |
|---|---|---|
| Pineapples | 10,000 @ Rp. 25/fruit | 250,000 |
| Bananas | 300 bunches @ Rp. 300 | 90,000 |
| Papaya | 20/day x Rp. 20/fruit | 146,000 |
| Cloves (after reaching production 0.1 kg/tree @ Rp. 8000/kg) | | 20,800 |
| Corn | 4000 ears @ Rp. 15/ear | 60,000 |
| Coffee | 60 kg @ Rp. 1000/kg | 60,000 |
| Rice | 525 kg @ Rp. 140/kg | 73,500 |
| Cattle (after repayment of 2 calves) 0.6 calves/year @ Rp. 250,000 | | 150,000 |
| Village chickens: | | |
| eggs - 700 eggs @ Rp. 100/egg | | 70,000 |
| birds - 10/year @ Rp. 2000/bird | | 20,000 |
| | | -------- |
| Total gross income: | | 940,300 |
| Gross income per household member: | | 188,060 |

Net cash income:

Sales:

| | |
|---|---|
| Pineapples, bananas, cloves, corn, coffee | 480.800 |
| Cattle (after repayment) | 150,000 |
| Village chickens | 90,000 |
| | ------- |
| Total sales: | 720,800 |

Expenses:

| | |
|---|---|
| Fertilizer 30 kg @ 100/kg | 3,000 |
| | ======= |
| Net cash income: | 717,800 |
| Net cash income per household member: | 143,560 |

Strengths of system - Diversified source of income, integration of livestock and crop through the use of manure. Income will show gradual improvement as general area develops, more land is cleared, pest problem declines and tree crops reach full production levels. Good forage plots, cattle doing very well.

Weaknesses of system - Little use will be made of draft animals given the nature of the cropping system, hilly land and poorly cleared plots. Very poor fertility will limit food crop and cash crop yields, manure essential for crops. If additional land could be cleared, area could support more livestock. Generally poor prospects in this area because of poor soils and hilly topography.

D. **Slash and burn (swidden):**

1. Crop-based system with pigs, Dayak Farmers, Bukit Rawi, Central Kalimantan

Location: Lowland riverine floodplains, heavily timbered. Villages along riverbanks. Pigs kept around villages. Village has specified-area communal land ("adat" system) and individual households have use rights on plots that they first claimed by clearing a plot and cropping. System requires 15-20 ha per family based on 2 years of cropping and 15-20 years fallow. Most families supplement agricultural income by forestry, handicrafts, rubber tapping and trading.

Family: Average of 6 per household.

Land: On average, one ha cleared every 3 years. Year 1 - clear, burn, crop. Year 2 - crop. Year 3 - abandon due to fertility decline and invasion of grassy weeds. Bananas usually harvested next 2-3 years until tree re-growth takes over. Farms considerable distance from villages, have temporary huts for periods of field labor.

Cropping system: Cut and burn forest during dry season, February - August. Takes 2-3 months, part-time.

Year 1 - September - October: Plant 1st year crops of sweet potatoes, bananas, taro, vegatables, corn, cassava. Almost all crops for household consumption.

Year 2 - Plant in upland rice during rainy season, followed by vegtables. Rice yield of 2.25 tons/ha, family consumption 1.5 tons. No fertilizer, manure, draft power applied on these plots.
Household plots - Bananas, fruit trees, coffee, cloves, cassava, sweet potatoes. Pig manure applied to these crops.

Livestock system: Pigs and village chickens. Pigs kept on raised pens, generally full confinement. Production parameters are given in Chapter III (appendix table 3.52). Herds limited in size to 1-4 head as feed resources are not sufficient for more. Production coefficients: average litter size is 6, 10-15% piglet mortality, sell at 60-80 kg liveweight for 1250/kg l.w. Very little home consumption of pork; fish available cheaply or at no cost. Feeding system - household scraps, rice bran, taro, swamp cabbage, cassava leaves, banana stems.

Gross output: Insufficient data on cropping system parameters compounded by use of complex crop mixtures. Pigs provide average of 4 pigs for sale per year and 1 for home consumption, averages 70 kg liveweight @ 1250/kg = 437,500/sow.

Strengths of system: Self-sufficiency with low levels of labor input, pigs utilize household crop by-products efficiently.

Weaknesses of system: Destructive ecologically, very little marketed surplus because of labor involved in land clearing and weeding larger areas, and isolation from major market centers. Low productivity of traditional pig systems, but appropriate given low levels of management, feed resources, and animal health services that are available.

E. Specialized poultry systems

1. Mixed farming system in Central Lampung Province with commercial poultry unit

Family: Traditional Lampungnese extended family system, 12 members in household.

