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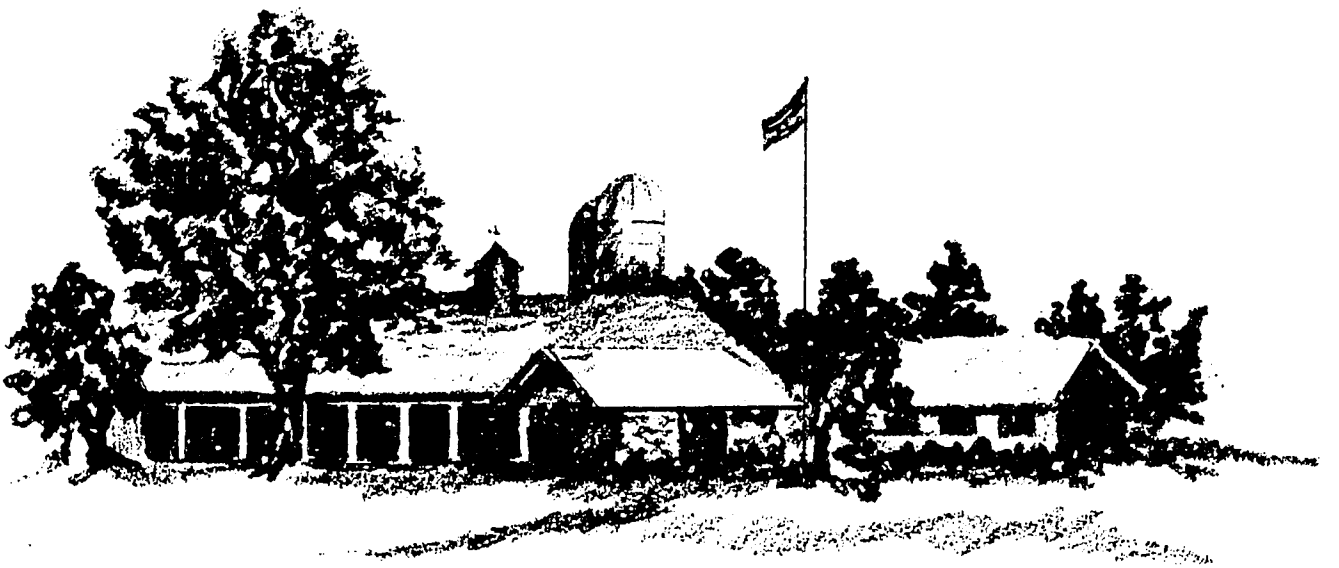
ANIMAL AGRICULTURE IN INDONESIA

by Dr. Allan D. Tillman



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by Dr. Allan D. Tillman

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Foreword

Dr. Tillman's paper presents an excellent description of the status of the livestock industry in Indonesia and the potentials for its further development. This treatise reflects his extensive on-site experience in Indonesia and his perception of the opportunities to improve the efficiency and productivity of its animal agriculture.

Attention is directed to the extremely high population density on Java, Madura, and Bali. In addition to 685 persons/km^2, there are approximately 50 animal units/km^2, clearly indicating that animals are an integral component of the prevailing small farm units that average only 0.4 hectares. Animals are vital to these small farm systems because they produce meat, milk, eggs, and hides for home use and sale and provide draft power. Also, ruminant animals that feed on deep-rooted plants have an important role in soil conservation in the critically eroded areas of Java, Madura, and Bali.

This paper clearly indicates that Indonesia possesses the feed resource base -- crop residues, pastures, forages, and by-products -- to support increased animal production, especially ruminants. The potential of the outer islands to produce pasture, forages, and other feedstuffs for livestock is high. And even on the densely populated islands livestock production can be increased through better utilization of crop residues and available pastures and forages.

This paper is an important addition to the literature on tropical agriculture and is a valuable source of information for agricultural development programs in Southeast Asia.

Ned S. Raun
Vice President, Programs

Preface

Even though Indonesia has only 0.07 of an animal unit per person and a daily consumption of 2.5 grams of animal protein, animal agriculture is important to its people. For an understanding of the significance of the above statement, it would be necessary to review the farming systems in Indonesia and the purpose of animals in these systems.

The purpose of this paper is to provide a concise, balanced, and objective description of animal agriculture in Indonesia. It considers the factors which affect animal agriculture, taking into consideration those which serve as constraints to future developments as well as those which present developmental opportunities.

During the author's assignment to Indonesia (1973-1980), he worked as an animal scientist in the Rockefeller Foundation's Education for Development (EFD) Program in the University of Gadjah Mada, Yogyakarta, Indonesia. This assignment involved extensive travel throughout the country permitting him to meet most of the indigenous and expatriate leaders in the animal sciences. This paper is based upon contacts with these colleagues, personal observations and experiences, and written reports. It is hoped that the paper will serve as a useful reference for those who have an interest in the animal sciences in Indonesia.

Acknowledgements

The author is indebted to many individuals and organizations for help in publishing this paper. During his stay in Indonesia, he met most indigenous and expatriate leaders in the animal sciences. Their friendly and constructive cooperation is gratefully acknowledged and appreciated. He wishes it were possible to recognize each individual for his/her contribution.

Secondly, the author expresses his sincere thanks to the Rockefeller Foundation for financial support throughout both the working and data-gathering period in Indonesia and the preparation phase of this paper in Morrilton, Arkansas.

Also, he extends his sincere thanks to Winrock International for furnishing a place to work in an inspiring surrounding and for access to an excellent library and efficient secretarial help. Without the help of many individuals in this organization, this publication would not have been possible.

Allen D. Tillman

Summary and Conclusions

1. Indonesia is located at one of the major crossroads in the world, thus it is of strategic importance. It forms a barrier between the Indian Ocean and the China Seas, thus is near the population centers of India, China, and Japan. The Straits of Malacca, a narrow and important waterway between Sumatra and Malaysia, is the most direct route between the Suez Canal and the mainland of China, Hong Kong, and Japan.

2. The physical environment of Indonesia has influenced its entire spectrum of development. The country is an island chain which extends about 5100 km from west to east along the equator from about 5° north to 11° south. There are about 13,667 islands which vary in size from a small reef to one as large as France (Kalimantan). All Indonesians live near the sea. In fact, Indonesians speak of their country as "tanah air kita" (our land and water), which to them has a natural and an inevitable relationship.

   Both in size and population, Indonesia is the third largest country in Asia, ranking behind China and India in both criteria. If it were superimposed on a map of the United States, both San Francisco and New York would be covered, and in places it is deeper in distance from north to south than is the U.S.

   Climate extremes are related to rainfall, varying from areas which are very wet most of the year to those which are quite dry at times, depending upon location and season. Two monsoons, from the northwest and southeast, bring rain to Indonesia; some regions receive moisture from both while others receive rain from only one.

   The sea serves both as a bridge and as a barrier, permitting communication as well as isolation. The early developments on all islands were in coastal cities leaving the interiors of most islands still primitive and undeveloped. In all of the islands but Java development in the interior only took place if navigable rivers were present. In addition to serving as a communication link with the world and other islands, the shallow waters between most islands provide sea food for local consumption and export. In recent years off-shore oil has become a valuable and important foreign-exchange earner.

   There are three major soil types in Indonesia that play a role in the distribution of people in the archipelago. The andosols and regosols of Java and Bali are fertile lands and easily cultivated in rice or secondary crops. Consequently, about 65% of the people live on the islands of Java, Madura, and Bali, which contain only about 7% of the land mass. In contrast, a high percentage of the soils on the outer islands are the red-yellow podzollic soils, which are of low fertility and more difficult to manage. Although constituting 93% of the land, only 35% of the people live on these outer islands.

3. Indonesia gained its independence in 1949 after about 300 years of Dutch colonial rule. The new nation, under President Sukarno, offered the prospect of rapid development. However, these bright prospects were not realized under Sukarno, and after 32 years of independence the country is still poor. President Sukarno was a leader of great popularity and persuasiveness, but the years under his leadership (1949-1965) were characterized by great instability and economic disaster. Since 1965, under the guidance of President Suharto, the government is addressing both the economic and social needs of the people. The rapid increase in the price of oil since 1973 has provided monies for infrastructure, and especially on Java the political power center. However, major problems remain:

   a. The economy is predominantly rural and agricultural yet there are many landless peasants. About 60% of the labor force is engaged in agricultural pursuits but agriculture accounts for only 30% of the gross national product. The average income in the country is only $370.00 per person with the peasant farmer on the lower income scale.

   b. Most of the production of crops and animals is concentrated on Java, Madura, and Bali on small farms which average about 0.4 ha or one acre per household. The subsistence farmers remain outside of the mainstream of economic activity, thus the production of both animals and crops is not affected by prices of saleable products to the same degree found in commercial production units.

   c. In its beginning, Indonesia was a mosaic of island societies with each having its own language or dialect, traditions, and culture that existed in isolation. Both Presidents Sukarno and Suharto have done much to unify the nation, but significant social changes require more than 32 years, even under optimal conditions. Therefore Indonesia is still a classic example of a plural society in which the pluralism encompasses both ethnic and linguistic variations, showing conflicts between Muslims and Christians, between the Muslim groups, between the Javanese political leaders and the Chinese minority who control the commerce and have the "know how" needed for development, and between the Javanese poor and the richer inhabitants on the outer islands.

4. Indonesia has few animals relative to its population having only 6,436,000 cattle, 2,313,000 buffalo, 620,900 horses, 2,870,000 swine, 11,688,000 sheep/goats, 104,267,700 poultry. Nearly all of the animals are owned by smallholders who use traditional, low-productivity systems. The smallholders, whose farms average about 0.4 ha per household, use the large ruminants (cattle and buffalo) for draft purposes and sell for slaughter only young bulls, old bulls, and cows which were used for land plowing, cultivation, and reproduction purposes. The large ruminants are kept in covered stalls near the homes so that the manure can be saved and used or sold; it is a valuable product in tropical soils. The smallholders consider both the large and small ruminants as a "living" savings account to be used when they need money. Therefore, marketing depends upon the smallholder's needs rather than upon factors which would maximize yields.

Sheep, goats, and swine are kept for the production of meat and manure. Chickens are kept as scavengers and for the production of meat and eggs on the small farming units. Duck-keeping is more specialized than that of chickens and both meat and eggs are obtained. It is estimated that 90% of the poultry meat and 40% of the eggs in Indonesia are furnished by the village poultry.

5. The species of animals found in Indonesia and their productive performances are described in Chapter 4. In general, the animals in Indonesia are small and their performances are low if compared to similar animal species found in many other areas.

6. The food crop residues (Chapter 6) are important sources for the feed base for ruminants in the subsistence farming system. One hectare of land in the intensive cropping system on Java will provide enough forage to meet the roughage needs of one pair of draft cows. Data on the quantity of each crop residue available, its chemical composition, and probable feeding value are also presented.

   Also, estimates were made of the quantities of other forages available to subsistence farmers in other areas. Results show ranching schemes on the outer islands to be feasible.

7. The Government of Indonesia's (GOI) services to the livestock industry consist of the provision of training, research, extension, specialized A.I. (artificial insemination) centers, distribution and credit schemes, veterinary services, and animal health schemes. The extent and qualities of these services are covered in Section IV, Chapter 9.

8. Some constraints upon livestock development in Indonesia (Section V, Chapter 10) are:

   a. The concentration of people, animals, capital, and agricultural leaders on Java, Madura, and Bali. Each km^2 on Java, Madura, and Bali contains 685 people, 31 cattle, 8 buffalo, 72 sheep/goats, 5 pigs, 1 horse, 428 chickens, and 57 ducks while the same land area on the outer islands contains only 30 people, 1 cattle, 1 pig, 1 buffalo, 1 sheep/goat, 17 chickens, and 4 ducks. However, people in the thickly populated areas do not voluntarily move to the outer islands.

   b. Agricultural leaders from the thickly populated areas who have established model ranches on the outer islands. These agriculturists seem to be more concerned with the maximization of land use rather than utilizing the resources available in a less intensive system.

   c. Shortage of foundation stock. The total number of large ruminants is about 8.5 million with a decline in the number of breeding animals since 1968. Due to high prices, inflation, and other factors, smallholders on Java are slaughtering young female stock, often pregnant, for meat.

d. Weak or no GOI support for:

1. Animal health program
2. Technician training
3. Production-oriented research in both animal production and animal health
4. Well-trained people in all programs
5. Laboratory and other training facilities
6. An adequate GOI salary base accompanied by stricter work requirements to maximize staff effectiveness in the primary job
7. Utilization of trained personnel
8. Improved marketing channels, especially on the outer islands
9. Simplified land tenure and transfer costs to encourage ranching developments on the outer islands

The opportunities for developmental improvement in Indonesia's livestock industry are in:

a. Feeding and management of livestock
b. GOI services to the livestock industry across the entire spectrum
c. Marketing schemes
d. Credit availability to livestock producers
e. Land tenure and transfer procedures
f. Productivity of Indonesian livestock (Section IV)
g. Integration of animal production with food crop production through curricula of universities and secondary agricultural schools (Section V)
h. Animal production and care in the transmigration areas
i. Infrastructure on the outer islands
j. The dairy industry in the thickly populated areas
k. Poultry and swine production in all of Indonesia

Section I. General Features of Indonesia

CHAPTER 1. GEOGRAPHICAL SETTING AND PHYSICAL ENVIRONMENT

The Geographical Setting

Indonesia's location at one of the world's major crossroads places it in a position of strategic importance. It forms a barrier between the Indian Ocean and the Pacific Ocean area of the China Seas. The Strait of Malacca is the most direct route from the Suez Canal to the Mainland of China, Hong Kong, and Japan; this important seaway is shared with Malaysia.

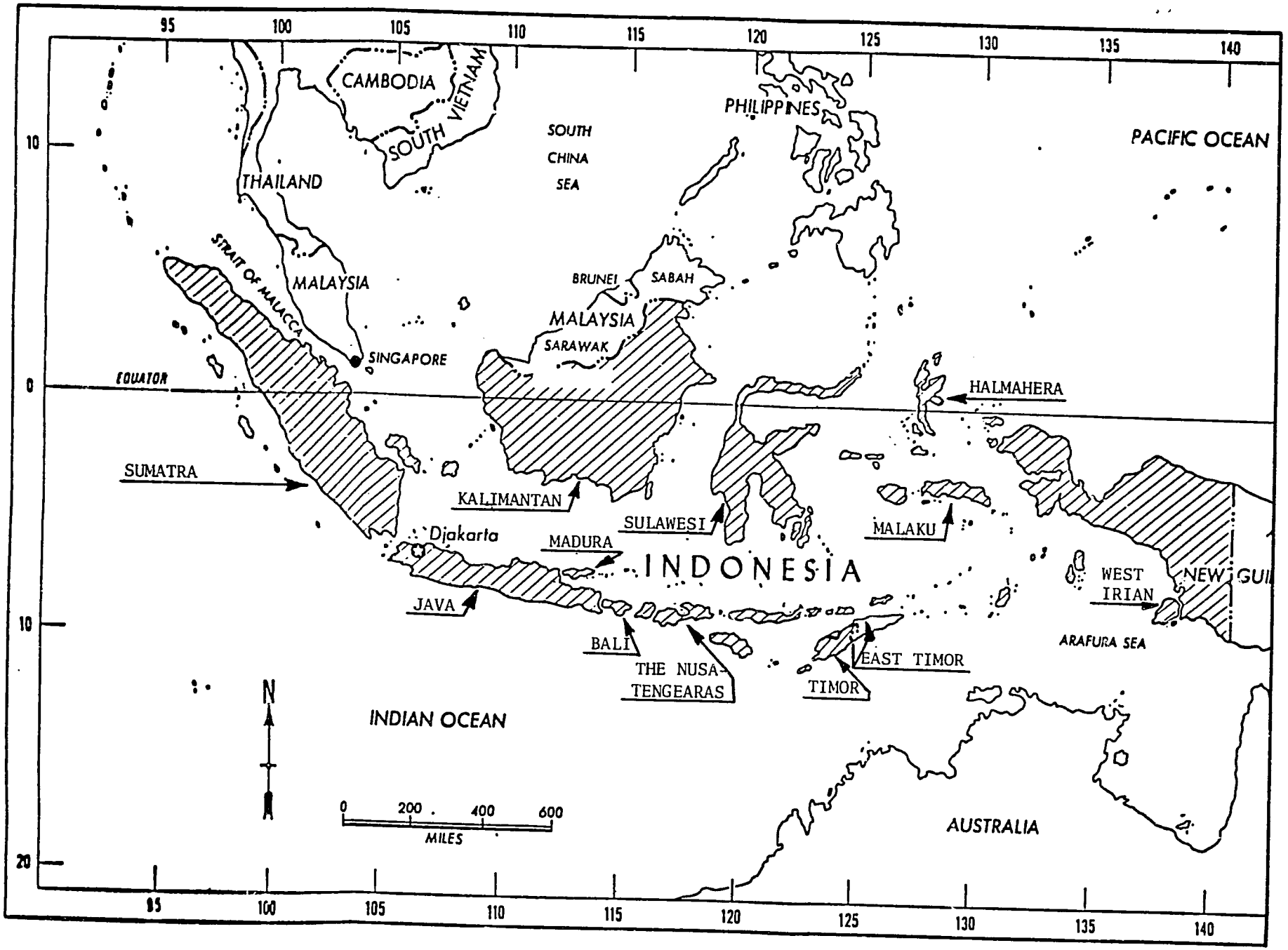
Indonesia consists of an island chain, and the islands lie on both sides of the equator, near the Philippines on the north and Australia on the south. Kalimantan is shared by Malaysia and Brunei. Even though its history as an independent country is short, it has often been in open hostility with its neighbors. However, since about 1967, its relations with its neighbors has improved. Its geographical location probably has played an important role in protecting it from the dominant role that China has played on Mainland Asia; but, even so, China played a role in the internal strife of Indonesia in 1965-66.

The islands are a part of the Malay archipelago. The islands of Sumatra, Java, Bali, Kalimantan, and the smaller islands in between rise from the submerged Sunda shelf, which is about 300-600 feet below sea level, and are considered to be a continuation of the Asian continent. Irian Jaya, a part of New Guinea, and some associated islands are the exposed areas of a platform that is a part of the Australian Continental Shelf. The waters between the Asian and Australian shelves are about 7000 meters deep. The channel between Bali and Lombok is the boundary between the shallow waters to the west and the deeper waters to the east; it is referred to as the Wallace line and is considered to be the boundary between the continental shelves of Asia and Australia. Animals, plants, and the ethnic groups of people are different in these two regions, adding support to the concept of different geographical and geological origins of two separate continents.

The Physical Environment

An Indonesian thinks of his country as "our land and water" (tanah air kita), which to him has a natural and inevitable relationship. This is more significant when one realizes that most Indonesians live close to the sea (Figure 1).

There are about 13,667 islands making up the archipelago ranging in size from a small reef to an island about the size of France (Kalimantan). These islands stretch southeastward from Asia to Australia for about 5,100 km, and then from about 5°N to 11°S, a distance of about 1,600 km. If the country were superimposed on the United States, both New York and San Francisco would be covered, and even the north-south measurements would overlap parts of the U.S. Indonesia is the third largest country in Asia, ranking behind China and India.


95
100
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CAMBODIA
SOUTH VIETNAM
THAILAND
SOUTH CHINA SEA
PHILIPPINES
PACIFIC OCEAN
STRAIT OF MALACCA
MALAYSIA
BRUNEI
SABAH
MALAYSIA
SARAWAK
SINGAPORE
EQUATOR
HALMAHERA
SUMATRA
KALIMANTAN
SULAWESI
MALAKU
Djakarta
MADURA
INDONESIA
WEST IRIAN
NEW GUI
JAVA
BALI
THE NUSA-TENGEARAS
EAST TIMOR
TIMOR
ARAFURA SEA
N
INDIAN OCEAN
0
200
400
600
MILES
AUSTRALIA

FIGURE 1

About 90% of the land mass in Indonesia is made up of the islands of Kalimantan (539,284 km^2), Sumatra (473,606 km^2), Irian Jaya (421,951 km^2), Sulawesi (189,035 km^2), and Java plus Madura (132,174 km^2). Along the length of this chain of islands are found tremendous volcanos and volcanic mountains (many still active), jungles, swamps, waterfalls, lakes, rushing rivers, palm trees, rice paddies, and plantations of coffee, tea, rubber, sugar and spices. However, most of the farms are small, subsistence-level units. Moreover, most of the livestock are found on these small farms.

The climate extremes, which are related to rainfall, vary from very wet to quite dry, and these vary with location and season (Table 1). There are only two seasons, wet and dry, and the seasonal differences may be marked by heavy floods that cause much destruction or severe droughts which cause starvation over localized or large areas.

In general, monsoons from the northwest and the southeast bring rains to Indonesia. However, there are variations: most of Central and East Java, Bali, and the Southeastern Islands receive little rain from the southeast monsoons that come across the deserts of Australia. However, West Java, as well as the other islands, may receive some moisture from both directions, whereas the extreme of Northern Sumatra (Aceh) has a rainfall pattern more like that of Thailand. In general, the Southeastern Islands receive about 1100 to 1500 mm of rainfall per year while West Sumatra and West Kalimantan receive over 3000 mm. Other islands are intermediate. For example, Aceh receives 1505 mm, East Java 1429 mm, South Sumatra 2558 mm, Southeast Sulawesi 1600 mm, and Irian Jaya 2400 mm. In the southeastern islands (Sumba, Timor, Sumbaya, etc.), the number of wet months varies from three to five. In those areas where both monsoons produce rain, the wet months may be as many as nine with only three dry months.

General figures are not too meaningful for ranching or agricultural purposes because amounts of rain and patterns are location specific. For example, the lee side of mountains during the prevailing monsoons may receive only a fraction of that received on the windward side. Also, rainfall patterns and amounts are affected by elevations. For ranch development, reliance on general figures could lead to disaster.

The sea, important to Indonesia, serves both as a barrier and/or a bridge, permitting both isolation and communication. The shallow and calm waters between the islands, particularly those of the north, have fostered seaborne transportation and communications. In fact, much of the population has settled on the coastal areas of the islands, thereby facilitating transportation and communication between islands. As a result, inland developments have lagged behind coastal developments on all islands. Lack of good roads continues to serve as a constraint to the development of the interiors, especially on Irian Jaya, Kalimantan, Sumatra, and Sulawesi.

