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SMALL RUMINANT

COLLABORATIVE RESEARCH SUPPORT PROGRAM

INTEGRATED PROGRAM PLAN

PART IV

INDONESIA

Prepared by the Management Entity

PART IV

REGIONAL SUB PROGRAM

INDONESIA

TITLE XII

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

BACKGROUND

Indonesia, a humid/sub humid tropical archipelago with a population of 135 million people, is the fifth most populous nation in the world. Its 3,180,000 sheep and 7,480,000 goats are concentrated in the areas of the highest population density, the islands of Madura, Java and Bali. Java, with a population of 85 million people crowded on a land area the size of California, is the world's most densely populated island and its sheep and goats are numerically important and fill a vital economic niche. Most of the animals are raised in highly intensive, crop/livestock small holder backyard production systems with a common herd size of 2-5 head per owner. Increased herd sizes are found in areas where dry farming is practiced.

Farm sizes have been declining precipitously in Java in recent years and the current average size is .3 ha per farm. This has resulted in a large increase in the sale of the cattle and water buffalo formerly used for draft power because large ruminants are not economical on such small acreages. As farm sizes get smaller, intensive 'cut and carry', confinement or semi-confinement husbandry systems become well developed. Increased crop intensity and yields have increased the supply of crop by-products and residue yields available to feed small ruminants. Tree crops also provide a wide variety of livestock feeds as do grasses and leaves gleaned from hedgerows. Native grasses, legumes (Leucaena glauca, Sesbania grandiflora) and introduced grasses are also fed. Tree leaves and food crops which serve as livestock feed include: banana, bamboo, cassava, corn, cucumber, hibiscus, jackfruit and sweet potato. In addition to the widely practiced 'zero grazing' confinement system, there is some grazing encountered along road sides and other unused areas. Small ruminants are primarily a cash crop on Java, raised for their meat and manure and marketed rather than consumed by the producer.

Concentrates are rarely used, as land is at a premium for growing food or estate crops. There are three major cultivation zones on Java, defined primarily by elevation and each one is associated with corresponding crops. In the lowlands, wet rice farming predominates. On the upper elevation slopelands are grown the revenue producing estate crops; coffee, tea, cocoa, rubber and spices. The highlands are characterized by intensive vegetable production systems.

The breed types found on Java display a continuum from thin tailed hair sheep to fat tailed wool sheep. Although there are local breeds and types, there is considerable evidence of extensive crossing with exotic breeds. In West and Central Java, the native Javanese thin tailed sheep is prevalent. In West Java, is the thin tailed Priangan and the

Garut fighting sheep is an example of this type. In East Java are found descendents of the fat tailed sheep. One consequence of the crossing with exotics is the prevalence of some degree of wool on many sheep on the island but most of it is low quality and not harvested, although some carpet wool is produced and sold to local factories.

The Kacang goat is the indigenous type and Kacang Etawah crosses are also common. The Etawah is actually a cross between the Jamanapuri imported from India and better local Javanese goat varieties.

The wide range of diversity found in the small ruminant population on Java and their equally diverse feed supply provide challenging opportunities for the Small Ruminant CRSP to develop and implement innovative solutions to the problems encountered in the agricultural production system.

INTRODUCTION

Research results generated on the island of Java could be applied to humid/sub humid, tropical lowland areas in South East Asia, Africa and Latin America. Work conducted here has particular relevance to areas where intensive small holder, small ruminant production is practiced in conjunction with intensive cropping systems, the animals are housed in confinement, and there is widespread 'cut and carry' feeding of crop residues and by-products. Because the problems of small ruminant productivity in Java are multifaceted and interact in a dynamic and complex manner, a mulitdisciplinary research effort will be required to meet the goals of the Small Ruminant CRSP in this region.

AARD (Agency for Agricultural Research and Development), the Indonesian research agency with which the CRSP will collaborate, is a multidisciplinary organization. It emphasizes a coordinated approach to the study of the physical, biological, ecological, economic and sociological elements in the agricultural production system of which small ruminants constitute an important segment.

The US scientists working in Indonesia intend to collaborate among themselves and with their Indonesian counterparts. Research facilities, experimental animals and data collection and dissemination duties will in many instances be shared, particularly at the village survey and research station level.

The Nutrition and Breeding projects will cooperate on a study to compare the response of sheep and goats, as well as different breeds within each of these species, to different diets. The Health project hopes to use data from the Nutrition and Breeding projects to assess the effects of various levels of nutrition and management on animal health status under varying conditions. The Economics project will need data from the Breeding and Systems projects on animal productivity, from the Nutrition project on crop by-products and residues, from the Health project for information on disease problems and from the Sociology project for characteristics of farmer groups and organizations for their model of small farm crop/livestock production systems. Economics and Sociology will cooperate on marketing and technology transfer studies, interact to evaluate constraints on production and assess the potential impact of various kinds of alterations and interventions on the current production system. Sociology will cooperate closely with Economics and Systems in the areas of livestock production, marketing, consumption studies, farm decision making and similar production system components which extend beyond the province of any single discipline. Sociology will, in addition, provide relevant

field observation data to the Health, Breeding and Economics and Systems projects.