Land: Controls 26 ha, of which 10 ha is cropped, 4.5 ha partially irrigated rice, 2.0 ha corn, 3.0 ha cassava, 0.5 ha of coconuts and household area.

Cropping system:

Rice one crop/year, yields 2.6 tons of Pelita variety. Seeded at the rate of 25 kg/ha. Plowing by pair of animals for 10 days, 2 1/2 hrs./day. No commercial fertilizer used, only manure.

Corn - Two crops/year, First harvest yields 2.3 t/ha, 2nd crop yields 1.6 t/ha. Fertilizer use: 100 kg TSP and 250 kg Urea/ha.

Cassava - 11.6 t/ha

Labor use: Pays in kind under sharecropping arrangement. If owner pays all cash costs plus plowing, laborers get 30% of harvest; if laborers provide all costs, 50:50 split.

Wage rates - Plowing with pair of cattle 2000/day with no food or cigarettes. If provided all food, 750/day cash wage, 4 hours/day.

Livestock:

Cattle: Eight cattle, 2 Ongole cows, 4 Bali cows, 2 Bali calves, 1 Bali bull. Farmer received 1 Bali cow and 1 Bali bull in 1977 under BPSD ("Bimbingan Peternak Sapi Daging") program, paid back all three calves in under 3 1/2 years. Feeding - natural grazing on fallow land plus plot of Setaria and corn stover (P.O. cows only). Manure used on paddy field.

Layer chicken unit: 300 layers, purchases day-old chicks and concentrate mix, mixes feed himself. Laying rate for mature layers 68-70%, 60/egg, or 1045/kg.

Budget for layer unit over lifetime:

Feed ingredient costs:

Commercial concentrate (26% of ration) @ 410/kg
Rice bran (32% of ration) @ 10/kg
Corn (42% of ration) @ 100/kg
Ration cost = 153/kg
Ration cost with labor added = 180/kg

Feed requirements:

Starter ration, 56 day @ 35 g/day = 1.96 kg
Grower ration, 28 days @ 60 g/day = 1.68 kg
Layer/developer, 70 days @ 90 g/day = 6.30 kg
Laying @ 22 weeks,
week 23-42, 140 days @ 125 g/day = 17.5 kg
Week 43-62, 140 days @ 110 g/day = 15.4 kg
Total feed = 42.84 kg/day
Approximate total cost of feed alone = Rp. 77.11

Additional costs:

| | |
|---|---|
| Day-old chick = | 365 |
| Medicine @ Rp. 2/day over 434 days | 868 |
| Labor, 3 man-days over 434 days @ 1500 | 4500 |
| Total cost/bird/lifetime: | 12,576 |

Income/bird/lifetime:

| | |
|---|---|
| Eggs: 280 days @ 65% average = 182 eggs @ 60/egg | 10,920 |
| Manure: 40 kg @ 10/kg | 400 |
| Cull bird sales | 3500 |
| Total income/bird/lifetime: | 14,820 |

Profit per bird = Rp. 2244
Profit per bird/month = 2244/14 = 160
Total profit per month from 500 bird unit = 80,000

Dual purpose (beef-draft) cattle unit: Assumption: Farmer receives 2 year old pregnant Bali cow, sells at 10 years of age, 60% calving rate, returns 2 calves to project.

Gross output from cattle:

| | |
|---|---|
| Calf sales - 3 @ 1 1/2 years of age | 540,000 |
| Cull cow - sell at 10 years of age | 300,000 |
| Draft power - 60 days/year at 2000/day for pair x 8 years | 480,000 |
| Manure - 12 kg/day @ 10/kg x 8 years | 350,400 |
| Gross output from cattle: | 1,670,400 |
| Gross output/year over 8 year period | 208,800 |

Note: In the budgets, the figure of 200,000 is used as the animal's contribution to net cash output so the costs to the farmer for draft power and manure are also subtracted in the item for crop costs. This avoids double counting.

Gross farm output:

| | |
|---|---|
| Rice : 4.5 ha x 2.6 tons @ 120,000/ton | 1,404,000 |
| Corn: | |
| 1st harvest: 4.6 tons @ 90,000/ton | 828,000 |
| 2nd harvest· 3.2 tons x 2ha @ 120,000/ton | 768,000 |
| Cassava: 3 ha x 11.6 tons/ha @ 26,000/ton | 904,800 |
| Cattle: average gross output/year/animal = 208,000 x 6 cows | 1,252,000 |
| Chickens (net) Rp. 80,000/month x 12 months | 960,000 |
| Gross farm output: | 6,117,600 |
| Gross output/household member: | 509,800 |

Net farm income:

| | |
|---|---|
| Rice: 11.7 tons less 30% for workers and less 2.6 tons home consumption | 672,000 |
| Corn: 15% output for workers | 1,356,600 |
| Cassava: | 904,800 |
| Cattle: | 1,252,800 |
| Chickens: (net Income) | 960,000 |
| Net farm income: | 5,146,200 |