The sea plays other important roles including the supply of food. Fish, shrimp, and other sea life provide a source of protein to the indigenous people and are an important export item to Japan and Western Europe. In spite of the importance

Table 1. Some Agroclimatic Data for Indonesia

Province	Av. Annual Rainfall (mm)	Average Temperatures Min. C°	Max. C°	Av. C°
Sumatra:				
Aceh	1505	23.1	32.4	26.3
North Sumatra	1984	23.1	31.4	26.1
West Sumatra	3080	22.3	-	-
Riau	2454	23.0	30.7	26.1
Jambi	2535	23.0	31.0	26.3
Bengkulu	2501	21.6	-	-
South Sumatra	2558	23.5	31.3	26.6
Lampung	2784	-	-	-
Java:				
West Java	1907	18.7	27.9	22.7
Central Java	1851	24.0	31.9	26.9
East Java	1429	23.8	31.3	27.5
Kalimantan:				
West Kalimantan	3382	-	-	-
Central Kalimantan	3377	-	-	-
South Kalimantan	2254	23.3	32.0	26.8
East Kalimantan	2570	20.9	-	-
Sulawesi:				
North Sulawesi	2765	22.6	30.0	25.8
South Sulawesi	3001	22.7	31.4	26.4
Southeast Sulawesi	1600	-	-	-
Bali	2031	25.2	30.3	27.8
West Nusatenggara	1274	21.5	-	-
East Nusatenggara	1146	22.8	-	-
Maluku	3101	-	-	-
Irian Jaya	2391	-	-	-
East Timor	1475	22.6	-	-

Source: Bureau Pusat Statistics, Indonesia (1971).

of the sea to Indonesian people, the country is not an important sea-faring nation; her maritime activities are limited mostly to fishing and interisland traffic within Indonesia. However, the sea brought the invaders from both Asia and Europe who greatly influenced the nation's history and culture for hundreds of years. But even with these invasions there were few penetrations into the interior for development purposes, with the exception of Java and Bali. Therefore, the interiors remained underdeveloped unless there were navigable rivers permitting the use of small boats for transport and communication purposes; it was easier and cheaper to use these rivers than to build roads across swamps and rugged mountains.

A significant question: why do the Javanese people remain on Java where land and resources are limited rather than move to the outer islands and develop the interiors that could offer more rewards? One constraint often assumed is that Indonesia has such great natural wealth that the government and the people feel that the wealth of the interior will be there to be used when needed. The author feels that the situation is so complex that constraints on development of the outer islands and their interiors may be some or all of the following: the colonial policy of the Dutch that concentrated on the development of estate crops for export; the revolution against both the Dutch and Japanese; an internal rebellion in 1965-66; lack of capital accumulation; political instability during the end of the Sukarno era; a lack of well-trained technicians in all areas; and the desire of the Javanese to remain close to their cultural roots.

Soils. The FAO/UNESCO study on soils was discussed in the second Asian Soils Conference in 1972 and it was reported that the following soil classifications could be used in Indonesia: (1) red-yellow podzolic soils which are accompanied by red-yellow ferral soils and ferrogenous tropical soils; (2) regosols which include the andosols and latosols; and (3) hydromorphic alluvial soils.

1. The red-yellow podzolic soils are widely distributed over Indonesia, covering about 51 million ha, or about 27% of the total land area; about 38,250,000 ha of these are found in Sumatra and Kalimantan. Traditional shifting agriculture, which uses the "slash and burn" (swidden) technique has caused most of these areas to be covered by the alang-alang grass (*Imperata cylindrica*), Lantana, *Eupatorium spp.*, and bracken fern. These soils are low in fertility and structure, thus easily erode once the grass cover is removed. Unfortunately, these are the main soils available to the transmigrants leaving Java and Bali. However, when water and fertilizer are available, the soils will produce rice. There are problems in this farming system, especially when the land allocation is small (about 2 ha). Preliminary results indicate that these soils will support excellent growth of grasses, legumes, and a grass/legume mixture. Therefore, ruminant livestock could play an important role in a rotation system in which some land in the rotation scheme would be planted to forage crops to produce ruminant feeds. The manure from these animals should play an important role in the production of food crops needing high fertility. Present food-crop yields of many transmigrants are quite low.

2. The andosols, or the black volcanic soils, cover an area of about 1.3 million ha in northern Sumatra and extensive areas in Java. These are high-fertility soils that have many uses in the production of annual and permanent food crops. However, many of these excellent soils have been poorly managed, resulting in severely eroded lands on Java, Madura, and Bali. These critical soils can be restored only by returning them to forests or by changing the cropping systems in which forage production for ruminant feeding would play an important role in the production system. The use of wide and permanent terraces, covered with permanent grasses and legumes, such as Leucaena leucocephala in combination with several grasses, would be excellent for this purpose.

3. The regosols, of recent volcanic action, cover about 70,000 ha in Bali and Java. These are fertile soils and should be used for food crop production.

4. Hydromorphic alluvial or mangrove soils are found in the coastal regions of all major islands, and especially on the east coast of Sumatra and south coast of Irian Jaya. There are about 1.3 million ha of this land being used for firewocd, tannins, and other wood products. There has been no agricultural use, which is probably satisfactory as long as so much other land is available in the interiors of most major islands.

CHAPTER 2. THE PEOPLE

Indonesia, which stretches from the mainland of Southeast Asia to the north coast of Australia, is the largest archipelagic nation and has the world's fifth largest population, estimated to be about 148 million in 1980. The nation, which became independent in 1949, has the potential to become prosperous. However, its development has been slow over the past 32 years -- most of them under the leadership of President Sukarno who was a leader of great popularity and persuasiveness. During a period of fast population increases and an inefficient bureaucracy, these were years of great instability, general neglect of social and economic needs, mismanagement of resources, and costly foreign adventures.

President Suharto replaced President Sukarno in 1967, and by 1970 the political and economic conditions appeared to be more favorable than at any time since independence. Under his leadership, the country embarked on a series of developmental projects that were incorporated in five-year plans called pelita.

The problems of development are formidable because some of their roots extend back to the colonial period. The problems of overpopulation on Java, Madura, and Bali and the accompanying poverty are so great that there is doubt whether any program can help alleviate these conditions.

As shown in Tables 2, 3, and 4, Java, Madura, and Bali have a population of about 91,744,000 people, 63.7% of the total population. This enormous population is crowded onto a land area of only 137,748 km^2, a population density of about 685 people/km^2. In other words, 63.7% of the people live on 7.1% of the land. In Central Java and the District of Yogyakarta (D.I.Y), some 28,752,000 people live on 37,375 km^2, a density of 769 people/km^2.

As many new nations emerged from the collapse of western European colonialism, Indonesia as a country was created by war, revolution, and international diplomacy, hence its political boundaries follow neither ethnic nor natural lines. Within its boundaries is an extraordinary diversity of ethnic groups, languages, and religious faiths. These diversities are accentuated by both the physical and economic characteristics of Indonesia.

For many years in Indonesia there was a mosaic of island societies in which each had its own language dialects and cultural traditions existing in relative isolation. Various influences (Indian and Islamic) made some progress in creating larger societies but were unable to weld the entire archipelago into one nation. These influences toward creating one nation were suspended by Dutch colonial rule. Therefore, it was the responsibility of the Indonesian leadership after 1950 to pull together a nation from disparate and often incompatible elements. By use of incomparable rhetoric, the shared experiences of a long and bitter struggle for independence, a campaign to acquire sovereignty over Irian Jaya, a battle with Malaysia in Kalimantan, and an overriding aim to create an Indonesian political personality completely incompatible with Western forms, President Sukarno did much to create "one nation." However, he created economic disaster in the process.

Table 2. Areas and Populations of People, Buffalo, Cattle, Goats, Sheep, Chickens and Ducks by Provinces in Indonesia in 1980[1/]

Name of Province	Area Km^2	Human Number 000	Human Density No/km^2	Cattle[4/] Number 000	Cattle[4/] Density No/km^2	Buffalo[4/] Number 000	Buffalo[4/] Density No/km^2	Goats/Sheep[3/,6/] Number 000[5/]	Goats/Sheep[3/,6/] Density No/km^2	Swine[4/] Number 000	Swine[4/] Density No/km^2	Horses[4/] Number 000	Horses[4/] Density No/km^2	Chickens[4/] Number 000	Chickens[4/] Density No/km^2	Ducks[4/] Number 000	Ducks[4/] Density No/km^2
D.I. ACEH	55,392	2,595	46.8	164	3.0	170	3.1	153.7	2.8	11.7	0.2	5.1	0.1	2,587.1	46.7	995.7	18.0
North Sumatra	70,787	8,554	120.8	145	2.0	105	1.5	215.0	3.0	532.0	7.5	9.0	0.1	5,762.9	81.4	886.1	12.5
West Sumatra	49,778	3,607	72.5	156	3.1	99	2.0	70.0	1.4	1.6	0.0	7.0	0.1	1,747.7	35.1	629.4	12.6
Riau	94,562	2,091	22.1	10	0.1	15	0.1	90.0	1.0	25.0	0.3	2.0	0.0	1,164.2	12.3	129.2	1.4
Jambi	44,924	1,299	28.9	13	0.3	31	0.3	57.0	1.3	5.0	0.1	1.0	0.0	1,019.0	22.7	227.3	5.1
South Sumatra	103,688	4,448	42.9	88	0.8	35	0.8	100.0	1.0	28.0	0.3	0.5	0.0	2,091.7	20.2	562.9	5.4
Bengkulu	21,168	670	31.7	21	1.5	29	1.4	28.0	1.3	-	-	1.0	0.0	618.4	29.2	115.9	5.5
Lampung	33,307	3,587	107.7	73	2.2	22	0.7	196.0	5.9	21.0	0.6	1.0	0.0	2,217.4	66.6	280.0	8.4
DKI Jakarta	590	7,345	12449.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West Java	46,300	25,526	551.3	118	2.5	465	10.0	3281.0	70.9	27.0	0.6	20.0	0.4	15,130.7	326.8	2,756.8	59.5
Central Java	34,206	25,814	754.7	1,022	29.9	368	10.8	3292.0	96.2	64.0	1.9	53.0	1.5	19,610.8	573.3	2,675.0	78.2
D.I. Yogyskaria	3,169	2,938	927.1	174	54.9	20	6.3	447.0	141.1	12.0	3.8	4.0	1.3	3,159.4	997.0	252.5	79.6
East Java	47,922	30,121	628.5	2,570	53.6	211	4.4	2876.0	60.0	22.0	0.5	49.0	1.0	18,309.8	382.1	1,621.1	33.8
West Kalimantan	146,760	2,545	17.3	55	0.4	-	-	25.0	0.2	256.0	1.7	-	0.0	2,168.7	14.8	180.5	1.2
Central Kalimantan	152,600	882	5.8	11	0.1	1	0.0	3.0	0.0	45.0	0.3	-	0.0	581.4	3.8	45.2	0.3
South Kalimantan	37,660	2,141	56.9	23	0.6	8	0.2	17.0	0.5	3.0	0.1	1.0	0.0	1,550.4	41.2	638.9	17.0
East Kalimantan	202,440	924	4.6	1	0.0	-	0.0	8.0	0.0	26.0	0.1	-	0.0	464.4	2.3	15.2	0.1
North Sulawesi	19,023	2,163	113.7	158	8.3	1	0.1	36.0	1.9	158.0	8.3	8.0	0.4	1,202.2	63.2	51.4	2.7
Central Sulawesi	69,726	1,151	16.5	108	0.0	9	0.1	74.0	1.1	38.0	0.5	6.0	0.1	612.8	8.8	86.8	1.2
South Sulawesi	72,781	6,533	89.8	567	7.8	357	4.9	174	2.4	139.0	1.9	163.0	2.2	2,857.7	39.3	1,191.9	16.4
Southeast Sulawesi	27,686	899	32.5	15	0.5	11	0.4	52	1.9	1.0	0.0	6.0	0.2	670.1	24.2	48.1	1.7
Bali	5,561	2,645	475.6	366	65.8	13	0.2	22	4.0	555.0	99.8	4.0	0.7	2,748.0	494.2	480.9	86.5
West Nusatenggara	20,177	2,747	136.1	147	7.3	204	10.1	128	6.3	12.0	0.6	85.0	4.2	1,667.7	82.7	270.8	13.4
East Nusatenggara	47,876	2,864	59.8	403	8.4	140	2.9	266	5.6	638.0	13.3	194.0	4.1	2,019.9	42.2	41.6	0.9
Maluku	74,505	1,359	18.2	18	-	-	-	62	0.8	24.0	0.3	-	-	-	-	-	-
Irian Jaya[7/]	421,981	1,153	2.7	10	-	-	-	2	0.0	3.0	0.0	1.3	-	603.6	1.4	18.8	-
East Timor[7/]	30,775	1,515	49.2	-	-	-	-	13.3	-	225.7	0.5	-	-	-	-	-	-
Total	1,934,944	148,116[2/]	76.2[8/]	6,436	3.3	2,313	1.2	11688.0	6.0	2873.0	1.5	620.9	0.3	90,065.7	46.5	14,202.0	7.4

Footnotes: [1/] From Biro Pusat Statistics, [2/] This is a projection; a preliminary report of 1980 census indicated 147.4 million people.

[3/] Estimated - 1977 figure, [4/] 1978 figure, [5/] 1976 figure, [6/] Goats and sheep figures are not separated.

[7/] Data are not available for most livestock, [8/] 1980 census figure used for calculations.

Table 3. Number and Density of People, Livestock and Poultry on the Densely Populated Areas (Java, Madura, Bali) Versus the Less Densely Populated Outer Islands[1/]

Island Group	Area km^2	Human		Cattle		Buffalo		Sheep/Goats		Swine		Horses		Chickens		Ducks	
		Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2	Number x 000	Density per km^2
Sumatra	473,606	26,851	56.7	670	1.4	506	1.1	909.7	1.9	624.3	1.3	25.6	0.1	17208.4	36.3	3,826.5	8.1
Kalimantan	539,460	6,492	12.0	90	0.2	9	.02	53.0	.1	330.0	0.6	1.0	-	4764.5	8.8	879.8	1.6
Sulawesi	189,216	10,746	56.8	848	4.5	378	2.0	336.0	1.8	336.0	1.8	183.0	1.0	5342.9	26.8	1378.2	7.3
E. Nusa Tenggara	47,876	2,864	59.8	403	8.4	140	2.9	266.0	5.6	638.0	13.3	192.0	4.1	2019.9	42.2	41.6	0.9
W. Nusa Tenggara	20,177	2,747	136.1	147	7.3	204	10.1	128.0	6.3	12.0	0.6	85.0	4.2	1167.7	82.7	270.8	13.4
Maluku	74,505	1,359	18.2	18	-	-	-	62.0	0.8	24.0	0.3	-	-	-	-	-	-
Irian Jaya	421,981	1,153	2.7	10	-	-	-	2.0	-	225.7	0.5	1.3	-	603.6	-	18.8	-
E. Timor	30,775	1,515	49.2	-	-	-	-	13.3	-	-	-	-	-	-	-	-	-
Total	1,797,596	53,727	29.9	2,186	1.2	1,236	0.7	1,770.0	1.0	2,190.0	1.2	490.9	0.3	31107.0	17.3	6,415.7	3.6
Java, Madura	132,187	91,744	694.0	3,884	29.8	1,064	8.0	9,896	74.9	125	0.9	126.0	1.0	56210.7	425.2	7,305.4	55.3
Bali	5,561	2,645	475.6	366	65.8	13	2.3	22	4.0	555	99.8	4.0	0.7	2748.0	494.2	480.9	86.5
Total	137,748	94,389	685.2	4,255	31.3	1,077	7.8	9,918	72.0	680	4.9	130.0	0.9	58958.7	428.0	7,786.3	56.5
Grand Total	1,934,944	148,116	76.5	6,436	3.32	2,313	1.2	11,688.0	6.0	2,870.0	1.5	620.9	0.3	90065.7	46.5	14,202.0	7.4
% on Java, Madura, Bali	7.1	63.7		66.1		46.6		84.9		23.7		20.9		65.5		54.8	
% on outer islands	92.9	36.3		33.9		53.4		15.1		76.3		79.1		34.5		45.2	

1/ From table 2

Table 4. A Comparison of the Populations of People, Their Livestock, and Densities in Indonesia, Java, Madura and Bali, and the Outer Islands[a]

Items	Indonesia		Java, Madura, Bali			Outer Islands		
	Numbers 000	Density km^2	Numbers 000	Density km^2	% of Total	Numbers 000	Density km^2	% of Total
Land Area, Km^2	1934.944		137.748		7.1	1,797.196		92.9
Populations								
Human	148,116	76.5	94,389	685.2	63.7	53,727	29.9	36.3
Cattle	6,436	3.3	4,250	31.3	66.1	2,186	1.2	33.9
Buffalo	2,313	1.2	1,077	7.8	46.6	1,236	0.7	53.4
Sheep/Goats	11,688.0	6.0	9,918	72.0	84.9	1,770.0	1.0	15.1
Swine	2,873.0	1.5	680	4.9	25.7	1,967.3	1.1	74.3
Horse	620.9	0.3	130	0.9	21.1	490.9	-	79.1
Chickens	90,065.7	46.2	58,958.7	428.[illegible]	65.5	31,102.0	17.3	34.5
Ducks	14,202.0	7.3	7,786.3	56.5	54.8	6,415.7	3.6	45.2

[a] Data from table 2

Although the rhetorical and symbolic appeals of the Sukarno era have subsided under President Suharto, the government still uses the Panca Sila, the five principles defined by the 1945 constitution to influence national values. These principles are: belief in one Supreme God, a just and civilized humanity, nationalism, democracy, and social justice. Perhaps the greatest single factor insuring unity under President Suharto is that the members of the armed forces, which are well integrated under centralized command, hold high positions in all levels of the civil administration as well as in the economy of Indonesia.

Indonesia is a classic example of a plural society; the pluralism encompasses ethnic and linguistic variations and is reflected in conflicts between Muslims and Christians and between the Javanese and a powerful Chinese minority whose commercial interests and expertise are essential for development. These conflicts are expressed regionally and in local societies -- particularly the rivalry between the Javanese poor and the wealthy people on the underpopulated outer islands.

None of the above variations form a single and nationally dominant cleavage, as is the case in Malaysia. However, the diversity is a factor to consider at all times when planning developmental projects in Indonesia.

The economy remains predominately rural and agricultural with some 60% of the labor force engaged in agriculture. Agriculture in the thickly populated areas of Java, Madura, and Bali consists of subsistence farms. There are about 6.6 million farms with land holdings less than 0.5 hectare and about 7.8 million with farms exceeding 0.5 hectare. There are about 2.2 million hectares in estate crops. Agriculture accounts for about 30% of the GNP and its proportion is decreasing annually; services and the mining sectors are growing at much faster rates. The average yearly income is about $370 per person.

The Gross National Product (GNP) in Indonesia appears to be growing at about 8.0% per year while agricultural production appears to be increasing at about 2.9 to 3.5% per year. Since about 60% of the labor force is still engaged in agriculture, the income of the farmers is still low, perhaps as low as any in the world. At the other extreme of agriculture are the highly capitalized and modern industries, especially those of mining, forestry, and fishing. The government owns the national petroleum company that is Indonesia's economic giant. With the tremendous increases in the price of oil on the international markets, the GOI's revenue position has taken a quantum jump, thus the government finally has funds to build the infrastructure needed for faster economic development. It now appears likely that some of the benefits of the oil wealth will reach those who live in poverty.

Section II. Agricultural Livestock Resources and Constraints

CHAPTER 3. FARM LIVESTOCK

The Livestock Population

The population of farm animals in relation to human population in Indonesia is low by any standards; it is the lowest among the tropical Asian countries -- only 0.07 animal unit per inhabitant (Table 5).

Table 5. Livestock Population in Indonesia Expressed in Animal Units

Kinds of Animals	Number (000)	Factor to Obtain Units	Animal Units
Cattle	6,436.0	0.8	5,148.8
Buffalo	2,313.0	1.0	2,313.0
Horses	620.9	0.8	496.7
Swine	2,870.0	0.3	861.0
Goats/sheep	11,688.0	0.1	1,168.8
Poultry	104,267.7	0.001	104.3
Total	--	--	10,092.6

Source: Table 2.

Indonesia has about 6,436,000 cattle, 2,313,000 swamp buffalo, 11,688,000 sheep and goats, 620,900 horses, 2,870,000 swine, 90,065,700 chickens and 14,202,000 ducks. Almost all of the female cattle and buffalo are used for draft purposes, and nearly all of these are owned by the smallholders. It is estimated that about 1.9 million pairs of female cattle and buffalo are used in cultivating the crops and that most of the beef comes from these animals. As was shown earlier (Table 2) about 63.7% of the people live on the islands of Java, Madura, and Bali or only 7% of the land; thus 36.3% of the people live on about 92.9% of the land. There are 4,250,000 cattle and 1,077,000 buffalo on Java, Madura, and Bali out of a total of 8,739,000, or about 61%; the density of these large ruminants is about 39 buffalo-cattle per km^2. The density of these large animals on the outer islands is only about 1.9 per km^2; the density on Java, Madura, and Bali is about 20 times greater. In addition, the thickly populated area has 85% of the sheep/goats, about 66% of the chickens, and 54.9% of the ducks. Therefore, on one square kilometer on Java, Madura, and Bali, there are 685 people, 31 cattle, 8 buffalo, 72 sheep/goats, 5 pigs, 1 horse, 428 chickens and 57 ducks. In contrast, the outer islands have only 36 people, 1 bovine, 1 buffalo, 1 pig, 1 sheep/goat, no horses, 17 chickens, and 4 ducks. Clearly the land available for animals lies on the outer islands.

Uses of Animals

Cattle and buffalo are kept by the smallholders as a source of draft power, manure for crop production, meat (primarily from old cows and young male animals), milk and milk products, hides, and other animal products. Animals, as a living savings account, are also a source for "ready" cash.

Since the large animals are used mainly for draft, they are found in the thickly populated areas; about 63.7% of the people live on Java, Madura, and Bali, and about 66.1% of the cattle and 46.6% of the buffalo are found there. As will be discussed later, there have been no great increases in livestock numbers in response to price increases for meat (Mubyarto 1974); therefore, the farmers are placing very little emphasis upon the production of meat. It appears that large ruminant meat production must move to the outer islands and in larger commercial-type units if more beef is to be produced in the country in response to needs and price movements. A middle class population, composed of technological experts, military leaders, etc., is developing at a rapid pace, thus demand (and price) for beef is increasing much faster than supply. A recent FAO/World Bank study shows that the shortfall in supply is being partially met by the slaughter of large draft bulls (used in road transport but being replaced by motorized vehicles), and young, often-pregnant heifers. As the females are needed by the transmigrants, slaughter of fertile females is a constraint to the expansion of large ruminants. The population of cattle and buffalo has been decreasing since 1968.

Manure from farm livestock is a valuable by-product in the vegetable-growing areas in Indonesia; therefore, most animals are kept in covered stalls near the home. Bedding, composed of straws and other crop residues, is used to retain the manure in the sheds. Urea is the available nitrogen source, and the farmers have learned that the response to urea application is enhanced when manure or other sources of organic matter are present in the soil.