Costs:

| | | |
|---|---|---|
| Draft power 60 days @ 1000/day | | 60,000 |
| Rice: | | |
| Fertilizer (manure only) | 15,000 | |
| Seed | 9,000 | |
| Insecticide | 22,000 | 46,000 |
| Corn: | | |
| Fertilizer (manure) | 15,000 | |
| TSP, 100 kg/ha @ 125/kg x 2 ha | 25,000 | |
| Urea, 250 kg/ha @ 100/kg x 2 ha | 50,000 | 90,000 |
| Cassava: all costs, 20/kg | | 696,000 |
| Cattle: Labor 2 hrs/day for herd | | 90,000 |
| Total costs: | | 1,195,000 |

| | |
|---|---|
| Net cash income: | 3,951,200 |
| Net cash income/household member: | 329,267 |



673

Strengths of system: Plentiful grazing resources supplemented by good stand of <u>Seteria Lampungenesis</u> results in good cattle productivity. Good demand in local area for draft power and manure. Highly productive land for corn. Well integrated system in terms of use of crop by-products (corn stover) for animals, use of manure for crops, and efficient use of household labor between crops and livestock. Good supplemental income from layers. Low costs for layer feed based on local products.

Weaknesses of system: High cash income only because of very large area of cultivated land (10 ha) and access to family lineage (Adat) cummunal grazing areas (200 ha between 6 families). Layer unit subject to price fluctuations and marginally profitable now.

Conclusion: Good model farm for making effective use of draft animals and for village-based commercial poultry unit using concentrate plus local feed resources. Very productive corn farming.

2. Poultry Nucleus Estate Schemes

These are part of mixed crop-livestock systems as described in (1) above, or can function basically as stand-alone units which can be used to supplement farm income or can be operated by village households who own or rent no agricultural land at all. The institutional background of this scheme is set out in Chapter VIII, part A. The budgets which follow were developed during field visits by the consultants. Five variations on the basic model are discussed.

a. Model I: Shop absorbs market price risk, producer absorbs feed price risk:

- Type of unit: Broiler only
- Size of unit: 500 broiler standard unit
- Credit package: 750,000 for d.o.c.s, feed and medication, six week cycle.
- Contract: Poultry shop gives guaranteed purchase price to producer, feed price varies.

Description: A 500-bird poultry house costs about 500,000. Credit for the house is available from the poultry shop and repayment terms are included in the contract. At the time of the visit, the guaranteed purchase price was 1,154.72 per kg liveweight for birds averaging 1.78 kg liveweight. The poultry shop was reselling the broilers in the open market for 1,225/kg liveweight.

Representative budget :

| | | | |
|---|---|---|---|
| Returns: | 468 broilers x 1.78 kg/bird x 1,154.72/kg | | 959,622 |
| Costs: | 500 d.o.c.s @ 455 | 227,500 | |
| | Starter ration, 750 kg @ 379/kg | 284,250 | |
| | Finisher, 850 kg @ 345/kg | 293,250 | |
| | Medication | 18,550 | |
| | Total | 823,850 | 823,850 |
| Profit/cycle of 500 birds | | | 135,772 |

If a market for poultry manure is available, additional revenue of 1,500 kg x 10/kg = 15,000 can be added to the above total. The 150,000 can be applied to repayment and repairs of the poultry house and returns to family labor. Farmers are producing about 4 cycles per year of broilers resulting in an annual net income of about 1,000,000 given the above prices for d.o.c., feed and purchase contract. This system had the advantage that the poultry shop gets repaid for its loan since it takes delivery of the output.

b. Model II: Layer PIR

Feed and other inputs are channeled through a KUD to the farmer groups. No price guarantees or contracts are involved other than the obligation to repay the loan for inputs and layer house. A budget for these units is shown below, excluding costs for loan repayment, family labor and revenue from manure sales.

| | | |
|---|---|---|
| Returns: 280 laying days @ 65% laying rate | | |
| = 181 eggs @ 77/egg | 12,740 | |
| cull bird sale | 3,500 | |
| | ------- | |
| | 16,240 | 16,240 |
| Costs (per layer): | | |
| Day -old chick | 400 | |
| Starter ration, 56 days @ 35 g/day @ 318/kg | 623 | |
| Grower ration, 28 days @ 60 g/day @ 257/kg | 432 | |
| Layer developer, 70 days @ 125 g/day @ 250/kg | 1575 | |
| Layer I,140 days @ 125 g/day @ 274/kg | 4795 | |
| Layer II,140 days @ 110 g/day @ 260 | 4004 | |
| | ----- | |
| | 11,829 | |
| Medicine Rp 2/day for 434 days | 868 | |
| | ------ | |
| Total cash cost | 12,697 | 12,697 |
| | | ====== |
| Profit per layer over 14 month cycle = | | 3,443 |