All farm livestock are used as a source of meat (Table 6). Sheep/goats (small ruminants) are considered by most farmers to be the main "living savings account." These are sold when money is needed for parties, weddings, school fees, clothes, etc. Also, farm livestock is used as an effective hedge against inflation. Goat and sheep meat is in demand by the people in Indonesia for the preparation of sate or satay, pieces of the meat cooked over burning wood coals on wooden skewers. Therefore, goats and sheep are used primarily as a source of meat and other animal products, especially hides.

Table 6. Meat, Milk, and Eggs Produced in Indonesia

Animal or Product	Number of Animals	Yield Per Animal (Kg)	Total Production (Metric Tons)
Beef and veal	897,000	156	161,000
Buffalo meat	211,000	160	34,000
Mutton and lamb	2,084,000	10	21,000
Goat meat	3,746,000	10	38,000
Pork	2,109,000	55	116,000
Horse meat			1,000
Poultry meat			102,000
Total meat			473,000
Cow's milk	40,000	1725	69,000
Eggs			80,000
Cattle/buffalo hides			28,122
Sheep skins			4,168
Goat skins			7,491

Source: FAO Production Yearbook (1979).

A unique system for producing beef from buffalo was described by Hutasoit (1974). In South Kalimantan, the Barito River and its tributaries overflow each year during the main rainy season, covering about 500,000 ha with 1 to 2 meters of water. Large parts of the flooded area contain grasses that grow to the surface of the water. One of these grasses, Leersia hexandra, is quite nutritious; therefore, farmers have initiated low-cost production systems to exploit this resource. About 10,000 swamp buffalo are grazed on this area. The unique feature of the operation is that the animals, kept in groups of 50 to 100 animals, are allowed to graze during the day time by swimming in the water. However, at night they return to a large platform to rest.

Swine are kept primarily as a source of meat. Since the Indonesian population is predominately Muslim, swine numbers are small. Therefore, the industry is found in areas where there is a concentration of indigenous Chinese, Christians, Balinese, Torajanese, and foreigners.

The dairy industry is small with the total number of dairy cattle probably being less than 100,000. Most dairy units are found on Java near the capital city of Jakarta. Dairy cattle are used for milk, meat, manure, etc.

The poultry industry takes two forms: (1) the indigenous chickens (related to the jungle fowl) kept as scavengers by all smallholders and (2) the modern broiler and layer industry that is rapidly developing near the large cities. Scavenger chickens are important because they furnish about 90% of the poultry meat and 40% of the eggs in Indonesia. Ducks are important in the production of meat and eggs for the poorer people.

CHAPTER 4. FARM LIVESTOCK BREEDS AND PERFORMANCES

Breeds of Beef Cattle

There are three major breeds of beef cattle: Ongole, Bali, and Madura. All of these cattle are small and appear to be well-adapted to the various climates and stresses found in the country.

Ongole (*Bos indicus*) cattle are the most numerous of the three major breeds with 4.5 million scattered throughout the country. The breed can be divided into two major groups -- the Sumba Ongole and the Peranakan Ongole (grade Ongole). The Sumba Ongole, descended from an importation of *Bos indicus* cattle in 1914, have been kept pure on the island of Sumba where they are the primary source of most purebred Ongole in the country. The Peranakan Ongole resulted from the crossing of Sumba Ongole with native cattle, primarily local Javanese cattle.

Bali Cattle (*Bos bibos* or *Bos sandaicus*) are descendants of the indigenous wild Banteng animals that became domesticated through a long period, perhaps since prehistoric times. The indigenous Banteng are found in several countries in Southeast Asia but are now chiefly found in Bali, Sulawesi, and in the West and East Tenggaras. The breed is maintained pure on Bali and is used in Sulawesi and other islands for crossbreeding with Ongole. However, since most of the males resulting from the first crossing with Ongole appear to be sterile, there are no conceptions when the F_1 hybrid bull is used. Therefore, the F_1 females are backcrossed with either Bali or Ongole bulls. It is estimated that there are one million Bali cattle in Indonesia of which 366,000 are kept as purebreds in Bali.

Madura cattle probably resulted from an early crossing of Bali and the indigenous cattle on Madura, which were introduced by Arab traders. It is possible that some *Bos taurus* breeding is found in the Madura breed.

Grati cattle, which resulted from a cross of Holstein-Friesian, are also used for beef even though their primary use is for dairying.

Description of the Breeds of Beef Cattle

Haircoat color of the Bali cows, calves, and steers is red, but that of the males later turns black when they are 12 to 14 months of age. Both males and females have a distinct black line along the back, white areas on the hindquarters that extend along the belly, and socks starting from the hoof to just above the hock. In addition, there are white hairs inside the ears, around the muzzle, and on the tail. Madura cattle are brownish-fawn to red in color with a somewhat lighter color around the muzzle and on the legs and tail. Pure Sumba Ongole cattle are whitish-grey in color; the hump, neck, and head are generally dark grey with black color around the eyes. Peranakan (grade) Ongole exhibit a variety of haircoat colors varying from that of Sumba Ongole to almost black. Red spots of hair are often found on the body.

Both the Bali and Madura cattle have small ears that extend straight outward; the Ongole have side ears that tend to droop.

The horns of the Bali cattle are small and grow in a semicircle extending outward and backward on the same plane. The Madura animal also has small horns which curl upward. The horns of the Ongole vary in size and shape, but most are relatively short.

Bali cattle have no hump, but the males have a distinct cervical crest. On the other hand, Madura cattle have a broad-based hump which is forward from the shoulders. Ongole cattle have large humps, characteristic of the Bos indicus.

The udder and teats of all three breeds are small and poorly developed, thus milk yields are low.

Bali cattle are watchful and alert, while Madura cattle are much less so. Grade Ongole on Java are docile and easy to manage.

Heat tolerance in all three breeds appears to be good. Using the Rhoad method, Sutrisno et al. (1978) reported heat tolerance coefficients of 92.9, 81.9, and 83.7 for Bali, Madura, and Ongole cattle, respectively. Moran et al. (1975) reported that the rectal temperatures and respiration rates of Ongole bulls in the sun versus those in the shade did not differ significantly. However, Madura cattle in the sun exhibited increased cutaneous evaporation. Resistance to both parasites and diseases appears to be good (Wartomo and Astuti 1979) in all breeds, but the Ongole appear to be more resistant than the two small breeds. In recent years, Bali cattle have suffered from Jembrana disease (see Chapter V) while Ongole appear to be resistant.

Weights of the animals vary depending upon nutrition, management, and other factors. Hutasoit (1974) reported adult weights of the breeds as shown in Table 7.

Table 7. Weights (kg) of Cattle by Breeds

Item	Ongole		Bali (on Bali)	Madura (on Madura)
	Grade (Java)	Sumba (pure)		
Cows	400	300	300	180
Bulls	550	400	400	300

Source: Hutasoit (1974).

Hardjosubroto and Astuti (1979) estimated that fully-grown and mature Bali, Madura, and Ongole bulls weigh 400, 300, and 530 kg, respectively. Based upon data obtained on animals in abattoirs, Hardjosubroto and Astuti (1979) presented the following data (Table 8).

Table 8. Sizes of the Breeds of Beef Cattle Found in Indonesia (Slaughterhouse Data)

Item	Ongole		Bali (on Bali)	Madura (on Madura)
	Sumba (pure)	Grade (Java)		
Body weight, kg				
Males	544	384 (11)[1]	384 (40)[1]	305 (3)[1]
Females	408			
Height at withers, cm				
Males	149	132 (3)	128 (5)	127 (2)
Females	132	125 (1)	110 (4)	109 (0.4)
Girth at chest, cm				
Males	210	169 (1)	188 (8)	169 (1)
Females	147	162 (2)	163 (5)	162 (2)

[1] Numbers in the parentheses are standard deviations.
Source: Hardjosubroto and Astuti (1979).

The FAO/World Bank Team (1978) estimated the weights of the breeds by ages, and the data are shown in Table 9.

Table 9. Weights (kg) of Cattle and Swamp Buffalo at Different Ages

Item	Cattle				Swamp Buffalo
	Bali	Grati	Madura	Ongole	
Birth weight	16	22	14	20	30
One year old					
Males	110	150	90	120	170
Females	90	130	70	90	150
Two years old					
Males	220	280	180	230	300
Females	170	240	130	180	270
Three years old					
Males	320	400	250	330	430
Females	240	330	180	250	380
Four years old					
Males	400	500	300	430	550
Females	300	400	220	320	480
Adult					
Males	400	500	300	430	600
Females	300	400	220	320	530

Source: FAO/World Bank Team (1978).

Performance Data on Beef Cattle

Hardjosubroto et al. (1980) collected baseline data on 1,000 grade Ongole cattle in three different villages in the Special District of Yogyokarta (DIY) over a four-year period. These cattle were owned by over 400 small farmers who used the animals for draft, for manure production, and for beef production; they sold young males and old stock for the latter purpose. Cattle also served as a source of savings and were sold when they needed to finance a special function rather than when the weight and condition of the animal would make the most profit for the operation. The experiment was in a nonirrigated area and the cows were grade Ongole. Among the findings were: average weight of the cows 250 kg; yearly percentage calf crop 34.4%; gestation period 284 days; postpartum matings 228 days; calving interval 526 days; services per conception 2.3; mortality 2%; and weaning age 255 days. Weight gains and losses were as follows: April, May, and June -- a gain of 0.11 kg/day; July, August, and September -- a loss of 0.10 kg/day; October, November, and December -- a loss of 0.30 kg/day; and January, February, and March -- a gain of 0.34 kg/day.

Nutritional data obtained by Soedomo et al. (1980) on the same cows indicated that the crude protein level was almost sufficient during all periods of the year while energy was limiting during all periods of weight losses. Phosphorus appeared to be limiting during most of the year. Trace minerals were not studied but deficiencies of several were suspected.

In studies on a large ranch in Sulawesi, Sumadi et al. (1980) compared the performances of four different "breeds" of cattle that were maintained under extensive ranching conditions. The breeds of cows were Brahman (bull) crossbred with Hereford - Shorthorn (cows), purebred Ongole, purebred Bali, and a purebred Bali crossbred with purebred Ongole. The average percentages of pregnancies in 1977, 1978, and 1979 were 49, 44, and 50%, respectively; the drop in 1978 was probably due to the change from year-round breeding to a 90-day period of restricted breeding. In 1979, the breeding system was again changed to consist of two periods of breeding of 90 days, each beginning six months apart. Reproductive performances were poor. By severe culling, better nutrition, and twice-yearly breeding periods of 90 days each, the reproductive performances could improve. Despite improved attention to reproduction, the calf crop still remained less than 50 percent. When year-round breeding was used on the large ranch, most of the conceptions occurred from February through May, probably a nutritional effect.

Daily gains of calves of all breeds were low, averaging less than 0.20 kg/day, thus weaning weights were about 100 kg or less in all breed groups.

A combination of native pastures and native pastures overseeded with various legumes was used on the large ranch. Data on mineral composition of the forage are not available. However, deficiencies of energy, protein, phosphorus and (possibly) certain trace minerals are suspect when year-round nutrition is considered.

When fattening-type rations containing 85% concentrates were fed to Bali, Madura, Grati, Ongole, and swamp buffalo bulls, Moran (1979) found that the fastest-growing animals in two trials were the Grati bulls, which also had the highest voluntary feed intake. Ongole and buffalo were the next fastest growing bulls while the Bali and Madura grew the slowest of the five breeds. The results of the 154-day test are shown in Table 10.

Animal performances in this experiment reflected the differences in mature sizes and the effect of increasing degrees of maturity upon rates of live weight change and relative rates of fat deposition. The fastest growing Grati bulls grew at a similar rate during the entire feeding period. However, the slowest growing Madura and Bali bulls had almost stopped growing at the end of the trial. It appears that the mature live weights of Bali and Madura bulls are about 400 kg, thus they must be finished at a lighter weight than the Grati, Ongole, or buffalo. The Ongole were almost mature when the trial ended, indicating a mature weight of about 500-550 kg. The buffalo and Grati cattle were still growing at the end of the trial. Carcass fat contents of the bulls at the end of the trial were inversely related to body size: Bali and Madura carcasses were excessively fat while the Ongole and Grati had much lower fat contents.

Table 10. Production Performance of Breeds of Indigenous Cattle Fed a High Concentrate Diet

Item	Breed of Cattle				
	Madura	Ongole	Bali	Grati	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
g/kg 0.75/day	72.6	72.3	76.8	84.9	76.6
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, cm2	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 (1979).

Moran (1979) also compared Ongole to the swamp buffalo when Pennisetum purpureum (elephant grass) was the only feed in the diet and both breeds gained 0.2 to 0.3 kg/day. When rice bran was added to provide 55 to 60% of a diet containing elephant grass as the forage, gains in both breeds were increased to 0.5 to 0.6 kg per day.

Ongole fed increasing levels of rice bran in the elephant grass-based diet (0.18, 35, 51, 58%) demonstrated responses in total feed intake, gains, and feed-conversion ratios that did not differ from linearity; the buffalo demonstrated different responses to the added rice bran in that dry matter intakes over that when no concentrates were fed were only improved by the 58% rice bran diet (the highest level). Feed intake levels were lower in the buffalo at all levels; however, there were only small differences in feed conversions by the breeds.

Payne and Rollison (1973) summarized available data on the productive performances of Bali cattle in Bali and the data are shown in Table 11.

Table 11. Production Performance of Bali Cattle

Type of Cattle	Feed	Live weight Gains kg/day
Young bulls		
Over 60 kg in weight	Grass only	0.13
	Grass + copra meal	0.87
	Grass + rice bran	0.43
	Grass + copra meal + rice bran	0.87
Young males		
Over 1 year, steers	Grass only	0.24
Over 1 year, bulls	Grass only	0.23
Adults, steers	Hay only	0.35
	Hay + rice bran	0.51
	Hay + chopped sweet potato	0.45

Source: Payne and Rollison (1973).

Payne and Rollison (1973) also reported that Bali adult steers in good, average, and poor condition had dressing percentages of 57.3, 56.5, and 54.3%, respectively, while the corresponding percentage for adult females in good condition was 56.6%. The average carcass composition of Bali cattle is shown in Table 12.

Table 12. Carcass Composition of Bali Cattle

Component	Percentage	Component	Live weight	Dressed Carcass
			- - - - - %	- - - -
Carcass	52			
Head	6	Meat	41.7	80.0
Hide	8	Bones	9.2	18.0
Offals	29	Fat	0.6	2.0
Intestinal		Tail	0.4	
Contents	5	Waste	0.1	

Source: Payne and Rollison (1973).

Extensive ranching schemes are developing in Indonesia for both cattle and buffalo. In 1977, the Directorate General of Animal Husbandry in Indonesia summarized data on local breeds found in Indonesia in an attempt to predict how they would perform on large ranches (Table 13).

Table 13. Characteristics of Local Indonesian Cattle

Items	Bali	Madura	Ongole
Fertility	+++	++	+
Calving difficulties	-	-	-
Calf mortalities	+	++	+
Birth weight, kg	13 to 15	12 to 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

+ = poor, ++ = good, +++ = excellent
Source: Directorate General of Animal Husbandry (1977).

In 1980, Reksohadiprodjo summarized observations (Table 14) on local cattle under the extensive ranching conditions in South Sulawesi.

Table 14. Live Weights of Bali and Ongole Cattle in South Sulawesi at Different Ages

Bali Cattle			Ongole Cattle		
Age Months	Male kg	Female kg	Age Months	Male kg	Female kg
12-18	70-167	46-50	12	165	125-170
18-24	-	160-199	15	-	185-200
30-36	225-380	155-279	24	185	205
48-72	288	-			

Source: Reksohadiprodjo (1980).

In addition, Reksohadiprodjo (1980) made the following observations: Bali cattle in South Sulawesi are smaller than those on Bali; Bali cattle, which were purchased from smallholders in Bali and transferred to South Sulawesi, do not handle well in cattle yards needed in extensive ranching conditions; high calf mortality was found when Bali calves were weaned; postnatal calf losses were high (25-30%) in Bali calves dropped on the range; Bali x Ongole crossbred calves, under ranch conditions, had a 10% postnatal mortality; Sumba Ongole bulls and cows, when transferred to South Sulawesi, have required 9 months or more to adapt to the range conditions found on the large ranches. Since Sumba has a much drier climate and different external and internal parasite threats, a part of the adaptation process probably relates to the disease factor. Also, the cattle were purchased from smallholders who had used different management and feeding conditions. All ranches in South Sulawesi are experiencing low reproduction rates (Sumadi et al. 1980) probably due to the condition scores of the cows at breeding time.

Buffalo

There are three types of buffalo (Kerbau) in Indonesia: the swamp buffalo, which is similar to those found throughout Asia; the dairy type, which is the Murrah breed; and the wild Anca, a dwarf buffalo found in Sulawesi that has no significant economic importance. Swamp buffalo number about 2,313,000 and are found all over Indonesia (Table 3). All the Murrah buffalo (6,000) are found in North Sumatra where they were brought in by Indian immigrants long ago.

Description of buffalo breeds. Since the Murrah buffalo are similar to those found in India and there are so few in Indonesia, the breed will not be described in detail here. In general, the hair and skin are black, and some have a white tail tip. The horns are short, turning backward and upward and spiraling inward.

Swamp buffalo usually are found in the swampy areas of rice-producing areas where land is difficult to plow. Mature males weigh about 600 kg, whereas mature females weigh about 500 kg. The skin is grey at birth tending to turn to a slate blue or dark grey with age. The horns, hooves, and hair tend to have the same color. White animals also are found in Indonesia, especially in Bali, but the frequency is not known. However, there are reports that the frequency of white buffalo in the Philippines is about 10%, about 50% in Malaysia, and about 10% in Thailand. South Sulawesi has rare piebald swamp buffalo (with extensive white and grey areas) that are valuable for the Toradjas' Burial Ceremonies. The grey buffalo have white or light grey chevrons, one just below the jaw and the other below the neck on the front of the brisket. The horns of the swamp buffalo are similar to those of the Murrah breed. However, in Sumba the large swamp buffalo often have quite long horns. Hornless animals are quite rare.

Swamp buffalo are heavy-bodied and stocky. The belly is large and the body short; therefore, they present a "pot-bellied" appearance. The neck is long and the withers are quite prominent. The forehead is flat, the orbits prominent, and the face is short while the muzzle is wide. The legs are short and thin. The shoulders are well-developed and powerful, but the hindquarters are poorly developed. Wither heights for females are 120-127 cm while those in males are 129-133 cm; chest girths for males and females are about 191 and 180 cm, respectively.

Heat tolerance in swamp buffalo is only fair. There is obvious distress when they are exposed to the sun; both respiration and body temperatures rise rapidly. It is reported that the swamp buffalo are less susceptible to diseases than are cattle (Hardjosubroto and Astuti 1979).

Performance data on the buffalo. Milk production in the Murrah breed varies from 2 to 7 liters per day and the milk fat percentage is about 7% while the solid nonfat level is about 10%. Therefore, buffalo milk is much richer than that from cows. Milk yield for the swamp types is very low, about 1 to 2 liters/day.

The swamp buffalo is particularly valuable in certain rice-growing areas where its chief use is for plowing, harrowing, and puddling paddy fields before

planting; it is capable of pulling large loads under very heavy soil conditions if slow movements are permitted. These qualities make it more valuable than beef cows under these conditions.

Southeast Asia Investigators (de Guzman 1975) are putting much emphasis upon already initiated research on the swamp buffalo in the Philippines, Thailand, and other countries, including some in Indonesia.

Birth weights are higher (about 27 kg) in buffalo than in cattle, and the daily gains of about 0.41 kg/day are higher than in cattle. Arganosa et al. (1975) compared the carcass characteristics of buffalo to the native cattle in the Philippines (Table 15).

Table 15. Buffalo Versus Cattle in Carcass Yields

Criteria	Cattle	Buffalo
Slaughter weight, kg	349.3	334.2
Dressing percentage	50.3	46.3
Carcass length, cm	128.0	118.6
Rib eye area, cm^2	50.9	40.7
Marbling score	3.5	4.6
Saleable cuts, %	77.3	75.9

Source: Arganosa et al. (1975).

Moran (1978) found that gains of the buffalo bulls fed a high-concentrate diet were as good (Table 9) as gains of the Ongole bulls. However, the dressing percentage of the buffalo is lower than that of cattle. Research reports indicate that the quality of buffalo meat is equal to that of cattle; therefore, discrimination in price is not justified. Buffalo are becoming popular with the producers on the eastern islands of Indonesia who export to Jakarta or Surabaya for slaughter because buffalo are larger and shipping costs are on an animal basis regardless of body size or weight. Swamp buffalo accounted for about 10.2% of the meat produced in Indonesia in 1977.

Dairy Cattle

Dairy farming was introduced into Indonesia by the Dutch settlers in the 19th century using imported Holstein-Friesian (Friesian) cattle from the Netherlands. There are a few Hissar cattle in North Sumatra that were introduced by Indian immigrants. Both Hissar cattle and Murrah buffalo can now be found on the same farms in North Sumatra. Friesian and Hissar cattle have been crossed with the local breeds (the Friesian cross is called Grati) that, after many generations, are well-adapted to sea level and wet areas.

Description of the dairy breeds of cattle. The Hissar cattle apparently came from the Punjab and retain the characteristic grey-white color of the short-horned *Bos indicus* type. In Indonesia they are small and do not produce much milk.

Grati cattle represent a cross of Friesian with native Javanese cattle. In addition, they could have some genes from the Madura, Ayshire, and Jersey cattle. However, the Grati cattle resemble the Holstein-Friesian found in Europe and the U.S. Each year semen from prime Friesian (from Australia, New Zealand, U.S.A., and Holland) is being used more extensively to upgrade the Grati cattle. As a result the size of the animals is increasing steadily: chest girth and wither heights for males and females are about 193 and 180 cm, and 130 and 120 cm, respectively. Body weights for males and females are about 500 kg and 400 kg, respectively. It is estimated that purebred Friesian constitute about 4% of the 100,000 dairy cows in Indonesia.

Performance data on dairy cattle. Milk production from domestic herds provides less than 20% of the domestic needs (Hardjosubroto and Astuti 1979). Because of the great increases in domestic consumption of milk and the possibilities of increasing domestic production, the GOI is emphasizing the expansion of domestic milk production. The importation of Friesian cows from Australia is one means of meeting this goal; thus the proportion of purebred Friesians is increasing as this program progresses.

The level of milk production in the Grati animals is increasing each year as a result of improved breeding, feeding, and management. It is estimated that the average production of the Grati cows is about 2,500 kg per year; however, some herds are exceeding this by large margins. (The author was in close contact with two herds which had average productions above 4,500 kg per year. The genetic potential in some herds is even higher than that, especially by using rations containing high levels of readily available energy.)

Milk production in the Murrah buffalo and Hissar cattle is quite low -- from 2 to 7 liters per day.

Reproduction performances of all dairy cows are low. Natural mating is being replaced by artificial insemination (A.I.). Natural mating is still in use by the smallholders, but they are interested in A.I. Age at first parturition is about 38 months and there appears to be no seasonality of estrus. The interval between successive parturitions is about 14 months and calf mortality is about 8 to 10%.

Peak production in most herds is obtained in the fourth lactation, or when the cow is about seven years old. The length of lactation period is extended to about 323 days in the milk-producing areas of Central Java (Hardjosubroto and Astuti 1979) and about 305 days elsewhere.

As reported earlier, Grati bulls respond well to high-concentrate diets (Moran 1978): these bulls gained at a rate of 0.90 kg per day, with a dressing percentage of 59.3%. Carcass quality of Grati beef is excellent. Growth rates of Friesian bulls under traditional systems of management (when no concentrates are fed) is estimated to be from 0.30 to 0.40 kg per day.

Small Ruminants

The statistical services in Indonesia make no attempt to separate sheep from goats in the data presented by provinces. However, goats are more numerous than sheep. Hardjosubroto and Astuti (1979) reported that in 1977 there were 3,337,000 sheep and 5,951,000 goats in Indonesia. The combined distribution is as follows: Java and Madura, 83%; Bali and the Nusatenggaras, 5.2%; Sumatra, 8.1%; Sulawesi, 3.1%; and Kalimantan, 0.5%.

All Indonesian sheep produce hair wool for carpets, meat, and manure, and serve the owners as a living savings account. In respect to savings, many landless peasants own sheep or goats but are not able to keep cattle or buffalo that must be integrated with crop productions. Goats are kept for meat, manure, as a living savings account, and a few (Ettawa goats) are kept for milk production. A few sheep and goats are kept for sporting purposes.

Description of the breeds of sheep and goats in Indonesia. There are three main breeds of sheep: Javanese thin-tailed, Priangan, and the fat-tailed.

The Javanese thin-tailed breed is quite small and its tail, which shows no sign of fat, does not reach its hocks. This breed constitutes 80 to 85% of the sheep in West and Central Java (Mason 1978). The hair-wool color is usually white and many have black patches around the eyes, on the nose, and elsewhere. The ewe is usually polled whereas the ram has closely curled horns. Normally, the ears are medium to small and are in a partially pendulous position.

The Priangan sheep apparently originated in the Garut district of West Java from a cross of Cape sheep from South Africa (possibly the Afrikander) with local sheep (Hardjosubroto and Astuti 1979). However, there is doubt whether this is a separate breed from the thin-tailed breed (Mason 1978). The author, in agreement with Mason (1979), finds it difficult to distinguish the Priangan from the Javanese thin-tailed, thus he feels that they are of the same breed.

Mason (1978) estimates the number of Priangans to be about 250,000. The Priangan rams are used for breeding the local thin-tailed sheep in an attempt to upgrade them -- another reason why it is difficult now to distinguish the Priangan from the Javanese thin-tailed sheep.

The fat-tailed sheep also are called the East Java fat-tailed sheep. They were brought to Indonesia by Arab traders (from southwest Asia, possibly Iran) who settled in the coastal areas of East Java in the 19th Century. Mason (1978) points out that sheep in Indonesia are called domba and that dumba in Persian is "tail," a term used to refer to the fat-tailed sheep in Iran, Afghanistan, and Pakistan. Most sheep in East Java and Madura are fat-tailed but only an estimated 50% of the sheep in Central Java are fat-tailed.

The color of the fat-tailed sheep is usually white, with some having black or brown patches. Both ewes and rams are hornless, but there are occasional spurs on the rams. Mason (1978) describes the ears as being of medium size and "semi-lop." He also reports that genes for being earless are present in the breed.

Description of breeds of goats. There are three major breeds of goats in Indonesia: Kacang, Grade Ettawa, and Gembrong or Bligor.

The Kacang (peanut) goat, the most numerous breed in the country, is found over a wide area. It is a small goat with no uniformity of color; the base colors are black, brown, and white with all variations in between. The ears are small and both the males and females have short horns that slope backward with the tips bent outwards.

The Grade Ettawa is a cross of the purebred Ettawa (Jumnapari, from India) and the local breeds. It has large horns and medium to long lop ears that are carried in a pendulous position. The colors are usually brown with black and white spots. It is used for both milk and meat production.

The Gembrong or Bligor goat is a bit more difficult to define. Its color is usually white with gold patches in various spots over the body. The breed is somewhat larger than the Kacang.

Performance data on the small ruminants in Indonesia. The mature weights of both sheep and goat breeds were summarized by Hardjosubroto and Astuti (1979) and are presented in Table 16.

Table 16. Weights of Mature Sheep and Goats in Indonesia

Breeds	Male kg	Female kg
Sheep		
Thin-tailed	40	30
Priangan	60	35
Fat-tailed	40	35
Goats		
Kacang	35	30
Grade Ettawa	60	50
Gembrong	45	38

Source: Hardjosubroto and Astuti (1979).

The fleece on Indonesian sheep is light, consisting of extremely irregular, coarse, hair-type wool. It is used for making carpets of poor quality. The ewes are not milked; thus they serve to produce meat and carpet wool.

It is estimated that the average slaughter weight of thin-tailed sheep is only about 24 kg and the wither height is about 57 cm. Priangan sheep are a bit heavier, with an estimated slaughter weight of about 38 kg in males and 20 to 30 kg in females. Fat-tailed sheep are about the same size as the Javanese thin-tailed, having a slaughter weight of about 24 kg in females and a bit more in males.

Prolificacy is high in all sheep breeds; the ewes normally have one or two lambs at birth -- occasionally three. Mason (1978) reported that prolificacies (lambs born per 100 ewes lambing) vary from 145 to 213% in the Priangan, from 145 to 156% in the fat-tailed, and from 104 to 160% in the thin-tailed sheep. In all

breeds there are triplets and quadruplets. Hardjosubroto and Astuti (1978) reported that the proportions of singles, twins, and triplets in sheep are about 63.7, 32.9 and 3.2%, respectively. There is a "usual" 8-month lambing interval. Since there is no seasonality of estrus, twice-yearly breeding and two lamb crops are possible. However, this would require improved nutrition and management conditions. Males are first used for natural mating at an age of about 12 months. The age of first parturition is about 15 to 18 months. As there is no seasonality of estrus, births occur year-round. Preweaning mortality in sheep in Central Java (Hardjosubroto and Astuti 1978) is 7.9%, but in the postweaning sheep the mortality rate is 4.2%.

Daily gain of fat-tailed sheep is about 80 to 140 grams per day. Dressing percentage of sheep is about 51% (Hardjosubroto and Astuti 1978).

There is no seasonality of estrus in goats, thus reproductive performance could be the same as in sheep. However, intervals between successive parturitions in the usual production systems is about 7 to 9 months. Also, mating in goats is by natural service. Twinning is common in all breeds of goats.

The mature weights of the three goat breeds are shown in Table 16, and the dressing percentage in the Ettawa and Kacang is about 51%. Daily gains range from about 50 to 150 grams per day and are higher in the Ettawa. Milk production in the Ettawa goat ranges from 500 to 1200 ml per day, with a lactation period from 3 to 7 months.

The meat from goats and sheep in Indonesia is in great demand for making sate (satay in Malaysia). As mentioned earlier, the small ruminants represent a valuable resource for Indonesia and for all of Southeast Asia; about 77% of the goats and 96% of the sheep of Southeast Asia are found in Indonesia. High fertility rates in both sheep and goats make them valuable genetic resources. Even though all goats and sheep are small in size when compared to world standards, their small sizes and slow rates of growth could be the result of harsh environments rather than genes. Therefore, adaptability to such an environment is an important genetic resource.

Swine

Rollison and Nell (1974) reviewed the swine production potential in Indonesia and pointed out that about 90% of the people profess the Islam religion. Therefore, the swine industry is small and is expected to remain so. It is estimated that the total swine population in Indonesia is about 2,870,000 with 23.7% on Java, Madura, and Bali (Table 4). The remainder are found on the outer islands, with high concentrations in certain regions on Sumatra, East Nusatenggara, Sulawesi, and Kalimantan.

Description of the swine breeds found in Indonesia. There are three recognized breeds of pigs in Indonesia:

1. The Java pig originated from the crossing of European breed boars with the indigenous animals found on Java, which are short, fat, have a mild

swayback condition and a heavy mane of bristles on the neck and along the snout. However, in most improved herds, the crosses now more closely resemble the European breeds than the native pigs. For the most part, some pure Yorkshire and Landrace boars have been used for breeding the indigenous and crossbred sows.

2. The Bali pig is of the Chinese type with an extreme swayback condition; the belly in females usually touches the ground. This black and white pig has numerous skin folds.

3. The Sumatra pig, probably derived from the East Indian pig, is related to the feral pig (Robinson 1977) still found in the jungle. The Sumatra pig has black hair and, like the Bali pig, has short, small, erect ears.

The average weight of a Bali pig when one-week old is 0.6 kg, and it has a weaning weight of only 4.7 kg. Its average slaughter weight is about 50 kg. Javanese pigs have slaughter weight of about 90 kg in males and about 70 to 80 in females. Mature weights of Sumatra pigs are about 80 and 70 kg, respectively, for males and females.

Performance data on Indonesian swine breeds. Bali and Sumatra pigs are kept by smallholders to scavenge freely around the households and on the streets. This practice is found among the Toradja people who live in the uplands of South Sulawesi. These animals receive very little supplemental feeds other than scraps from the table. However, some grain is often fed just before slaughter to obtain a very fat animal. Since the Bali pig apparently has low genetic potential for muscular growth, it is quite fat when slaughtered.

Some swine units on Java are similar to commercial units found in the West. Many units are owned by the indigenous Chinese, and in some cases are located near tahu (the old Chinese soybean curd) production units. The pigs in this system are fed the liquid proteins that are not precipitated in the process of manufacturing the tahu. They are kept in stalls and are fed rations composed of rice bran, soybean meal (or tahu liquids), copra meal, and green leaves from cabbage, bananas, sweet potatoes, etc. They are fed a wet mash ration several times a day. In many operations the feed is dumped into troughs in which there are several inches of water above the feed.

Castration is performed at about weaning time or 11 weeks of age. Daily gains on all animals are low, especially the Bali and Sumatra pigs. However, in the case of Javanese pigs, the low gains stem more from diet than from genetic potential. In Java the animals are slaughtered at about 9 to 12 months of age.

As the pork consumption base is small, price fluctuations are great; the supply can rapidly exceed demand following periods of high prices. Farmers anticipate these rapid fluctuations by keeping large numbers of sows that are fed maintenance diets composed of coarse and economical feeds during long holding periods. When the future price situation appears favorable, the sows are bred. Prices also dictate the type of rations fed growing/fattening pigs and the time

required to "finish" the pig for the market.

The mating system in Javanese systems is controlled by the farmers. Males are used for service when one year old, while the age of first parturition in females is about 12 months. The interval between successive parturitions is about 7 months and an average litter size is about 9. Preweaning mortality is about 15% while postweaning mortality is about 5%. The Javanese pig carcass is about 70% of live weight, while the Bali pig dresses out a bit higher.

Horses

Horses in Indonesia number about 621,000 and are used for road transport and for racing. There appears to be some consumption of horse meat, but the amount available is small. Because horses are of small economic significance in Indonesia, the discussion on horses will be brief.

Description of Indonesian horses. Most horses in Indonesia are from the Eastern Islands of Sumba and Sumbaya. They are small like ponies but appear to be hardy and capable of trotting long distances when pulling light loads in light carriages. Most are used to transport people in public horse-drawn taxis that are found in most villages or small towns. Data on the performance of horses were not available to the author.

Poultry

The native poultry in Indonesia consist of Kampung and Kedu chickens and Tegal, Alabio, Bali, and Manila ducks. The numbers of turkeys, guinea fowl, geese, and others are too small to be of economic significance; therefore, the discussions here are limited to chickens and ducks. The number and distribution of chickens and ducks are shown in Tables 2, 3 and 4.

Description of the native breeds of chickens. Both the Kampung and Kedu chickens are considered to be descendants of the indigenous Red Jungle Fowl; both breeds were domesticated over a long period. The Kampung chicken has varied plumage of white, black, brown, and grey, and some resemble the Red Jungle Fowl. The Kedu Chicken is either black or white with a green metalic sheen. The Kampung chicken has either single or rose combs in which the comb color, as well as that of the ear lobes and wattles, is red. The Kedu chickens have black combs when young that turn to red at the age of about 6 months. The temperament of both breeds is "semiwild," alert, and aggressive. They are fast of foot and some can fly for short distances.

Performance data on the native chickens in Indonesia. The native chickens are thought to be more resistant to the common diseases in Indonesia. The diseases and percentage of the losses (in parentheses) are as follows: coccidiosis (17.5%), Newcastle disease (11.9%), Marek's disease (8.8%), aspergillosis (13.6%), nematodes (11.1%), and others (37.1%).

The native chickens are kept under open range conditions in average flocks of from 5 to 10 birds. Young chicks are obtained by natural hatchings; the hen sets after laying about 10 to 12 eggs. For the most part chickens survive by scavenging for insects, ants, worms, and grain and waste products from the kitchen.

Some farmers may provide extra feeds such as rice bran, cracked rice, cassava chips, and others.

The weights of the native chickens at different ages are shown in Table 17.

Table 17. Body Weights of Native Chickens at Different Ages

Age (weeks)	Kampung Chickens (grams)	Kedu Chickens (grams)
1	38	41
4	113	128
8	359	369
12	713	708
20	1170	1220

Source: Hardjosubroto and Supiyono (1972).

The females and males run together at all times; the sex ratio is about 1 male to 5 females. The pullets begin laying when about 200 days old and the hatchability of the eggs is about 65% (Hardjosubroto and Supiyono 1977). Kingston (1979) reported that mortalities in young chicks up to 6 weeks of age were about 69% and in adult chickens about 7%. The lack of disease resistance in indigenous chickens kept under the traditional system is costly.

Hardjosubroto and Supiyono (1977) reported that the average slaughter weight of Kampung and Kedu chickens is about 1,200 grams and that the dressing percentage is about 60%. The age at slaughter varies but is about 20 weeks. Many Indonesians express a preference for meat from the native breeds over that from the modern hybrid broilers. However, the author found the meat from the indigenous chickens to be much tougher and drier with a "gamey" flavor. As indicated earlier, about 90% of the meat and 40% of the eggs come from the native chickens and ducks.

Hybrid chickens are beginning to play an important role in poultry production in Indonesia. Performances of hybrid chickens are similar to those found in the U.S. and Western Europe. In fact, most of the hybrid chicks are furnished by international companies from the West that have established units in Indonesia, primarily in West Java. Most of these companies have headquarters in the U.S., England, Thailand, and in other countries, making a variety of hybrids available for broiler and egg production. The hybrids are beginning to make fast inroads into the smaller holder units on farms near the cities, with laying units more popular than broiler units. One key to the success of these units that use hybrids is the availability of protein-mineral-vitamin supplements that can be purchased from general poultry stores, along with good instructions for mixing these supplements with the local grains. If pricing for eggs and broiler meat is maintained at favorable levels, the use of hybrids in both broiler and egg production is expected to increase quite rapidly. However, during times of low prices the emphasis shifts back to the traditional practices that utilize the indigenous chickens for low-cost production.

Description of the breeds of ducks. Indonesians use four breeds of ducks: Alabio, Bali, Manila, and Tegal. However, the author does not attempt to describe each breed except to indicate that the color pattern in ducks exhibits three divergent types: brown or grey base color with white dots; green with black stripes; and white (from the Pekin ducks).

Performance data on ducks. The flock size varies from about 40 to 200 birds. Tegal and Bali ducks are penned at night and shepherded to rice fields in the morning where they remain all day. In general, the herders select rice fields that have just been harvested. The ducks can gather insects, fallen rice grains, snails, small fish, etc. from these fields.

In South Kalimantan, the Alabio ducks are kept in one-story houses that float in the shallow waters. The ducks are "freed" for feeding in the shallow waters during the day and are penned at night. The young are hatched by natural hatchings, but the farmers use Manila ducks to sit on the eggs. Ducklings are kept separate from the adults and are fed four times daily using rice bran, cracked rice, chopped snails, and chopped eels. In some areas, fresh sago palm is available for feeding adult ducks. Egg production in this system of rearing Alabio ducks can average 240 eggs per year in an unselected population. When seven months old, young ducks weigh about 1500 grams.

In duck flocks the sex ratio is about 1 male per 30 females. Young ducks begin to lay when about 6 months old and egg fertility ranges from 76 to 86%. Mortality rates vary. The mycotoxins are a continuing problem in all flocks and vary in their severity.

In a year Tegal and Bali ducks lay from 80 to 150 eggs that weigh from 54 to 63 grams. Most ducks are kept in the laying flock for about three years.

CHAPTER 5. DISEASES OF FARM LIVESTOCK

The animal disease situation in Indonesia is complex. The geographic condition of the country has advantages and disadvantages. Disease control is difficult because of poor infrastructure and long distances to travel, but the distance between islands offers advantages in controlling the spread of contagious diseases from one island to another.

The present status of the animal industry and overall rural development is such that veterinary services will have to be provided by the Government of Indonesia (GOI); it is doubtful that the private sector will ever develop to the extent that it will support private veterinarians.

Disease control is now monitored by the GOI's Veterinary Services. In addition, the Veterinary Services are charged with animal production responsibilities that are too wide for their limited animal production experiences. As a result, systematic investigations of the important diseases and their economic significance have not yet begun. Rather, the Services have been more concerned with "putting out fires" than with animal health programs and disease prevention. The GOI has stated that animal diseases result in yearly losses of about 110.4 billion rupiah ($176 million US) per year to the animal industry; these losses are in deaths and wasting effects. The basis of this figure is not known. It is likely that the "wasting effects" are the results of poor nutrition during the dry seasons. It is also true that general animal health all over the country would be greatly improved if nutrition and management of the animals were adequate.

In general, the GOI has given priority to trying to control such damaging diseases as hemmorrhagic septicemia, anthrax, and foot and mouth disease. Parasitic diseases (rabies and surra) have been given lower priorities.

Bacterial Diseases

1. Hemorrhagic septicemia is almost country-wide in its occurrence in buffalo, cattle, goat, sheep, swine, and horses. It is most prevalent during the monsoon season when there is high humidity. Control is possible through the use of "ring vaccinations" when an outbreak occurs. Where the disease is recurrent, regular animal vaccinations are recommended. The oil adjuvant vaccine, formerly produced by the Animal Health Research Institute in Bogor, is now being produced in Surabaya in the Vaccine Production Institute.
2. Anthrax is a killer disease. According to the GOI, it is found in West Java, the Nusa-Tenggaras, Sulawesi and Jambi. Control is possible through animal vaccinations in the infected areas. Since the duration of the immunity is about one year, the vaccinations with the Sterne vaccine are carried out for at least three consecutive years after the outbreak. The GOI reports that the incidence of outbreaks has decreased in past years.
3. Blackleg (anthrax) has been reported in Indonesia but its importance is not known.

4. Brucellosis is found in Indonesia and deserves more study since the investigative work on the disease has been confined to dairy cows. The Animal Health Research Institute now has an active program using serological examination of blood from dairy cows. The disease has also been reported in swine and beef cattle. The GOI prescribes the use of Strain 19 in vaccination schemes.
5. Bovine tuberculosis does not appear to occur in Indonesia. However, the extent of the tests is not known to the author. Human tuberculosis is widespread in Indonesia which prompts questions as to how the animals escape it.
6. Bovine trichomoniasis is present in Indonesia. Trichomonas fetus, a pear-shaped protozoan, has been reported to cause abortions primarily in dairy cows; its importance is unknown.

Viral Diseases

1. Foot-and-mouth disease in Indonesia dates back to an outbreak in Malang, East Java, in 1888. It spread to Bali and South Sulawesi and probably occurs in many other areas. The O_1 vaccine is being used in an apparently successful eradication program. The GOI reports that Bali is now free of foot-and-mouth disease and that the disease is now being contained in East and Central Java. There will be indigenous production capability for this vaccine in Surabaya.
2. Newcastle disease is widespread in poultry all over the country. The Central Veterinary Services have established guidelines for the provincial administrations to use in vaccination campaigns to eradicate the disease. This is an ambitious program since most of the poultry is owned by the smallholders in the villages.
3. Fowl pox, leucosis, and Marek's disease do occur, but the author knows of no general control procedures now in use.
4. Bovine malignant catarrhal fever is found in Java, Bali, the Eastern Islands, and Irian Jaya. It is possible that the reported bovine malignant catarrhal symptoms have been confused with rinderpest, which also has been reported.
5. Jembrana disease was first reported in Bali in 1964; it also has been mistaken for rinderpest. Jembrana is probably caused by a vector-borne virus that spreads rapidly in Bali cattle and buffalo. Mortalities were high in the first outbreaks but appear to be less in subsequent outbreaks. *Boophilus microplus* appears to be the main vector, but the causative organism remains elusive.

Parasitic Diseases

1. Endoparasites - Trematodes. One of the main helminth problems in Indonesia seems to be caused by faciolosis or liver flukes. The author visited many slaughterhouses during his seven years in Indonesia and found most livers (probably more than 90%) of cattle, buffalo, and sheep to be infested with liver flukes; the disease is widespread.
2. *Trypanosoma evansi* and, possibly, *T. equinom* are blood parasites in Indonesia causing *Surra* in horses, swamp buffalo, and possibly swine. The economic importance is not known to the author.
3. *Babesia bigemina*, *Anaplasma marginale*, *Theileria mutans* and *annulata* are also blood-parasite diseases present in Indonesia.

Sporadic Diseases

The term sporadic diseases is used here to cover many conditions that are present but do not justify separate discussions. They include interalia, mastitis, uterine infections, foot rot, gastritis, milk fever, infertility, mange, and others. In addition, the mycotoxins are important in poultry, especially in ducks.

Mineral Deficiency Diseases

A wide area in Indonesia is phosphorus deficient and supplementation is indicated during much of the year. Deficiencies of calcium do not appear to be widespread; however, special care is needed in regard to levels of dietary calcium in diets of lactating cows, chickens, swine, and horses, and especially since rice bran is a common component in the diets of these animals. Rice bran is quite high in phosphorus and low in calcium. Nutritional hyperparathyroidism, often known as bran disease, is widespread among horses used for transportation or racing purposes in Central Java. The symptoms, often described as bighead, are found in many horses.

Investigations on the trace mineral status of Indonesian feedstuffs and animals are just beginning. In general, there appear to be marginal deficiencies of iodine in Central Java and it is suspect in many other areas. Preliminary results indicate that copper, selenium, molybdenum, and zinc also might be deficient in some areas. In considering the soil types, high rainfall levels, intense cultivation, and other factors in Indonesia, it is possible that deficiencies of certain minerals may be involved in the low fertility problems found in many parts of the country. Also, observations on the swine population indicate that borderline deficiencies of zinc are widespread. If the swine rations used by most farmers were fed in dry or mash forms, they would be severely deficient in zinc, and possibly other trace minerals. Individual farmers have reported to the author that a mixture of trace minerals has greatly improved reproduction rates in their swine herds.