Manure sales would add another 400 to this total for a net cash profit of about 4,000/bird. A 1,000 bird layer unit would thus produce a net cash income over 14 months of 400,000 or about 28,500/month.

c. Model III: <u>Fixed ratio between feed:output price, guaranteed profit to producer</u>

This model was used for broilers under a PIR scheme in Medan supported by Charoen Phokhand (C.P.) feed mill. They plan on contracting with 80 farms, 60 already operating under the program. Poultry shops handling C.P. products operate through a distirbutor (a C.P. agent) who provides inputs to the farmers. Contract are for between 1,000 and 3,000 broilers per cycle. The farmer is guaranteed a price of 3.495 times the price per kg of feed purchased, on a liveweight basis, less a 6% discount. All inputs are purchased by the farmer on credit. C.P. purchases the broilers at the fixed price and repays the farmer the balance of receipts. If mortality is less than 1%, the farmer gets to keep extra birds based on a standard mortality rate of 2%. If the mortality rate is higher, farmer absorbs the loss.
The standard selling weight is 1.2 kg liveweight. The contract is based on multiples of 1,000 birds to be marketed (1,020 d.o.c.s distributed, with 2% mortality results in 1,000 birds for marketing). If the farmer has more

than 1,000 birds (mortality less than 2%), he keeps them. Using local prices at the time, the following budget results (using the 2% mortality rate):

Costs:

| | |
|---|---|
| 1,020 d.o.c.s @ 400 | 408,000 |
| Starter feed, 1,010 kg @ 360/kg | 363,600 |
| Finisher, 1,150 @ 340/kg | 391,000 |
| Medication | 37,700 |
| Cost per 1,000 broilers marketed | 1,200,300 |

$$\text{Weighted price of feed: } \frac{363{,}600 + 391{,}000}{2160 \text{ kg}} = 349.4$$

| | |
|---|---|
| Guaranteed price for broilers = 349.4 x 3.495 | = 1,221.15 |
| per kg liveweight less 6% discount | = 1,148/kg |
| Revenue = 1,000 birds x 1.2 kg/bird x 1,148/kg | = 1,377,600 |
| Cost per 1,000 broilers marketed (from above) | = 1,200,000 |
| Profit per 1,000 birds, excluding family labor | = 177,300 |

The 6% discount is used to repay C.P. for the loan needed to build the poultry house and interest on the input loan. Farmers in the scheme were producing 4-5 cycles of broilers per year and selling manure at Rp 10/kg. The farmer is guaranteed against the major source of economic risk; the fluctuations in feed and broiler price, the major sources of risk for these units

d. Model IV: Poultry Shop supplies all inputs for layers, takes eggs for repayment (Used by Viterna Poultry Shop in Lampung City).

| Nucleus (INTI) | Poultry Shop | | |
|---|---|---|---|
| Farmers group (kelompok) | concentrate feed only | complete feed only | complete feed and concentrate feed |
| Plasma (Individual farmer) | 8 members | 6 members | 8 members |
| | 26,000 layers | 3,000 layers | 4,000 layers |

Contract details: Egg purchase price from farmers based on current retail market prices for eggs. Poultry shop picks up eggs from farmers twice per week and credits their account at the poultry shop or pays cash to farmer. Feed, d.o.c.s and medicine sold at regular prices, eggs purchased on following prices (Rp/egg) :

| Open market price range | Contract price to producer |
|---|---|
| Rp 50 - 60 | 55 |
| Rp 60 - 70 | 65 |
| Rp 70 - 80 | 75 |

The poultry shop resells to customers through the poultry shop and to the open market.

The scheme has problems in loan repayment because farmers often sell their eggs on the open market and don't repay the loans from the poultry shop. If the price is high, they sell on the open market; if the price is at the lower end of the above ranges the producers dump all their eggs onto the poultry shop which then suffers losses. The first farmers group still owes the poultry shop over Rp 3 million.

e. Model V: Ration contract for layer

The producer gets credit for 4.7 kg of feed for each kg of eggs the poultry shop picks up. Using the budget developed for Model II above, the farmer with one layer sells 182 eggs or about 10.7 kg of eggs. This gives him credit for 50.3 kg of feed at the poultry shop. His actual requirement per complete 14 month cycle is 42.8 kg. So the difference represents his extra credit for feed that he can use for payment of d.o.c.s, medicine, interest, family labor, cost, etc. Alternatively, the poultry shop pays 4.7 times the weighted cost of feed used, in this case Rp 1,267/kg or Rp 1,254/kg of eggs picked up. This scheme has not proven very popular with producers.