It seems unlikely that severe vitamin deficiencies would be found in the livestock in Indonesia.

Section III. The Feed Base

Feed represents from 60-75% of the total cost in any practical animal production system.

Many authorities have shown that levels of production of tropical livestock are lower than those found in the temperate zones, and that levels of reproduction are major constraints in the monoparous animals. Because the forages available in the tropics will not support the maintenance requirements of ruminants throughout the year, the shortage of total feed energy is likely to be a major factor in the low efficiency of production and reproduction problems.

Many factors affect the feed base in Indonesia:

1. Availability of food crop residues from the small and intensive farming units found on Java, Madura, Bali, Lombok, and the outer islands. (Some crop residues could be processed for maximization of their use in ruminant rations.)
2. Other sources of feeds for ruminants on the small and intensive units.
3. Changing monoculture patterns of land use by the large estate crops to include ruminants.
4. Development of livestock programs, and especially of ruminants, in the transmigration areas in Kalimantan and Sumatra.
5. Development of extensive ranches on the outer islands to utilize forages found there.
6. Improvement and standardization of feeds for nonruminants in Indonesia.

Land use figures bear on all of these factors and are presented in Table 18.

Table 18. Land Use in Indonesia

Land Use	Area (ha x 1000)	Percent
Total land area	193,494.4	100.0
Arable land	12,310.0	6.4
Permanent crops	2,137.0	1.1
Permanent pasture	14,443.0	7.5
Forest and woodland	124,800.0	64.5
Other + inland waters	39,804.4	20.5

Source: Table 3 and FAO Production Yearbook (1979).

Table 19. Production of Food Crops, 1979

Food Crop	Hectares Planted ('000)	Yield Per Ha (kg)	Total Production Metric Tons (x '000)
Rice (padi)[1]	8,850	2,977	26,350
Maize	2,600	1,231	3,200
Cassava[2]	1,398	9,371	13,100
Sweet potatoes[2]	309	7,005	2,350
Peanuts (in shell)	517	1,430	739
Soybeans	710	810	575
Sugarcane	165	97,927	16,158
Bananas[2]	-	-	3,905
Coconuts[2]	-	-	10,800
Sesame seeds	16	375	6,000
Avocadoes	65	-	300
Cotton (seed)	4	568	2,000
Palm kernel[2]	-	-	115
Coffee	456	586	89

[1] Unmilled rice.
[2] Net product.
Source: FAO Production Yearbook (1979).

The residues from the above food crops (Table 19) play an important role in the feeding of livestock in the intensively cropped area. These are examined in the following section.

Food Crop Residues

Nell and Rollison (1974), Muller (1974), and Tillman (1975) have studied the problem of feed crop residues extensively and frequent references to these reports are made. For example, Muller (1974) estimated that crop residues on Java and Madura (Table 20) supply about 25 million metric tons of dry matter (DM) and that, if these residues were properly used, their DM would support about 7 million animal units (AU), a term established by the FAO equivalent to about 500 kg of live weight. DM production is a bit higher now than in 1974, but more recent data are not available.

Table 20. Food Crop Residues in Java and Madura in 1979 and Their Potential for Livestock Feeding

Food Crop	Land Area ha ('000)	DM Per Hectare kg ('000)	Total DM Production ton ('000)
Rice straw	4,336	2.5	10,850
Maize residues	1,508	6.0	9,480
Sugarcane (tops and leaves)	23	4.0	920
Cassava (aerial part)	1,108	1.0	1,108
Sweet potatoes (aerial part)	159	1.5	240
Legume straws	846	2.5	2,115
Total	7,980	-	24,713

Source: Muller (1974).

Muller's assumptions in regard to the feed value of the above crop residues are based upon "proper" use of the forages in ruminant production systems. He reports that, if these forages were properly processed (ground, treated with an alkali, pelleted, etc.) and supplemented with energy-protein-mineral supplements, the above amounts of forage would provide the roughage needs for 15 million cattle weighing about 250 kg each. Even though such a utilization is beyond the realm of immediate practical use, the idea is worth pursuing. However, it must be kept in mind that optimum utilization of crop residues is only one of many ways to increase the feed base. Economic conditions will dictate which methods should be used.

Table 21. Food Crop Residues in Indonesia

Food Crop	Area ha ('000)	DM per ha kg ('000)	Total Production M. tons ('000)
Rice straw	8,850	2.5	22,125
Maize residues	2,600	6.0	15,600
Cassava (aerial)	1,398	1.0	1,398
Sugarcane (tops and leaves)	165	4.0	660
Sweet potatoes (aerial)	309	1.5	4[illegible]
Soybean residues	710	2.5	1,775
Peanut residues	517	2.5	1,293
Coffee hulls	456	0.2	91
Palm oil residues	15	1.0	150
Total	15,020	-	43,556

Source: Muller (1974).

Total crop residues in Indonesia (Muller 1974) amount to about 43 million tons of DM (Table 21). This represents about 40 million tons of organic matter that, even without treatment, would have a digestibility of about 45% and would yield about 18 million tons of digestible organic matter if used properly.

Rice crop residues. Basically, there are three crop residues derived from rice production: rice hulls, rice straw, and rice bran plus broken grains.

Rice hulls are not suitable for feeding to any animals because of their high silica content and the ligno-cellulose complex; they have more value as a fuel.

Rice straw is a valuable feed resource that, if properly used, could contribute much to the feed base for ruminant production in Indonesia. Rice straw is bulky, low in crude protein, high in crude fiber (ligno-cellulose complex) and is slowly digested by ruminant animals. Also, it is unpalatable to ruminants unless it is properly supplemented; the supplement should contain some readily available energy, crude protein, minerals, and under some circumstances some of the vitamins.

Soedomo et al. (1980) reported that the total digestible nutrient (TDN) level in the typical rice straw in Central Java is about 27%, which is lower than the calculated values of Hartadi et al. (1981). However, Soedomo et al. (1980) found that rice straw was a valuable ingredient for feeding growing Ongole bulls weighing about 200 kg. In their experiment, the concentrate portion of the ration was fed twice daily while the animals had free access to the forages. Results of the experiment are shown in Table 22.

Table 22. Rice Straw Versus Elephant Grass in Rations of Growing Ongole Bulls (DM Basis)

Item	Diet 1	Diet 2
Rations:		
Rice bran, kg/day	1.50	1.50
Leucaena meal, kg/day	0.80	-
Elephant grass, kg/day	-	2.63
Rice straw, kg/day	2.59	-
Total	4.89	4.13
Daily gains, kg	0.55*	0.45
Feed/gain, kg	9.9	9.6

* Signicantly higher, ($P < 0.05$).
Source: Soedomo et al. (1980).

In a second trial, Soedomo et al. (1980) treated rice straws with sodium hydroxide and compared the treated rice straws to untreated ones when fed to Ongole bulls weighing about 200 kg. The animals had free access to the forages at all times and the results are shown in Table 23.

Table 23. Sodium-Hydroxide-Treated Rice Straw Versus Untreated Rice Straw in Rations of Growing Ongole Bulls (DM Basis)

Item	Diet 1	Diet 2
Rations:		
Rice bran, kg/day	1.72	1.72
Leucaena meal, kg/day	0.80	0.80
Treated rice straw, kg/day	3.27	-
Untreated rice straw, kg/day	-	2.93
Total (DM)	5.79	5.45
Daily gains, kg	0.58*	0.34
Feed/gain ratio, kg feed/kg gain	10.2	16.3
Feed cost/day, Rp 1/	293	247
Feed cost per kg gain, Rp	506	725
Time required to produce 100 kg gain, day	172	294
Dry matter digestibility, *in vitro*, %	40.1	39.2
Dry matter digestibility, *in vivo*, %	53.5	51.8
Organic matter digestibility, *in vitro*, %	38.6	36.8
Organic matter digestibility, *in vivo*, %	64.5	61.5

*/ Differences are significant, ($P < .05$).
1/ 625 Rp = $1.00 (U.S.).
Source: Soedomo *et al*. (1980).

Dried and ground leaves of *Leucaena leucocephala* were used in both trials as they supplemented the protein deficiency of rice straw. The author's colleagues at the University of Gadjah Mada have research underway to determine what feeds and combinations can be used to supplement the rice straw found in Central Java for the proper feeding of ruminant animals.

Rice straw is a valuable feed resource which could be used to increase ruminant production in Indonesia. Also, it has been shown that sodium hydroxide treatment will improve the nutritive value of rice straw. However, the author has many reservations concerning wide usage of sodium hydroxide on rice straw in Indonesia; he would prefer to evaluate the possibilities of other treatments, and in particular fermentation of the rice straw in a process similar to silage-making. All treatments require inputs and knowledge which the farmers do not yet possess. Therefore, wide usage must be preceded by research and extension.

Rice bran and the broken grain are valuable milling by-products that can be used for feeding both nonruminants and ruminants. It would be more appropriate to discuss these under grains and milling products (Chapter 8).

Maize crop residues. Maize is produced by the smallholder in Indonesia for home consumption and for sale. There are five fractions of the residues -- stalk, leaf, husk, cob, and stover. The smallholders are presently using the stalk and leaf portions of the maize crop quite well; it is customary just prior to the harvest of the grain to remove the top of the maize plant just above the ear of corn. Since the tops are still green and fresh, they are readily consumed and efficiently used by all ruminants. After harvesting the grain, the corn husk is removed from the ear and the bottom leaves of the stalk gathered for feeding to ruminants; utilization of these portions could be improved by processing and supplementation.

Cassava leaves and stems. It is estimated that about 1.4 million hectares of cassava are planted each year yielding about 1.4 million tons of stems and leaves. Because it is detrimental to tuber production if the green leaves and stems are removed during growth, farmers utilize these after the tubers are harvested. Mature stems contain about 6% crude protein while the leaves contain about 15%. Therefore, the combination of leaves and stems could be used to supplement the protein deficiencies of rice straws. However, in the author's experience, the farmers use their forages when they are available. As a result, they use up the supply of cassava leaves and stems soon after harvest and save rice straw until the end of the dry season when it is the only feed available.

Sugarcane tops/leaves and bagasse. There are two sugarcane residues available for ruminant feeding -- tops/leaves and bagasse. The sugarcane tops and leaves are removed at harvest and are in demand by the smallholder farmer whose ruminants readily consume this fresh product. The protein level, dry matter basis, is about 6%, thus supplemental protein is needed for optimum growth of large and small ruminants. Because harvest takes place during the dry season when green feed of any kind is in short supply, sugarcane tops and leaves play an important role in providing feed for animals in a poor state of nutrition. Even though the sugarcane residue might not be the best supplementation to use with dry rice straw, it does provide some protein, energy, minerals, and provitamin A to animals in need of all of these nutrients.

Bagasse is presently being used as a fuel source in many sugar mills. Because of the high cost of heating oils, this may be the best use for it. Since bagasse is collected at the site of the mills, it could be processed to separate the cellulose portion from the outer rind that is primarily lignin. Bagasse, dry basis, contains 19.7% lignin, 29% pentosan, and 48% cellulose. The pith contains pentosans and cellulose, both of which have high values as an energy source in ruminant feeding. Preston and associates (1974) have described methods for separating bagasse into its components and have made suggestions for use of the nonlignin products in ruminant feeding. If there were sufficient demand for the lignin component of bagasse, the process could be used for producing animal feed, but only as a by-product of the process. Otherwise, the economics of the process would not justify its use.

Sweet potato residues. There are about 300 thousand hectares of sweet potatoes in Indonesia that yield about 450 thousand tons of vines valuable in feeding ruminants. The mature vines, which contain about 12% protein and 68% TDN, are fed as the only feed until the supply is used up. This procedure does not represent optimum utilization of this resource for production purposes; however, the limited quantity available to each smallholder makes supplementation, preservation for future use, and other alternatives fruitless. However, if the village chief would coordinate these alternatives on a village level, it is possible that alternate usages would be justified.

Soybean crop residues. Soybean crop residues are presently used for feeding ruminant animals in Indonesia. About one-and-three-quarter-million tons of this residue are available in Indonesia. The stalk represents about 60% and the empty

pods about 40% of the available residue. Unfortunately, these are fed when many of the leaves have fallen. The crude protein level of the stems, dry basis, is about 15%, thus the product could be valuable in supplementing the low-protein rice straws.

Since most soybeans are grown as a secondary crop during the dry season, their appearance in the smallholder's feeding system is timely and important. Processing could result in some improvement in the feeding value of soybean residues, but this would have to be a simple procedure. However, the efforts of extension personnel to obtain a better balance of required nutrients by mixing residues of different feedstuffs could be rewarding.

Peanut crop residues. Peanut crop residues, and especially peanut vines, are a valuable feed ingredient for ruminants on Java. The area planted to peanuts is over 500 thousand hectares producing about 1.3 million tons of vines per year. Vines contain (dry basis) about 15% crude protein and 65% TDN; thus they are a valuable feed resource in demand for feeding dairy cows and horses. The vines are fed fresh right after harvest.

Processing would improve nutritive value of the vines; however, it is doubtful if processing could be justified on an economical basis. Extension efforts to teach smallholders how to better utilize peanut vines in their feeding systems would have more value than processing.

Other food crop residues. There are other food crop residues that can be used in feeding livestock: coffee hulls, palm oil residues, cassava peelings, mature vines from various pulses, sweet potato peelings, vines from sesame plants, leaves from *Sesbania grandiflora* trees, and sorghum crop residues (the total production of sorghum is quite low; however, the amount of land being planted to sorghum is increasing). All of these are valuable products and, where available, could be used in feeding systems.

It is emphasized that the present tendency by the smallholders is to use crop residues as they become available. There are few attempts to preserve these for future use; neither are there many attempts at mixing food crop residues to obtain a balanced diet for the ruminants. Educating farmers on the nutritive requirements of animals and the value of mixing crop residues with supplements containing nutrients would perhaps be more valuable than processing residues and using other costly inputs.

The FAO/World Bank Team (1978) made estimates on crop residue production on smallholder farms and reported that about 8 tons of dry matter are required to support two mature cows or buffalo for one year. In most cropping systems in Indonesia, there is a sufficiency of crop residues produced per ha to support one pair of cows; their calculations were independent of the available supply of rice straw.

Other Sources of Forage Available to the Smallholders

Nell and Rollinson (1974), Muller (1974), and Tillman (1975) have discussed the availability of forages on Java and Madura. In addition, Nell and Rollinson

(1974) made estimates of present forage production on Java and Madura (Table 24).

Table 24. Forage Production and Utilization in Java and Madura

Source of grass	Area ('000) ha	Dry matter ('000) metric tons
Rice field dikes	162	2,400
Estate crops	24	360
Cultivated forests	45	670
Secondary forests	13	200
Roadsides	15	230
Dry fields and shifting cultivation	56	840
Cultivated lands	198	2,960
Improved grasslands and pastures	10	
Total	523	7,900

Source: Nell and Rollinson (1974).

Rice field dikes. The areas of the rice field dikes and waste lands in the rice-growing areas were estimated by a survey in 1970, and these figures were used by Nell and Robinson (1974). If the dikes were planted to improved grasses and properly fertilized, forage yields would be higher than the estimated 2.4 million tons that are shown in Table 24.

Forage from large estates. Forage production and utilization on estate land is low because many operators of these units will not permit animals to graze the grass under estate crop trees (rubber, clove, palm, etc.). However, about 5% of the estate land does yield forages that are harvested by the smallholders using the cut-and-carry system for their small and large ruminants, but this is low compared to the potential.

Cultivated forests. The forage production figures in Table 24 consider only 5% of the total area because foresters, concerned with potential destruction of trees, will not permit free-running ruminant animals in the forests. These figures are low in comparison to the potential.

Secondary forests. The forage production figures for secondary forests are low because it is assumed that only 2% of the area will produce grass available for ruminants. This is much lower than the potential.

Roadsides. Forage production on roadsides was estimated by assuming that grass grows on an area 2.5 meters on each side of the road; therefore, for each kilometer there is 0.5 ha of grassland. These figures represent the maximum forage possible from this source.

Dry fields and shifting cultivation. Forage production from dry fields and shifting cultivation areas was estimated by assuming that 1% of these areas is used to produce grass that is used during the dry season. The potential is not much higher for these lands.

Cultivated lands. These lands produce some forages during the dry season. It is assumed that about 20% of the arable lands on Java and Madura produce only

one crop per year and that during fallow periods these produce grass at a level of about 10% of the normal grasslands. However, the potential for growing legumes on these lands during the dry seasons is much higher.

The total production of forages on Java and Madura, primarily grasses, was estimated to be 7.9 million tons of dry matter (Table 24), which is used to feed the large and small ruminants already in place. A large fraction of this forage source is "cut and carried" to animals that are maintained in the villages in pens nearby the homes of their owners. This zero-grazing scheme is found on most of Java, Bali, and Madura. The owners could improve the overall value of their feed source by (1) separating the cut forage into fractions based upon quality and feeding the highest quality forage to those animals that are growing, working, and/or producing milk, leaving the poorer quality products for those animals on maintenance ration and (2) by properly supplementing these products with energy, protein minerals, and certain vitamins (vitamin A is probably the most deficient vitamin).

Possibilities for Increasing Forage Production

The critical areas. In the nonirrigated farming areas, particularly where water erosion has caused extensive damage, legume shrubs offer much promise for supplementing the protein deficiencies of both the crop residues and grass forages when these are used individually or in combination as the major feed source. Two of these, *Leucaena leucocephala* and *Sesbania grandiflora*, are used in some areas of Java. Soedomo *et al* (1980) found that farmers in the Gunung Kidul area were using so many *Leucaena* leaves in the diets of their cattle and goats that protein was not a limited nutrient, but that energy, phosphorus, and possibly trace minerals were. Many of the farmers were using the *Leucaena* leaves from plants being used as "living posts" on fence rows. However, some farmers are now beginning to plant cultivated grasses and to expand the production of both *Leucaena* and *Sesbania*. Another legume shrub which offers promise in both dryland and irrigated areas is *Gliricidia sepium*, which is easily grown. However, it is not as palatable as the other two shrubs. In all three legumes, frequent but judicious removal of leaves and stems can be carried out without permanent damage to the plants. The crude protein level of a mixture of leaves and stems from all three plants is consistently 21% or more, making these excellent protein supplements to all low-protein feeds found in Indonesia.

The legume shrubs could also be the basis of soil conservation schemes in the critical eroded areas in Indonesia by using a combination of shrub legumes and grasses that could be planted on permanent terraces to provide feed for ruminants. This would permit the areas in between the terraces to be used to produce food crops. Since the manure from the animals, as well as some leaves from the legumes would be available to fertilize the food crops, yields of food crops might very well exceed those now obtained from cassava (the primary crop) in an ever-increasing soil erosion process. The "Paron" system of ruminant production that was developed for the hilly areas of Timor in cattle feeding bears further study for possible use in Java as there are already ten or more critical areas in the outcropping of the major volcanic mountains. (The "Paron" system in Indonesia is a method of alternating food crop production on hilly land with the

shrub legume, Leucaena leucocephala. Leucaena leaves are "cut and carried" and used as the primary forage in a six-month fattening period for 30 to 36-month-old Bali bulls kept tethered under trees during the dry season. After the bulls are sold and before the beginning of the rains, the legumes are slashed and burned in preparation for the growing of food crops.)

Some years ago the FAO/UNDP developed a scheme for use in the Solo area of Central Java that consisted of reforestation of the mountain outcropping areas having slopes of 50° or more. While the young trees were being started, Pennisetum purpureum was planted in between the small trees. By fertilization with urea, yields of forage were quite high. However, the sharp degree of slope and presence of small trees prevented grazing the forage; therefore, the familiar "cut and carry" system was used to feed the animals which were kept in covered stalls in the villages. The high cost of gathering the forage is a constraint upon further development of the system.

Growing forages under coconut trees. Another way to increase forage production is to plant a mixture of grasses and legumes under coconut trees that are owned by smallholders. Nitis (personal communication 1980) found that a mixture of exotic grasses and legumes, planted under mature coconut trees in Bali, produced almost as much forage as obtained in areas free of coconut trees, and the additional forage was obtained with no decrease in the yield of coconuts. Muller (1974) estimated that there are about 183,000 ha in coconut trees that could produce about 20,000 kg of DM per ha or enough forage for one year for about 841,000 animal units.

Intercropping of food crops and legumes. Another way to increase forage production in the thickly populated, nonirrigated areas would be to intercrop food crops and legumes such as Stylosanthes spp, Calopogonium spp, Centrosema spp, Desmodium spp, and others. By planting these legumes during the latter part of the rainy season, they could be grazed during the dry season. In research at Gadjah Mada, Soedomo (personal communication 1980) found that the legumes will continue to grow during the dry season but grasses do not. Therefore, this method would greatly increase forage production in the nonirrigated sections in Central and East Java.

Improved grasslands. Forage production from improved grassland and cultivated pasture should be encouraged in Indonesia for some livestock production schemes. Nell and Rollinson (1974) estimated the improved area (mostly on Java) to be about 10,000 ha, but there are no forage production estimates. However, the production possibilities are very high. For example, Muller (1974) reported that one farmer in the Bandung area is meeting the forage needs of 100 dairy cows on 4 ha of land. These cows weigh about 400 kg and produce an average of about 13 kg of milk daily over a 305-day lactation period, an annual average of about 4,000 kg per cow, or about 400,000 kg of milk per year from 4 ha; this represents a yield of 14,000 kg of protein. Forages provide about 60% of the nutrients in milk; thus they produced 8,400 kg of milk protein or a yield of 2,100 kg of milk protein/ha/year. Muller estimated that the DM production on the farm was about 60,000 kg/year/ha, providing about 7 kg/day/animal.

Ruminant programs in transmigration areas. Development of livestock programs, and especially ruminant programs, in the transmigration areas of Kalimantan, Sulawesi, and Sumatra will help farmers to utilize their crop residues and forages and motivate them to produce more forage for their livestock. Traditionally Indonesians on Java, Madura, and Bali, the source of the transmigrants, use the female cattle and buffalo for draft purposes in land preparation. It appears that the cropping intensity on farms of 1.0 to 1.6 ha of land without the use of draft animals in land preparation is about 118 and 112%, respectively. However, by using draft animals, which permit faster and more timely preparation for double cropping, cropping intensity is increased to 170 and 156%, respectively. In some areas where the soils are heavy, improvement of cropping intensity on 1.0 ha farms increased to 180%. All of the transmigrants would readily participate in a program which would make draft animals available to them as it would increase their annual incomes. The transmigrants need animal draft power to improve their method of land preparation. In fact, the FAO/World Bank (1978) team reported that income on a 1.6 ha farm was increased from $226 (U.S.) to $615 per year when a pair of large animals was used for draft.

The writer has not visited all transmigrant areas in Kalimantan and Sumatra. However, the ones he did visit were on the red-yellow podzolic and peat soils in South Kalimantan. In both areas, the transmigrants were in dire need of draft animals for both the extension of land under cultivation for the main crop (rice) and for intensification of land use for the second crop of rice and/or the production of secondary food crops. Because there is no surplus of workers in the new areas as on Java, each family is responsible for its own land preparation and cultivations, both of which are now done manually. Considering the time required for land preparation and the critical timing with the monsoon pattern, settlers feel draft animals are necessary for extending and intensifying their farming systems.

The red-yellow podzolic soil of some transmigration areas is of low fertility, especially if the level of organic matter is low. When these areas are on rolling lands, water erosion is a problem. The farmers find that after the removal and burning of the Imperata cylindrica (alang alang), crop yields for the first year are excellent, often as good as those found on Java. However, if continuous cropping is carried out, the second-year yields of crops are low, and the third year the soils produce only low yields of the climax crop, cassava. It is obvious that they must develop a system which will maintain a high level of organic matter in the soil. Even though the use of animals is not the only method to maintain organic matter and soil fertility, it might be the most profitable. It is suggested that the farmers need a system that integrates forage crops with food crops in such a way that the food crops would follow pasture crops in the rotation system.

The author feels that the time is ripe for the GOI and/or an international group to consider initiating research which would have as its objective the development of farming systems which would provide satisfactory production with the minimization of loss of soil fertility in such areas. Such research, of course, would also address the question of what size holding is needed for developing such a

rotation scheme. It is suggested that the research should be done near or on the sites of the transmigrants because land is available at these sites without the problems of uprooting people to research sites. The research done at the transmigration sites could have immediate practical application. The increase in forage production and animal numbers could be significant.

The FAO/World Bank Study Group (1978) reported that draft animals could greatly increase the net farm income (Table 25).

Table 25. The Impact of Animals on Net Farm Income.

Cultivated Area Per Farm ha	Area in Padi ha	Net Farm Income, $US	
		Without Draft Animals	With Draft Animals
1.60	0.64	226	615
1.00	0.40	81	390

Source: FAO/World Bank Study Group (1978).

The possibilities for integration of animal and crop production presents many opportunities on the poorer soils of the outer islands while increasing the feed base for ruminants. Since the domestic price of beef and meat from small ruminants has increased faster than that of food crops, this practice will also increase the total incomes of the small farmers in these areas.

CHAPTER 7. SOURCES OF FORAGES FOR LARGE FARM UNITS

Changing the Monoculture Patterns of the Large Estate Crops to Include Ruminants

The two major estate crops in Indonesia that offer possibilities for forage production are rubber and oil palms. There are also coffee and tea estates, but they offer fewer possibilities for growing forages.

Rubber. There are about 2,287,000 ha in rubber tree estates in Indonesia (Muller 1974) of which 114,000 ha could be used for intercropping. Further, Muller estimated that one could expect about 2 metric tons of forage DM/ha from these lands, a total of about 228,000 metric tons of DM. If the owners were convinced that the grazing animals would not damage their trees, the total area for grazing could be greatly increased. Even so, the rubber estates, using Muller's figures, could furnish feed for about 63,000 animal units.

Palm oil. About 150,000 ha are in palm oil trees on large estates. The Oil Palm Research Institute has obtained good results with kudzu and other legumes when planted under palm oil trees, especially during the first 6 to 8 years. If yields of 2 tons of DM per ha could be obtained from growing forages under the palm oil trees, the total yield would be about 300,000 tons which would provide for about 83,000 animal units.

It is expected that the areas planted to both rubber and palm oil trees will increase. Certainly, in the early years of both, there are good possibilities for forage production. The presence of forage plants would decrease the work of removing shrubs, weeds, and other materials; thus growing forages, especially legumes, is indicated. Both GOI and private estate managers feel that the grazing of these areas by either large or small ruminants will not be carried out in the near future. This is unfortunate since grazing under the trees makes weed control easier for the estate while at the same time producing meat.

Since the prices of farm animals is going up at a much faster rate in the transmigration areas than the prices for food crops, the benefit of farm draft animals is even greater in 1981 than in 1977 (Table 25).

Development of Beef Cattle Ranches on the Outer Islands

Mubyarto (1974) and many others have shown that the smallholders who own almost all of the large and small ruminants in Indonesia do not increase production in response to price increases. In fact, during the past decade, the prices of beef have risen dramatically while the population of beef cattle and buffalo has actually decreased. The shortfall in beef production has come from the slaughter of mature bulls, formerly used for road transportation, and young, often pregnant females. The future needs for animal protein are shown by GOI figures and projections in Tables 26 and 27. These projections demonstrate clearly that Indonesia must in some way stimulate animal production, and particularly large ruminants on the outer islands. It is obvious that the thickly-populated areas do not have feed resources for all of the future needs.

How much land is there for development of ranching schemes on the outer islands? There is no clear answer. The GOI in 1977 estimated that there are 9 million ha outside of Java waiting for development and that this area could provide a feed base for 3 million animal units. However, Nitis (1980) estimated that there are 16 million ha in Imperata cylindrica (alang alang) on the islands outside of Java that are growing by 150,000 ha per year because of the removal of trees and burning of shrubs. Nell and Rollinson (1974) made high and low estimates of land that is available for use as permanent pastures. The lowest estimate was 9 million ha while the highest was 28 million ha. There are estimates that there are up to 50 million ha in alang alang that could be developed into grazing areas.

Table 26. GOI Projections on Consumption Versus Supplies of Animal Products in Indonesia

Animal product	Short Term	Long Term
Beef (cattle & buffalo)	Deficit	Deficit
Goat/sheep	Deficit	Deficit
Pork	Match	Match
Chicken	Deficit	Match
Duck	Deficit	Match
Eggs	Deficit	Match
Milk	Deficit	Match

Source: Directorate General of Animal Husbandry (1977).

Table 27. GOI Projections on Quantities of All Sources of Meat Production Versus Consumption Over Time.

Item	1978	1983	1988	1993	1998	2003
	- - - - - thousand tons - - - - - - - -					
A. Highest projection						
1. Demand	576	675	797	938	1100	1281
2. Production	514	582	681	796	932	1090
Gap	-62	-93	-116	-142	-168	-191
B. Lowest projection						
1. Demand	520	585	659	742	836	941
2. Production	476	524	578	633	704	777
Gap	-44	-61	-81	-109	-132	-164

Source: Directorate General of Animal Husbandry (1977).

The red-yellow podzolic soils are dominant on the large islands, and the climax grass, alang alang, dominates the grasses. However, this is not always true on the eastern islands of Sumba, Sumbaya, and Timor where there are many nutritious range grasses in many areas. A review of the land-use patterns in Indonesia (Table 18) reveals that there are about 14 million ha in permanent pastures and about 125 million ha in woodland. As the woodlands are being rapidly exploited, the area of pasture land is increasing at a fast rate, giving credence to the idea that there are probably 28 million ha available for grazing. If one uses

the GOI estimate of carrying capacity -- 3 ha for one A.U. -- this area represents a feed base for about 9 million A.U., or about 20 million head of mixed cattle.

All the above figures are estimates. However, if one used the lowest estimate of 9 million ha, it is readily seen that even this figure represents a rich feed resource which is not being exploited. After addressing the question of why haven't these resources been exploited by the Javanese who are found on the thickly populated island of Java, it was apparent to the GOI that the answer is a complex one. One reason was the lack of indigenous experience in managing and operating large ranches. Therefore, in the early 1970s, the GOI decided to establish several model ranches for the purpose of increasing the level of local expertise in ranching skills.

Model ranches. Reksohadiprodjo (1980) reported on the development of P.T. Bina Mulya Ternak, the GOI model ranch. When Indonesian authorities recognized the situation of static numbers of large ruminants and its causes, their interest in developing ranching on the outer islands was heightened. Therefore, in 1970 they commissioned the Asian New Zealand Development Consultants Ltd. (ANZDEC) to conduct feasibility studies. The studies, which were quite extensive, were favorable to the development of several large ranches to serve as models for future ranching developments on the outer islands. As a result, the GOI requested the International Development Association of the World Bank (IDA) to provide financial and technological aid for their development. The ANZDEC plan, financed by the New Zealand Government, was used by GOI to set up a ranching corporation, the P.T. Bina Mulya Ternak or persero, a government-owned corporation. P. T. Bina Mulya Ternak (BMT) was established in December 1972 and got underway in October of 1973.

The proposed project was a long-term development program. Its primary purpose was to introduce ranching technology for the production of beef cattle in Indonesia. Its secondary purpose was to train other Indonesians in beef cattle ranching technology, to supply breeding stock to the transmigration areas, to upgrade the beef cattle gene pool in Indonesia, and to provide technical help and advice to other ranching schemes.

The original scheme called for development of seven ranches of about 12,000 ha each. Because of high developmental costs, the magnitude of the plan was reduced to three ranches, which have a total area of 36,000 ha. There are two ranches in South Sulawesi and one in Sumba where 26,000 ha could be utilized but only 12,000 ha are being developed.

The development of model ranches has been much slower than expected, primarily because of the inexperience of the Indonesians and the lack of infrastructure in all areas. The decision was made to optimize production on all land where it was feasible to plow and to overseed with legumes. It was shown early that *Stylosanthes guianesis* was well-adapted to South Sulawesi and that both of the Australian-developed types of Cook and Scofield thrive. *Centosema pubesens* and *Calopogonium muconoides* also do well; however, sulfur and molybdeneum application

improves yields in all legumes. In Sumba, Phaseolus atropurpureus and Macroptilium lathynoides did well, while Townsville stylo performed less well. Stylosanthes hamata appears to do well in Sumba but needs further testing. Leucaena leucocephala also shows good possibilities in Sumba.

Grasses have also been introduced into the ranches in South Sulawesi and Sumba. In South Sulawesi, Setaria anceps, Brachiaria decumbens, Panicum maximum, and Melinis minutiflora have done well. Also, elephant grass, Pennisetum purpureum, will grow well under many conditions. In Sumba, Cenchrus ciliaris and Urocheoa mozam bicensis show promise. Other ranches in both Sulawesi and the Sumba region have had similar experiences to those of BMT.

Pasture establishment in South Sulawesi has been expensive, although relatively easy to establish; however, the maintenance of tropical legumes in the grasses has been difficult. Reksohadiprodjo (1980) reports that it is easier to maintain a fully improved pasture (complete seed bed preparation) than a semi-improved pasture (plowing and overseeding with legumes). He also reported that grazing management is required to maintain the legumes in the pastures. However, many ranch managers have reported that the legumes tend to disappear regardless of grazing management. Greatly intensified research on legumes that are adapted to tropical conditions is indicated. As there are no extensive seed production units in Indonesia, legume and exotic grass seeds must be imported from Australia from seed selected for adaptation to Australia. To avoid future failures, Indonesia should implement its own field testing and seed-production program.

There is doubt as to whether high-cost pasture renovation work on ranches on the outer islands can be justified on an economic basis, and especially if the infrastructures for inputs and livestock marketing are still weak. In fact, better results might be obtained by properly managing the present grass resources. Woodward (personal communication 1980) has obtained results that indicate that supplementing the nutrient needs of the cattle by use of protein-mineral-vitamin supplement might be the preferred method of utilizing the forage resources in South Sulawesi.

Imported crossbred cattle, with 50% or more of Bos indicus genes, are doing well in South Sulawesi on model ranches. A large buffalo herd on the Sumba ranch appears to be well-adapted to the conditions there and offers much promise, but there are indications that imported cattle with high levels of Bos taurus genes are having some difficulties in adapting to South Sulawesi.

In 1977, the GOI reported that there were 50 cattle ranches in Indonesia with a total area of 85,000 ha and varied in size from medium to large. About 50% of these ranches were owned by the GOI, 36% by large private ranchers, and the rest are parastatal ranches. The GOI also estimated that fully 60% of the ranches might become successful units.

The author is disturbed that the model ranches have placed so much emphasis upon pasture improvement rather than upon utilization of the feed resources already on hand. However, he would emphasize that the model ranches could offer ideal sites

for controlled research to determine which methods are the most economical for beef production. It now appears that the leadership in the various GOI schemes comes from Java accompanied by the Javanese bias that one must maximize production of the scarce resource, which (to them) is land. However, land is not a scarce resource on the outer islands where an infrastructure for intensification of land use and an efficient marketing system for livestock have not yet arrived. Therefore, intensification should come at a later time in the development scheme.

CHAPTER 8. FEEDS FOR NONRUMINANTS

Feeds which are usually designated for nonruminant feeding are not exclusively for nonruminants. Some nonruminant feeds are often used to supplement low-quality forages in order to obtain greater response from those ruminants fed the combination of forage plus supplement. In many such situations, the supplementing of certain low-quality forages with a grain, usually reserved for humans or nonruminants, causes such high increases in returns that it is more profitable to feed that supplement to ruminants. Ruminant nutritionists and producers must be aware of such opportunities, and it is their duty to point these out when working with GOI officials who are concerned with planning. Also, the planning economists, whose approaches to the problem of feed utilization are much more simplistic, must be made aware of these feeding opportunities.

Muller (1974) summarized the data on feeds available for nonruminant feeding (Table 28).

Table 28. Feedstuffs Available for Livestock, Dry Matter Basis.

Feedstuff	Total available (tons)
Rice (in hull)	320,210
Milled rice (broken grains)	108,350
Rice bran	1,038,600
Maize grain	79,360
Cassava roots	247,450
Sweet potatoes	24,690
Sago	30,000
Pulses	11,620
Peanuts	6,390
Soybeans	11,610
Fishmeal	23,040
Coconut cake	31,060
Peanut cake	4,690
Soybean cake	13,990
Palm kernel cake	1,000
Leucaena meal	
Total	1,952,060

Source: Muller (1974).

The estimates, shown in Table 28, are old. For example, rice production has increased by at least 25%; therefore, the level of rice bran would be increased by about 1.3 million tons. The importation of wheat, which is milled in Indonesia, has resulted in the availability of wheat pollards for the feeding of animals. However, estimates of the available amounts of this product vary considerably since the imports of wheat appear to be increasing at an ever-increasing rate. The estimates, however old, are still valuable. When all products are considered, there appear to be about 2 million tons of concentrate feeds available each year for feeding livestock. Because Indonesia has a very large trade surplus with several large grain-producing countries, including the U.S., Australia, and Thailand, grain importation is expected to increase as the poultry industry grows and as the demand for milk grows. Rather than pursue the question of availability of indigenous and imported feeds, it would be more valuable to consider the properties of some of the local feeds.

Rice bran. This is the main source of concentrate feed in Indonesia. Researchers at PPPT (Animal Research and Development Unit funded by Australian aid and [See List of Acronyms]) in Ciawi and the University of Gadjah Mada have shown that there are wide variations in the value of rice brans in the diets of chickens. For example, Soeharto and Nasruddin (1979-80) have shown that high-quality rice bran (low in crude fiber and free of rancid fat) will support fast weight gains of broilers when it replaces corn at graded levels, up to 45%; rations containing 15, 30 and 45% rice bran supported gains equal to the positive control diet which contained no rice bran. However, Cresswell and coworkers (personal communication) found wide variations in the performance of chickens when fed high levels of rice bran. They obtained improved performance by various heat treatments of the rice brans, but these effects were not consistent. Experimental results indicate that two components could play roles in determining quality in rice bran--level of hulls (crude fiber) and the state of oxidation of the fat contained. Some authorities (Muller 1974) feel that solvent extraction of the fat from low-fiber rice brans would improve its quality and keeping qualities.

The different grades of rice bran in Indonesia are described by Hartadi et al (1981) and make it clear that rice bran is a valuable feed ingredient for both ruminants and nonruminants but gives variable results in the latter animals.

Cassava roots. Cassava, under good management conditions, could be a highly productive crop in Indonesia. However, much of this crop is planted on infertile land as a climax food crop; it grows through the wet season and remains in the soil until harvested during the dry season. As no fertilizer is applied to the poor soils, yields are very low in comparison with their potential. It is a low-protein, high-energy feed, and it is quite valuable when added to rations containing high levels of rice bran; this increases the concentration of available energy. Cassava meal or flour can be mixed with other meals in the diet to form a mash, or the cassava meal or flour can be pelleted. When compounding diets containing 40% or more cassava, special attention needs to be given to the level of protein, certain essential amino acids, fat and other factors. When this is done, cassava meal is found to be an excellent energy source; it has high potential in Indonesia as an energy source for poultry, swine, and ruminants.

Sweet potatoes. They have nutritive properties similar to cassava; therefore, further discussion of this product is not necessary.

Fish meal. Fish meals produced in Indonesia are poor-quality products due to many factors: high concentrations of fat, bones, and waste products. Consequently, their protein levels are variable and often are quite low. Because of the low quality and extremes in variabilities, most of the fish meals used in purchased protein-mineral-vitamin supplements, which are widely available in Indonesia, do not utilize the locally produced fish meals. Rather, the manufacturers of these products use the standardized products produced in Japan or Thailand. Standardization of this valuable resource would eliminate this need.

Soybeans. Soybeans grown by the smallholders are usually consumed in the form of boiled soybeans, tempeh, or tahu. As a result, most of the soybean meal for animal feeding is imported from the U.S. or South America. The soluble portion of the soybean proteins in the old Chinese method of preparing tahu is fed "as is" to swine; many swine units in Java are found in combination with tahu factories.

Peanuts. Peanuts produced in Indonesia are usually for human consumption either as roasted peanuts or in tempeh. The problems associated with the fungus *Aspergillus flavus*, which produces the mycotoxins, reduce its usefulness as an animal feed. The nuts, therefore, are not used in rations for livestock.

Coconut meal and cake. These products are plentiful in Indonesia and both furnish an economical source of protein for nonruminants. The full-fat product contains about 8-10% protein and 50-56% fat while the mechanically-extracted product contains about 20% crude protein and 8% fat. The coconut meal or cake is valuable in the diets of both poultry and swine. In time, it could become a valuable product for ruminant feeding.

Leucaena meal. This product has been used in Indonesia for many years. The leaf meal contains about 25 to 27% crude protein and is an excellent protein supplement. Since *Leucaena* leaves and stems contain mimosine, their use in poultry rations is limited to about 2 to 5%. The product also contains high levels of the xanthophylls that give an appealing yellow color to egg yolks and to the skins of broilers. This is a valuable product on the world market and its production and use are increasing at rapid rates.

Indonesia still exports cassava flour and meal, soybeans, maize, rice bran, peanuts, copra meal and cake, and other feeds. It is expected that these exports will cease when the GOI puts greater emphasis upon indigenous production of eggs, meat, milk, and on the effective use of concentrate feeds in the farmers' livestock production systems.

Section IV. Support Services

CHAPTER 9. GOVERNMENT OF INDONESIA (GOI) SERVICES TO THE LIVESTOCK INDUSTRY

The GOI provides many services to the livestock industry:

1. Training
   a. University level education for technicians in animal husbandry, agriculture, and veterinary medicine
   b. Vocational training in secondary schools:
      1. Agriculture technology (SMTP) (See List of Acronyms)
      2. Agricultural development (SPP)
      3. Specialized vocational training within the Ministry of Agriculture
2. Research
3. Extension
4. Artificial insemination centers and services
5. Livestock distribution and credit schemes
6. Veterinary services
7. Laboratories and animal health schemes

There are two ministeries directly involved in the provision of the above services to the livestock industry -- the Ministry of Education and Culture (MEC) and the Ministry of Agriculture (MOA). Other ministeries, such as the Ministry of Research (MOR), the Ministry of Public Works (MOPW), and others exert influence but are not involved in implementations which affect the above services.

Training

The Ministry of Education and Culture (MEC) is responsible for the primary, secondary, and tertiary education of all Indonesians. The MEC provides advisory services to the special training programs which are offered in the MOA.

Tertiary animal husbandry and agriculture training. Fourteen faculties or departments in Indonesia offer four-year or five-year (sarjana) degrees in animal husbandry. The four-year degree corresponds to the bachelor's (B.S.) degree offered by American universities. Formerly, all sarjana degrees were five-year programs divided into two parts. The first three years consisted of basic and practical training for the sarjana muda degree, a terminal degree for many of the poorer students able to obtain jobs as livestock herdsmen. However, the better students could, upon application, be admitted to the sarjana program that required two additional years in course work and a thesis covering their research. Since students had to finance their research projects, many required more than five years to finish the requirements for the sarjana degree. Because of the thesis requirement, many Indonesians equate the sarjana degree with the master's degree (M.S.) of the U.S. and Western Europe; however, experience indicated that it was not equivalent and so Indonesia changed the system to be similar to that found in the U.S. and Western Europe.

Postgraduate training in animal husbandry is offered at both the Institute Pertanian Bogor (IPB) and the University of Gadjah Mada (UGM). IPB offers both the M.S. (pasca sarjana) and Ph.D. degrees while UGM offers the M.S. degree. The M.S. degree at both universities requires course work, research, and thesis in an 18-24 month program quite similar to that used in the U.S. The Ph.D. degrees at IPB, and the one planned at UGM for initiation in 1985, are similar to those found in the United States.

All universities may offer an in-country doctorate degree in a "free study" program similar to that found in some countries in Europe. This degree is expected to be phased out within the next decade.

Tertiary veterinary medicine training. This is offered by four degree-granting veterinary medicine faculties, three on Java (IPB, UGM, University of Airlanga) and one in Sumatra (University of Syiah Kuala). In addition, the University of Udayana in Denpasar, Bali, initiated a program in late 1980.

Postgraduate training for the most part is carried out through the use of fellowships for foreign study. Since the GOI does not finance these scholarships, they are provided by overseas aid for graduate training. Both IPB and UGM, if their facilities were improved, could initiate postgraduate work in the near future.

Secondary school and technical training. Animal husbandry and veterinary medicine are combined under animal husbandry, a specialization that is now available in two general types of agricultural senior secondary schools -- the agricultural technology schools (SMTP) and the agricultural development schools (SPP).

Both the SMTP and SPP schools admit students who have completed the middle school (grades 6 to 9). There are 113 senior agricultural secondary schools in Indonesia, 18 SMTP and 95 SPP schools. The SMTP schools are financed and administered by the Ministry of Education and Culture (MEC) while the SPP schools are financed three ways: (a) by the national government and administered by the Agency for Agricultural Education, Training, and Extension (AAETE) in the Ministry of Agriculture (MOA); (b) by the provincial SPP schools that are financed by the provinces and administered by their respective departments of agriculture; (c) and by the private SPP schools, which are financed and administered by the donors.

Quality of training. In 1980, the author served on a World Bank Study on "Supply/Demand for Managerial and Technological Manpower in Agriculture in Indonesia" in which he had responsibility for assessing the quality factors of tertiary education in animal husbandry, veterinary medicine, and fisheries. In the course of this study, he visited most of the faculties that offer degree programs in the three disciplines.

In animal husbandry, he found that the faculties at IPB and UGM were much superior to those of the provincial universities. However, even in the two major universities, he found that the curricula were too academic in a narrow and

specialized area. The students were poorly trained in the basic sciences, economics, crop production, forage production, and in the purpose of animals in production systems. The curricula were over-specialized in veterinary medicine training but were deficient in training veterinarians in the development and use of animal health programs. This is not surprising since the curricula were designed for the most part by veterinarians who made up the original staff of the animal husbandry faculties. Fortunately, this is changing; some universities are beginning to gain experience in animal production.

The libraries in both IPB and UGM are poor even though much better than the provincial universities. As most of the books and references are in English, usage is low. Unfortunately, the staff members who are capable of writing text books in Bahasa Indonesian are not doing so. Some feel that the students are not yet ready for a change from the oral method used in university teaching. Many staff members are beginning to prepare mimeographed materials as handouts for their students. This is a quantum jump forward since their notes could be used in future textbook writing.

Facilities for practical training at IPB and UGM are fair, and the facilities at UGM are well-utilized. Those at IPB did not appear to be well-utilized and were in a poor state of maintenance.

The quality gap between the provincial universities and those of IPB and UGM is wide. The weaknesses listed for the two leading faculties are also found in the provincial universities. The provincial faculties, nonetheless, are in much worse condition since most of them do not have practical training facilities or even animals with which students from urban environments can get practical experience. This deficiency is a critical weakness.

Both IPB and UGM have some well-trained staff members. For example, UGM has 46 staff members -- 15 with an overseas M.S. and 4 with an overseas Ph.D. degree. IPB is in much better shape in number and proportion of advanced degrees, and the staff members with advanced degrees at IPB are older and have had their advanced degrees much longer. IPB could be an outstanding faculty if some contraints were removed. All faculties, except IPB, are handicapped by the practice of hiring their graduates as staff members. This is especially true for the provincial universities on the outer islands. Such a high level of inbreeding could have merit if the faculties were outstanding and were offering outstanding programs.

Staff hours for work on the primary job in all universities are short and variable, thus performances are poor; the main constraint for more industrious performances appears to be low salaries paid by the GOI. In recognition of the low salaries, the GOI permits much freedom of work performance in the primary job. To some it appears that the secondary jobs are more important than the primary one because the latter provides an operating base, albeit the low salary that allows one to obtain secondary jobs at superior pay. As a result, work hours are short and the primary duties can be adjusted to accommodate obligations to secondary jobs. In addition, the administrative structure in the universities permits

much freedom for the individual to determine his duties and hours on the job; thus, effectiveness of the university programs is dependent upon self-discipline of individual staff members. It is felt that the key to improvement lies in raising the basic salaries. If salaries were adequate, the university administration could provide job descriptions and performance criteria for promotion purposes. This would hasten the process to improve staff performances.

Quality factors in technical training. The World Bank Study Group reported that the quality of training in five SMTP schools has improved since the initiation of a new curricula that is now in use. Six more SMTP schools plan to use the new curricula in 1981 while the remainder (7) will use the curricula as quickly as possible.

Training in the SMTP schools is divided into core (45%) and specialized courses (55%). About 60% of the overall time is spent in theoretical training, while 40% is spent in practical training. The Study Group found that most of the SMTP graduates are unemployed, apparently because of the lack of coordination of training with the needs of the employers.

The SPP schools, because they tend to provide the students with a broad background for general agriculture, provide most of the technicians for animal husbandry in Indonesia. Core subjects provide about 70% of the lecture aspect of the curriculum, social and natural science subjects 45%, and general agriculture 25%. The schools devote 30% of their time to specialized courses in agriculture or to animal husbandry, depending upon student interest. There are three SPP schools that specialize in animal husbandry, one in inland fisheries, and the other 91 specialize in the plant sciences.

The study group found that the national SPP schools were superior to the provincial or private ones. However, as many of the staff members in all were poorly qualified, their students reflect the poor training offered. The GOI is aware of the deficiencies of the SPP schools, thus resources are being used in an endeavor to improve them, such as World Bank Loan #1692 - Indonesia that was initiated in 1979. The loan will enable the GOI to establish five more SPP schools and expand others.

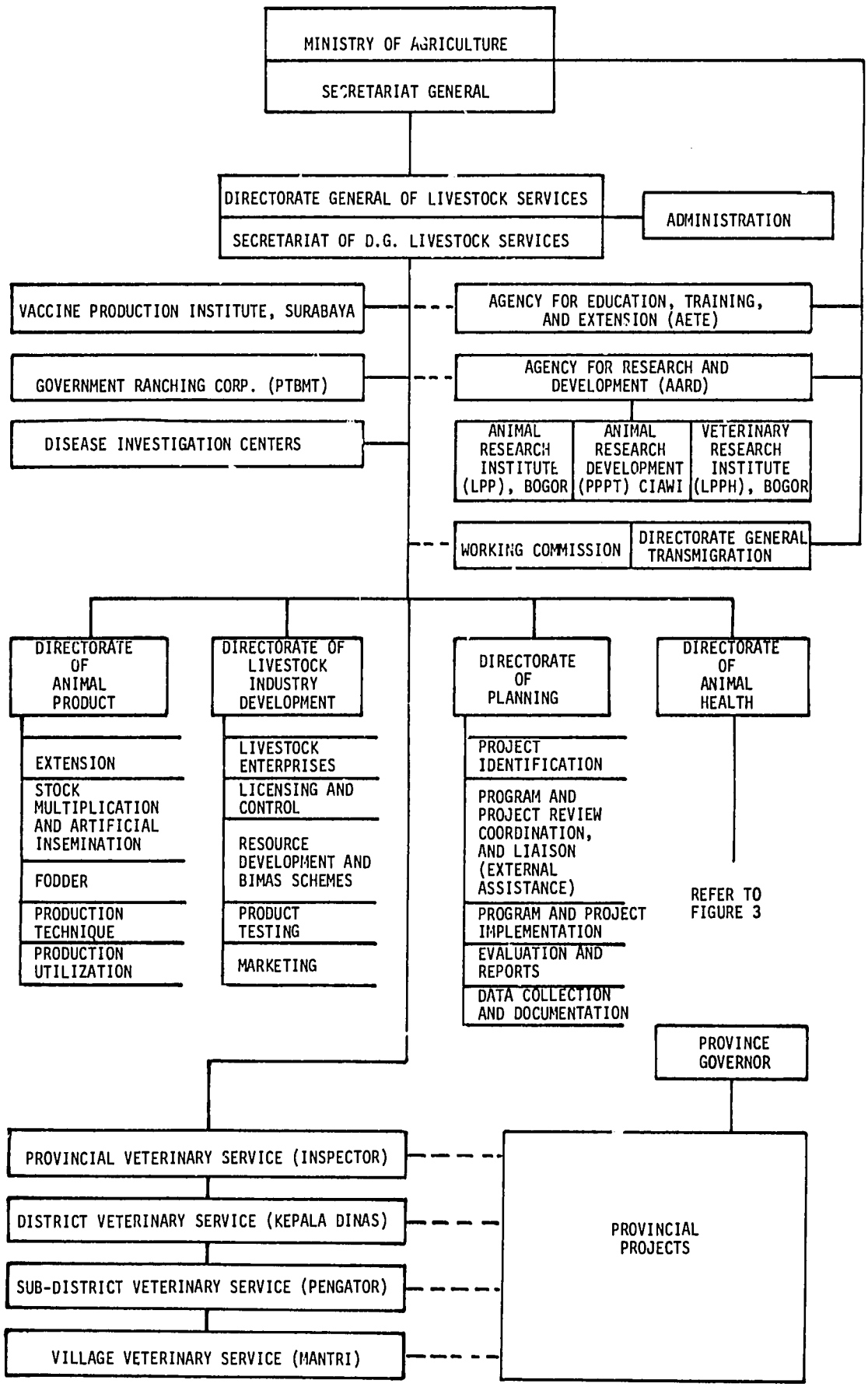
Much still remains to be done in the GOI endeavors to provide relevant training for this valuable manpower source.

Research and Extension

In 1974 the GOI established two agencies in the MOA that have responsibilities for research and extension: the Agency for Agricultural Research and Development (AARD) and the Agency for Agricultural Education, Training, and Extension (AAETE) (Figure 2). These agencies, each headed by a director, have responsibilities for all research and extension in the MOA. The policies for both research and extension are the function of a committee composed of the Directorate Generals of Livestock Services, Food Crops, Estate Crops, Forestry, and Fisheries. The committee on research is chaired by the Director of the AARD while the Director of AAETE chairs the committee on extension.

FIGURE 2

ORGANIZATIONAL CHART OF THE DIRECTORATE GENERAL OF LIVESTOCK SERVICES



Research. In all directorates, except livestock services, the move for AARD to conduct research on the commodities represented by each was prompt and resulted in rapid implementation of the policy. In livestock services the move was slow. It now appears that the AARD will assume responsibility for all livestock research, production, and animal health by April 1, 1981. The Directorate General for Livestock Services (DGLS) will continue his responsibilities for services to the livestock sector, while the AAETE will assume responsibilities for extension activities. Prior to the change, the DGLS had responsibilities for services, research, and extension for farm livestock. Before the recent change, the Animal Research Unit (PPPT) that was under the Directorate General of Livestock Services conducted most of the livestock production research while the AARD had a small research group, the Lembaga Peneletian Peternaken (LPP) in Bogor. LPP was staffed by Indonesian scientists; the chief research officers in PPPT were Australian senior scientists from CSIRO (Commonwealth Scientific Industrial Research Organization) with management responsibilities for the laboratory. It is anticipated that a consolidated effort by PPPT, LPP, and the Animal Health Research Units will greatly improve livestock research at the MOA level.

The universities employ most of the agricultural scientists who have overseas M.S. and Ph.D. degrees. Indonesia had 170 agricultural scientists with Ph.D. degrees in August 1980, and 132 of these were working in the universities. Unfortunately, as yet university scientists do not receive stable and long-term financing for agricultural research (Tillman 1980), nor are there plans for a national research program in Indonesia that would make the universities a part of the total Indonesian agricultural research effort.

Extension. The organization for the AETE has been discussed, but until recently there has been little coordination of extension activities. Indonesia does not have university programs for training personnel for agricultural training and/or communications. The extension system is just now developing with some well-trained people in several leadership positions. For example, the author is impressed with the services of the mantry in several areas of Indonesia. A mantry, an animal husbandry technician, is assigned to work in several villages, but the number of mantries is too small and the support given to them poor. At this time, there are plans for national and regional centers for preparation of animal production training materials that will alleviate some of the weaknesses in the mantry system.

Services to the Livestock Industry (Figure 3)

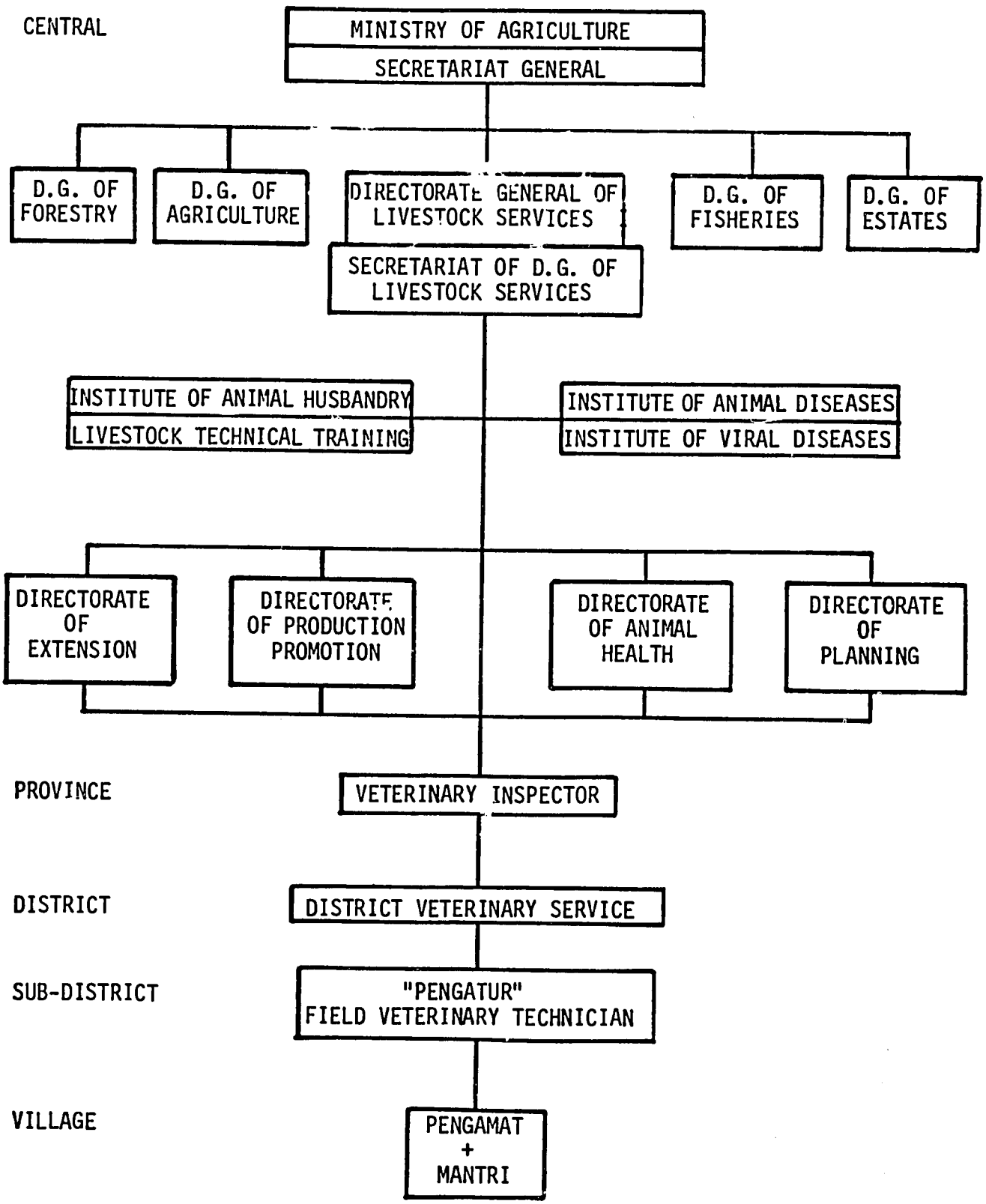
Artificial insemination centers. Artificial insemination was initiated in Indonesia in 1953, but it was not very effective until assistance from New Zealand in 1976 permitted the establishment of a national semen producing, processing, and distribution center in Lembang, West Java. Frozen semen is sent from the center to 13 subcenters. In addition, the national center trains inseminators and has developed a standardized procedure for administering and maintaining accurate records of field work.

Results from the use of A.I. in the dairy industry have been good; results in the beef industry are not as good.

FIGURE 3

ORGANIZATION CHART

(DEPARTMENT OF LIVESTOCK SERVICES)



As there seems to be little, if any, doubt that the indigenous animals are adapted to Indonesia, GOI authorities must be cautious of a wholesale introduction of genes from exotic cattle, and especially since there appears to be no national breeding plan or controlled research designed to determine the value of various crossbreeding programs. There are only two animal geneticists in Indonesia who have Ph.D. degrees in the field, and both of these work in universities that as yet have no facilities, funds, or a charge to conduct research on this problem. The opportunities for genetic research on the local animals are many and should be initiated as soon as possible.

Special livestock distribution schemes. In the early days, the Dutch administrators introduced a scheme to increase the number of owners of cattle among the smallholders. In the scheme, smallholders were given purebred Ongole cows and bulls. At the end of five years, the receivers had to return to the government cattle equal to the original number plus a percentage of the increase. The system was quite popular and has been copied by other groups in Indonesia.

The DGLS intensified and broadened its livestock distribution activities in 1972 when it began the distribution of imported strains of chickens under the Bimas Ayam program. Designed to increase the production of eggs in the areas around the large urban centers, the program provided credit for chicken houses and feed in addition to distributing hybrid layer chicks. The program is popular and meets a need.

The DGLS began its program for the distribution of slaughter cattle in 1974. In cooperation with the Bank Rakyat Indonesia (BRI), a national plan for fattening cattle was initiated. The Panca Usaha Ternak Potong (PUTP) scheme, which provided the farmers with a credit package for buying cattle and feed for a fattening program, offers excellent possibilities for success.

In 1976, the DGLS introduced, with the cooperation of the BRI, a national credit scheme for the distribution of young cows. The DGLS staff is using special development funds for the distribution of cows to smallholders in a system similar to that of the Dutch. In this program, farmers return cattle in payment of the loan. This has been a fairly successful program except that the price paid by the GOI for young cows on Java, Madura, and Bali is below the market price. As a result many young cows, some pregnant, are slaughtered (FAO/World Bank Study 1978) for meat instead of being sold to the GOI. At the same time the GOI and private ranchers are importing young cows from Northern Australia, and the GOI has just begun a potentially successful program (1981) that transfers young cows from Java, Madura, Bali, and South Sulawesi to the transmigration schemes.

Veterinary services. The main animal health services are the diagnostic laboratories, vaccine production units, the quarantine services, and the slaughterhouse and meat inspection services. Figure 3 exhibits the organization of the Animal Health Directorate.

The following units provide limited diagnostic services: the veterinary faculties, (Bogor, Yogyakarta, Surabaya, ACEH); the veterinary research institute, Bogor; the vaccine production unit, Surabaga; and three disease investigation centers in Denpasar (Bali, UNDP [United Nations Development Programme] assisted), Ujung Pandang (South Sulawesi, UNDP assisted), and Bukittinggi (Sumatra, West Germany assisted). Several small poultry-disease investigation centers are in operation in Surabaya (Belgium assisted), Bogor, and Yogyakarta. Japanese assistance is provided disease investigation centers at Medan and Tanjung Karang in Sumatra. It is obvious that not all of Indonesia is covered by diagnostic services. Java has most of the animals and the greatest concentration of veterinarians. As pointed out earlier, the animal health aspect of a veterinarian's duties in Indonesia is diluted by his dual role in both production and health. This is changing as animal production personnel gain expertise.

Vaccine production units. Vaccine production units previously were for both vaccine production and research. In this case, the virus unit was in Surabaya and the bacterial and other disease units were in Bogor. In the new plan the unit in Bogor will become a research unit for all diseases and will report to the AARD rather than to the DGLS (Figure 2); the Surabaya unit will become a vaccine production unit and report to the DCLS. There is a development program underway at Surabaya which will enable it to produce all of the antigens and vaccines needed in Indonesia.

The research unit in Bogor will have direct responsibility for research on animal diseases and for the development of animal health programs.

Quarantine services. Regulations concerning quarantines are standard: animals spend 14 days in quarantine before being transferred from one island to another within Indonesia. During this 14-day period, the animals are observed and vaccinated against foot-and-mouth disease, hemorrhagic septicemia, and other diseases considered appropriate for the move.

For effective quarantine a special subdirectorate within the Directorate of Animal Health has been established and charged with the resonsibility of supervising the present system while developing a nation-wide system. The country is now subdivided into five quarantine units:

Unit 1 is located in Medan and has 16 quarantine stations in North and West Sumatra and Riau.

Unit 2 is located in Jakarta and has 20 quarantine stations in South Sumatra, West Java, Central Java, and West Kalimantan

Unit 3 is located in Surabaya and has 18 quarantine stations in East Java and Central, South, and East Kalimantan.

Unit 4 is located in Denpasar and has 19 quarantine stations in Bali and East and West Nusa Tenggara.

Unit 5 is located in Ujung Pandang and has 22 quarantine stations in Sulawesi, Maluku, and Irian Jaya.

When these 95 stations are completed, they should be sufficient for all of Indonesia. The program is promising.

Slaughterhouse and meat inspection service. Only abattoirs in the large cities have acceptable handling facilities; some of these are old and do not have refrigeration. A number of bilateral aid programs are improving the situation by supplying modern abattoirs to several large cities. The GOI has meat inspection laws and regulations that can be enforced in the larger units; those in the rural areas will, no doubt, continue to operate under substandard conditions for some years to come. Most rural units have only rudimentary facilities, and some have no facilities for effluent disposal.

Veterinary services in Indonesia, for the most part, are provided by veterinarians who are GOI employees; few veterinarians are in private practice. However, many GOI-employed veterinarians provide services to private clients before and after their working hours in the GOI. These services, which concentrate on pets and small animals, provide excellent secondary jobs for the many graduate veterinarians who are concentrated on Java and in larger cities.

Section V. Development

CHAPTER 10. DEVELOPMENTAL CONSTRAINTS TO LIVESTOCK INDUSTRY

The author attempts to identify and discuss factors that are constraints on present production and future development in the livestock industry in Indonesia. No attempt is made to rank these in order of importance.

Demand for livestock products, with the possible exception of pork, is rising but, with the exception of the poultry industry, supply is not keeping pace. Consequently, prices for animal products are increasing faster than inflation. Shortfalls in beef production are being met at the present time by the slaughter of old bulls, formerly used in road transport (now being replaced by motorized vehicles), and the slaughter of young females, often pregnant. The consequences of the latter phenomenon will be felt for years to come, especially since the FAO/World Bank Study team estimated that at least three million cows are now needed for draft purposes on the outer islands of Indonesia.

The Major Constraints of the Great Concentration of People, Animals, Capital, and Agricultural Leaders on Java.

As shown in Table 4, one km^2 on Java, Madura, and Bali (which constitute 7% of the land mass in Indonesia) contains 685 people, 31 cattle, 8 buffalo, 72 sheep/goats, 5 pigs, 1 horse, 428 chickens, and 57 ducks -- one of the greatest concentrations of people and livestock in the world. The outer islands containing 93% of the land have on each km^2 only 30 people, 1 bovine, 1 buffalo, 1 pig, 1 sheep/goat, 17 chickens, and 4 ducks. It is obvious that room for the expansion of livestock, other than poultry, lies on the outer islands. However, the leadership, expertise, and capital for this expansion must come from Java.

Java is fertile and the rainfall pattern supports an intensive agriculture; but sufficient land for the burgeoning population indicates that many of the Javanese could increase their material wealth by moving to the outer islands. For the most part few choose to move. They enjoy the unreal world of their kampungs (villages) where they can escape the realities of day to day living by hearing the mystical stories of the triumph of good over evil presented in wayang kulit (shadow plays) by a dalang (storyteller) who embellishes Indian classics with Javanese mysticism, often with all night performances.

As a result of their reliance on their village culture, only members of the military or the GOI Civil Service leave Java for the outer islands. Fortunately, this situation is beginning to change with some internal transmigration. Until now most of the transmigrants have been from Java and Bali. They are landless peasants who have suffered from some natural disaster (flood, famine, volcanic activities, etc.); only the poorest of the poor have migrated, and then in GOI-financed programs. Unfortunately, the professionals from their previous society do not migrate with them.

Wealth is beginning to accumulate in the hands of some private investors in Java and Bali as a result of investments in oil, real estate, tourism, and other endeavors. For many reasons a fair portion of this wealth is not going to the outer islands for development of the livestock industry. The center for investments is still on Java, but these go primarily to the urban centers.

For the most part, the Javanese dominate the leadership positions in the military, education, industry, and agriculture, and stay on Java. For example, one prominent Indonesian forester in Indonesia reported that 90% of the graduate foresters in Indonesia are on Java where there are few forests left. As a result, the exploitation of Indonesia's extensive forests is still being done by graduate foresters from outside of Indonesia, and the situation is similar in the livestock industry. Because most of the leaders in the livestock departments in the GOI have not had extensive experience in actual livestock production enterprises (mostly on Java), their developmental efforts are directed toward maximizing the use of land resources without regard to the cost of inputs necessary to do so. For this reason, there is an overemphasis upon the use of expensive fertilizers and other factors that permit the introduction of exotic legumes. This is done even before the necessary infrastructure is developed. Such inputs have preceded meaningful research that would yield data as to whether such inputs were justified. Thus, there is no information on efficient methodology for applying such inputs. There is evidence that maximization of profits in such areas accrues a management system that utilizes the feed resources already present but on a low-cost input basis as has been done elsewhere in the world (Woodward personal communication).

Shortage of Foundation Stock

The total number of large ruminants in Indonesia is about 8.5 million, but there appears to have been a decline in breeding herds since 1968. Since about 65% of the cattle, 47% of the buffalo, and 85% of the sheep/goats are on Java, which suffers from the pressure of steady human population increases, this decline in foundation stock would be expected. Other underlying causes for the decrease could be: (a) low farm incomes, (b) high beef prices, (c) lack of credit to buy animals belonging to neighbors, (d) the early failure of GOI programs to purchase breeding females for the transmigrants, and (e) inflation.

The combination of lower farm incomes, inflation, and high beef prices has caused the farmers to sell their female breeding stock. Another factor in the decline of large livestock is the availability of cheap labor for soil preparation in the thickly populated areas of Java. This causes human labor to be cheaper than draft animals or tractors (Nyberg personal communication). Because the GOI has not paid market prices when purchasing young female cows for the transmigrants, farmers on Java, Madura, and Bali have sold young female breeding stock for slaughter. Fortunately, this is changing.

Poor GOI Developmental Support.

The GOI is increasing its support to the agricultural sector. It is also addressing itself to establishing functional agricultural departments and to determining the best internal organization to provide quality agricultural training at

all levels. Because of previous weaknesses and present inadequacies, there is still a serious shortage of well-trained and dedicated personnel in both the DGLS and the universities who furnish the graduate production experts and veterinarians. Although the universities have better-trained people than the DGLS, the universities are not yet brought into the national plan for agricultural research and extension.

The lack of trained manpower is a constraint on:

1. Animal health programs that are weak because of a weak knowledge base; practical research results conducted on animals kept under practical conditions are not yet available;
2. Control of endemic diseases; free distribution of animals all over the country is not yet feasible. The incomplete quarantine scheme handicaps disease control and prevention in the outer islands;
3. Practical training programs for technicians from the agricultural high schools;
4. Production-oriented research; many developmental programs lack a knowledge base for successful operation;
5. Animal production-oriented personnel -- a critical deficiency in development programs;
6. Adequate facilities for the orderly purchasing, holding, and distribution of cattle;
7. Amount of time needed to establish facilities necessary to carry out job-related duties.

The low salary base and liberal work requirements of GOI employees encourage work in secondary jobs, thereby reducing the effectiveness of permanent staff members. There is no salary differential for hardship posts, thus there is no incentive for professionals to move to places where their services are needed.

The well-trained agricultural scientists who work in the universities on national agricultural research and development are poorly utilized. Tillman (1980) reported that in December 1979 there were 170 agricultural scientists with Ph.D. degrees in Indonesia; 132 (78%) of these scientists were working in the universities. However, the universities have not been brought into a national plan that would provide stable and longtime financing for agricultural research. This is particularly critical because both IPB and UGM are initiating graduate training programs with research an important component. Without funds for research, the universities will continue to emphasize the pedagogic aspects of the higher degrees without putting emphasis upon solving, by research, the problems facing Indonesian farmers. This situation has a continuing constraint which can only disappear if all higher-degree candidates are sent out of Indonesia for their training -- an obvious impossibility.

Poor Individual Animal Performance

Many authorities believe that most livestock in Indonesia has been selected for survival rather than for production; this has led to genetic restraints which will require years to remove. Further research will be required under optimum

management conditions to discover whether or not the poor performance is genetic or a management-imposed constraint. Research results indicate that Ongole cattle make satisfactory gains when fed high-concentrate diets under good management conditions. They also perform satisfactorily under the traditional systems. It is time for the animal production specialists in Indonesia to initiate research that would determine how good or how poor the indigenous animals perform for productive purposes. Such research must be initiated as soon as possible so as to determine if, by selection, animal performance in the present breeds could be improved.

Poor Utilization of the Feed Resources

In much of Java, the crop residues from one ha of foodcrops, if used properly, would support a pair of working cows. To properly utilize these residues will require minor feed processing plus proper supplementation of the residues with protein-mineral-vitamin supplements. Both research and extension are needed in this area.

The outer islands appear to have a large forage resource base but, at this stage, there is doubt whether the leaders in the livestock industry have the research data and experience necessary to maximize profits using animals to exploit this resource.

Lack of Credit

The credit schemes must be expanded. The principal limitation for such expansion concerns the allocation of a budget and the shortage of trained manpower for evaluating and monitoring. The failure to transfer cows from Java to the transmigrants is not only reducing meat production but also reducing the production of food crops.

Marketing Constraints

The facilities for receiving and holding animals at many centers are in need of improvements. The ships for interisland transport are poorly equipped for hauling cattle, and their charges are too expensive.

Most of the slaughter plants are on Java; therefore, live animals must be shipped live from the outer islands to Surabaya or Jakarta. The building of abattoirs at specific collection points on the outer islands would be a step forward for livestock development:

(a) For about 4-5 months each year the seas are too rough for shipping, thus timely shipping is not possible.
(b) Weight and death losses in the holding centers and during shipping are excessive.
(c) Even in good weather ships are unpredictable; therefore, livestock spend variable times on the holding grounds.

Land Tenure

The system of land tenure in Indonesia permits land to be owned individually, as Adat land, and by the state. Individual land ownership is similar to that in the

western capitalistic countries but is often complicated by previous land grants to a Sultan or other potentate, such as exists in the special district of Yogyakarta (DIY). The GOI has no direct authority over Adat land but it does exert some degree of control over state lands. Even though land allocation is the responsibility of the provincial government, the department of Agraria within the Ministry of the Interior has to sanction and register all land transfers. The processes are expensive in time and effort.

The Adat land ownership is similar to that found in the tribal societies of Africa and elsewhere: families, or groups of families, regardless of land use, have rights to the land, and these rights must be satisfied if such lands are to be purchased or leased. Apparently the land in Sulawesi, Sumatra, and some of the Eastern Islands (East and West Nusa Tenggara) is held under this system. Such land, and the area is vast indeed, is available for development only after many expensive delays.

The state or provincial government appears to have much land but this land has incurred much squatting and/or illegal occupation. Since the GOI recognizes the right to compensation to such occupants if the lands are converted to other uses, the acquisition of state lands requires time and expense.

Acquisition of both the Adat and state lands is possible, but the system does not appear to be standardized. In all cases, compensation must be paid to the squatters if the land is to be acquired for development. In general, the governor of the province appoints a council that decides upon the level of compensation for each proposed acquisition. The FAO/World Bank (1978) study team reported that the present rate of compensation for each square meter for raw land (land invaded by alang alang) is Rp 50, which at the present exchange rate (Rp625/US dollar) is $800.00/ha, an expensive output for an area where the infrastructure for livestock does not yet exist. If the land is semideveloped, the price increases to Rp150/M^2, and if developed to Rp300/M^2. These serve as definite constraints upon development.

Private individuals or companies may apply for government land through regional and provincial committees, and the applications are sent to the provincial governor. When the application is made, the applicant pays a fee and the appointed council establishes the rate of compensation. In addition, the department of Agraria may make other charges.

The land can be assigned to the applicant under two alternate plans -- temporary occupation and leasehold. Both plans are limited to 22.5 ha for 25 years. Leases are renewable. Most of the leases in both Sulawesi and Kalimantan are on the temporary scheme, and the fees are Rp2500/ha of which Rp500 are payable upon application.

CHAPTER 11. DEVELOPMENTAL OPPORTUNITIES

The GOI and its donor agencies (both bilateral and international) have always given crop-oriented agriculture a favored priority in the agriculture budget. Despite the interest in crop agriculture, the subsistence farmers, who own almost all of the farm livestock, are aware of the importance of animal agriculture in their total farming system. They are especially aware of the value of livestock in providing money when needed for various social functions and as a hedge against inflation. Most of the subsistence farmers live on small farming units where feed resources serve as a constraint to the expansion of livestock numbers unless there are major changes in the processing and supplementing of present feed resources. In addition, the outer islands are underpopulated in both people and animals, a situation that, in other countries, has been instrumental in the development of extensive livestock units in ranching schemes. Developmental opportunities for livestock, therefore, exist in every area.

Feeding and Management of Indonesian Livestock

In order to increase Indonesian livestock production through improved feeding and management, attention should be concentrated on the following:

a. Identification of the quantity and quality of each feed resource available for livestock feeding in all areas and the effect on feed resources of shifts in different crop productions.

b. Dissemination of information to the farmer by well-trained and motivated people on the feeding values of new sources of forages and their use in supplementing the deficiencies of locally grown feeds. For example, farmers in Indonesia have discovered by themselves that *Leucaena leucocephala*, *Sesbania grandiflora*, *Gliricidia sepium*, and others can play important roles in their total farming systems. Many farmers, however, are unaware of the increased value of these high-protein feeds when used as supplements for low-protein feeds such as rice straw.

c. The importance of legume shrubs in a soil conservation/animal production scheme in the outcrops of the volcano mountains where severe water erosion causes flooding in the lowlands during rainy seasons and severe droughts in dry seasons. The combination of legume shrubs and exotic grasses on wide and permanent terraces could be used to produce feed for ruminants while the areas between terraces could be used for food crops.

   Ten critically eroded areas in Java are causing severe sociological and agricultural problems. The ultimate answer would be to return some of these eroded areas to forests, except that people live there and are producing food crops, primarily cassava, in a system that finds yields decreasing each year. These people cannot afford the cost of establishing forests nor wait until planted trees yield returns that would

sustain their needs. If smallholders could secure credit, they could shift into a soil conservation/animal production scheme using the legume shrub. In fact, the "paron" system of food crop/animal production now used on Timor, near Kupang, offers an indigenous system that could have application on Java. Both research and development need to proceed simultaneously here.

d. The development through research of good feeding and management systems for all animals kept in stalls in a zero-grazing system. In reality, this system is excellent for testing the feed value of different feeds available in Indonesia. For example, the feed value of leaves from the legume shrubs as supplements for the low-protein crop residues must be known before their proper utilization can be made.

e. Development of feeding and management systems for the specific biological zones or ecological systems in Indonesia. This endeavor will require research that must precede development; for example, the constraints on productivity of cattle and buffalo ranches on the outer islands (Section 9). The key problem is to maximize the utilization of the feed resources already present on these ranches rather than to use scarce inputs to increase the feed supply. Such an approach should have research data on the nutritive value of the outer island feed resources and on the condition scores of the types of animals consuming these feeds. Such data are essential for the successful operation of ranches on the outer islands.

GOI Developmental Services to the Livestock Industry

The livestock industry needs improved GOI developmental services for the following:

a. Animal health programs
b. Production-oriented research
c. Information on feed resources, both qualitative and quantitative
d. Quarantine procedures
e. University and technical training facilities and procedures at all levels
f. Integration of university and MOA-based agricultural scientists in a national agricultural research and development program
g. Extension services
h. Gene pool research to identify the productivity of the present indigenous gene pool as compared to the introduction of an improved gene pool
i. Marketing system to provide market sites, scales, standards, and health inspection, and the private sector to continue the actual marketing operations

Credit for Livestock Producers

Financial assistance (credit) for the expansion and upgrading of their livestock holdings would benefit the livestock producers. Chapter 10 discusses this barrier to increased livestock production.

Land Tenure

There is little doubt that compensation to the indigenous people, who previously used the land, is necessary when the land is used for other purposes. The present prices being paid, however, appear to be excessive in areas where the infrastructure would permit only grazing in extensive ranching schemes. Livestock development requires so much time that one questions if the present 25-year tenure on state lands is sufficiently long enough to attract private capital and expertise to develop extensive ranching schemes. Only the GOI can change the present system.

Indonesian Livestock Production

Improvement in livestock production is a management function that cuts across many disciplines:

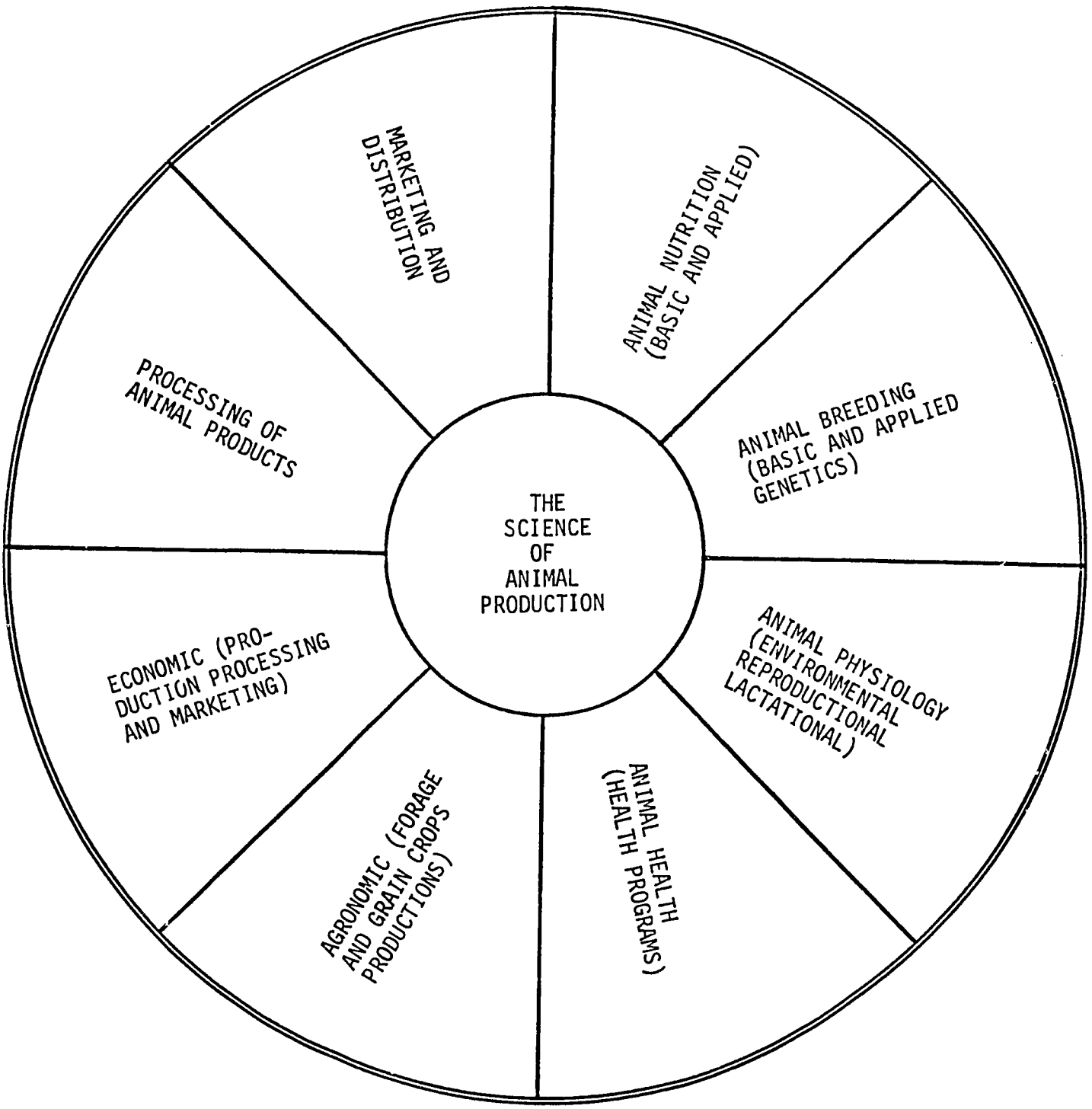
a. Animal nutrition
b. Forage and annual crop production
c. Animal genetics or animal breeding
d. Animal physiology
    1. Environmental
    2. Reproduction
    3. Lactation
    4. Egg production
e. Animal health
f. Economists
    1. Production
    2. Processing and marketing
g. Processing of animal products
h. Marketing and distribution

The many facets of livestock production can be shown best in Figure 4. With animal production placed in the center of the "pie," the slices (8) represent the disciplines or knowledge-base that are used by animal production personnel to obtain efficient production. It is obvious that the knowledge-base is established by research and/or by keen observations in the field. From previous discussions, it is apparent that there is a scarcity of keen animal husbandry experts who could in part obviate the need for research; nor is there sufficient research data on which to build successful production programs. The lack of animal husbandry experts and research data on animal production offers developmental opportunities.

Integration of Animal Production with Food Crop Production

In this area the farmers in Indonesia have more practical experience than the agricultural leadership. The lack of practical application is a major weakness in both animal husbandry and crop production curricula at the university level; both are overspecialized in academic subjects. The crop production curriculum

FIGURE 4: THE SCIENCE OF ANIMAL PRODUCTION



does not have basic courses in animal production, while the animal production curriculum has about 9 semester hours of course work in soils and forage productions; however, there is no emphasis upon food-crop production. Few attempts have been made by the two disciplines to integrate animal production with crop production. Integration of information from each discipline is especially important for professionals and subprofessionals who work in the extension services.

Animal Production in the Transmigration Areas

The numbers of transmigrants in South Sumatra and South Kalimantan have increased each year since the program began in the mid-1960s. The estimated number of GOI-assisted transmigrants was over one million people in 1977; this has now increased greatly. Most of the transmigrants have settled in Kalimantan, Sulawesi, and Sumatra.

The transmigrated families are involved in smallholder agriculture (Chapter 6), and many are settled in areas which permit only dryland agriculture. Since the soils are poor upland, their use presents problems which are unfamiliar to the farmers. Without draft cattle or buffalo, the farmers can prepare and cultivate only about 1 ha while the remainder is kept in the native grass, alang alang. Most farmers have neither draft animals nor hope of obtaining any without GOI credit and support.

The allocation of land has tended to vary from 2 to 5 ha per family. It is obvious that these farmers need large ruminants (Chapter 6) in their program. They also need help in working out cropping systems that would permit satisfactory yields with a minimum loss of fertility; these upland soils lose fertility quite rapidly if continuous cropping is practiced. The situation calls for the help of an international agency with experts in animal husbandry, agronomy, forestry, economics, and cropping systems, and an agency that could develop a viable agriculture through research on cropping/animal production systems. This work could be done near transmigration centers and on lands nearby where there would be no people living. However, people would be present in the nearby transmigration scheme when and if the systems were ready for the final test using people. This could be a major challenge to any international agency, as well as to the GOI.

Infrastructures on the Outer Islands

Needed improvements include:

a. Roads
b. Animal handling facilities
c. Shipping of meat and products
d. Building of abattoirs in select places equipped with processing and freezing units for shipping frozen meat to Java
e. Availability of drugs in animal health programs
f. Credit facilities

Increasing the Development of the Dairy Industry

The GOI will have to take the lead in bringing the smallholder's production of milk into the market channels that already import dry milk products and reconstitute them for sale in the larger cities. The problem is to train smallholders in sanitary milk-handling procedures. The small milk producers have reached a stage where they do understand the value of feeding a balanced diet of high-quality forages and concentrates to increase production. Feeding and management are the keys to increasing milk production.

Increasing the Production of Poultry and Swine

In the case of poultry, the gene pools are already present at reasonable prices to meet the requirements of the production process; most hybrid chicken companies have outlets in Indonesia and can more than meet the requirements for both broilers and layers. The variability of the quality of the feed supply is a definite constraint upon production of both broilers and layers. Rice bran is the most economical energy supplement but its quality is affected by two major factors -- the oxidation state of the unsaturated fats and the crude fiber level. A high level of crude fiber is indicative of the rice hull content of the rice bran. Since the hulls are indigestible by all animals, their presence exerts a negative effect upon the feeding value of rice bran. It would appear that the better grades of rice bran should contain less than 15% crude fiber. Many rice brans contain more than 10% ether extract as unsaturated fat; thus, rancidity occurs quite rapidly in the hot, humid climate of Indonesia. Rancidity can be reduced by the use of antioxidants, steam heating, and removal of the fat valuable for human consumption. The GOI must provide leadership in this area.

Since fiber level can be controlled by the milling process, the GOI needs to adopt a feed control law that would define the different grades of rice bran. The next step would be for the GOI to require the milking industry to sell rice bran products by grades for the benefit of livestock producers.

Fish meal is another product which has wide variability in quality. As with rice bran, fish meal should be sold by grade.

A feed and fertilizer control law similar to that used in the United States or other countries would help to standardize poultry feeds and rations in Indonesia, thereby removing a constraint upon production.

Lack of knowledge and standardization of feeds also serves as a constraint upon the production of swine. Even though the industry is small, it is led by some enterprising entrepreneurs who can adapt quickly to meet economic changes. As the demand base is small, the fluctuation in pork prices is the major constraint upon expansion. Standardization of feed quality is the major need in this endeavor.

Section VI. List of Acronyms

AAETE	Agency for Agricultural Education, Training, and Extension (Under the Ministry of Agriculture [MOA])
AARD	Agency for Agricultural Research and Development (Under the Ministry of Agriculture)
ANZDEC	Asian-New Zealand Development Corporation
BMT	Bina Mulya Ternak (Government owned ranching corporation)
BRI	Bank Rakyat Indonesia
CSIRO	Commonwealth Scientific Industrial Research Organization (Australia)
DGLS	Directorate General for Livestock Services
IPB	Institute Pertanian Bogor (The National Agricultural University of Indonesia)
LPP	Lembaga Penelitian Peternaken (Institute for Animal Production Research under AARD)
MEC	Ministry of Education and Culture
MOA	Ministry of Agriculture
MOPW	Ministry of Public Works
MOR	Ministry of Research
PPPT	Pusat Penelitian Dan Pengembangan Ternak (Animal Research and Development Unit in AARD under the MOA funded by Australian aid)
PUTP	Panca Usaha Ternak Potong (Cattle fattening programs)
SMTP	Secondary Agriculture Technology Schools
SPP	Secondary Agricultural Development Schools
UGM	University of Gadjah Mada
UNDP	United Nations Development Programme

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