An important component of the small ruminant collaborative effort will focus on integrating economic and sociological factors with agricultural data obtained in the field, to both delineate the current small ruminant production systems and develop a coherent series of recommendations for improving animal productivity and marketing efficiency. These recommendations should consider how the elements which comprise the various production systems operate in relationship to each other to influence the functioning of the overall small ruminant production system on Java. Towards this end all the project participants will cooperate on a baseline study to characterize the entire small ruminant production system on this island, the data from which will be useful to each project when they make their recommendations for improvements of the system and will also be made available to Systems Analysis for the Production Systems Simulation Model.

This collective approach to confronting the severe constraints upon animal productivity in this densely populated, intensively cultivated environment should facilitate the development of an integrated research endeavor which views the various agricultural problems of the region from a comprehensive rather than an isolated perspective. Table 1 indicates the Indonesian institutions with which the CRSP has drafted official collaborative ties. Table 2 lists the US and Indonesian principal investigators (PI's), participating US and Indonesian institutions, and the research area upon which each individual project will focus.

TABLE 1

INDONESIAN INSTITUTIONS

AARD	Agency for Agricultural Research and Development
LPP	Lembaga Penelitian Pengembangen - Bogor
LPPH	Lembagan Penelitian Pengembangen Hewan - Bogor
IPB	Institut Pertanian Bogor
Regional Research Stations	Maraguwati Station Pangarasan Station
LPP Research Farms near Bogor	Cilabut Farm Cicadas Farm

TABLE 2

PRINCIPAL INVESTIGATORS	US INSTITUTIONS	INDONESIAN INVESTIGATORS	INDONESIAN INSTITUTIONS	AREA OF RESEARCH
Eric Bradford	University of California	Mr. Subandryo	LPP	Breeding and Genetics
		E. Triwulanningsih	LPP	
		Maria Astuti	Gaja Mada University	
		P. Sitorus	LPP	
		Dr. Asikin	IPB	
William L. Johnson	North Carolina State University	S. Rangkuti	LPP	Nutrition (By-Products)
		B. Haryanto	LPP	
		M. Siregar	LPP	
		A. Djadjanegara	LPP	
		M. Batubara	LPP	
Blaine McGowan	University of California	Information not yet available	Information not yet available	Animal Health
John DeBoer	Winrock International Livestock Research and Training Center	M. Sabrani	LPP	Economics
		A. P. Siregar	LPP	
		M. Panjaitan	LPP	
Michael F. Nolan	University of Missouri	M. Sabrani	LPP	Sociology
		M. Panjaitan	LPP	
Thomas C. Cartwright	Texas A&M University	M. Sabrani	LPP	Systems Analysis

PROBLEM

The primary animal husbandry system encountered on the humid/sub humid tropical island of Java is intensive production of goats and sheep in association with highly intensive crop cultivation. Decreasing farm size and the increasing human population combine to create a situation in which ever larger numbers of people must subsist on ever smaller parcels of land. There is little land available for grazing or fodder production hence the small ruminants on Java are kept in confinement and fed wide variety of readily available crop by-products and residues. Although there are no obvious signs of nutritional deficiency in the livestock during the rainy season, there may be mineral deficiencies and the animals do not display optimum productivity levels, growth rates, fertility or lactation yields given the available resources. For example, the local sheep are very fertile, but exhibit a reproductive performance well below their potential. More information is needed about the genetic potential, nutrient requirements and health problems of the livestock, the nutritional value of their common feedstuffs, and the socio-economic constraints in the production system. Until these poorly identified and understood factors are investigated,it will be difficult to implement modifications in the system which optimize return and yield the highest cost/benefit ratio from small ruminant production.

ANIMAL BREEDING AND GENETICS

Extensive crossing between local and exotic sheep and goat breeds has resulted in a continuium of genetic types on Java. Poor record keeping and a lack of large scale coordination in breeding plans has made it difficult to assess the genetic potential of the highly varied local stock. It will be necessary to devote more effort to improved selection programs to accomplish the genetic improvement needed to increase small ruminant productivity in Indonesia.

NUTRITION (BY-PRODUCTS)

There is little information available on the nutritive value of most common small ruminant feedstuffs on Java. There is also a lack of knowledge about potential animal productivity as influenced by levels and combinations of common and exotic feeds and what constitutes an optimum feeding regimen. Village sheep and goats are fed combinations of the most readily available feeds and there is as yet no organized system for optimum ration formulation using the many feeds at each farmer's disposal.

ANIMAL HEALTH

The effects of inadequate nutrition are compounded by disease and parasitism which deplete the animal's resistance to environmental stress and further hamper their performance. The animal health problems on Java, a humid tropical island characterised by intensive production include infectious and contagious diseases and parasites which cause gastrointestinal and reproductive difficulties, early kid mortality and decreased productivity. A project is currently being developed by the University of California, Davis to address these problems in a manner appropriate to the constraints they place on small ruminant productivity on Java.

ECONOMICS

In addition to the physical and biological constrants on animal productivity on Java, a lack of knowledge about various production and marketing mechanisms and demand characteristics for small ruminant products further limits potential production system improvements. More specifically, declining farm size, limited capital resources and lack of well organized systems for producng sheep and goats all combine to limit the ability of farmers to effectively utilize small ruminants to supplement their income on Java.

SOCIOLOGY

Social and cultural attitudes are important and play a vital role in determining the overall pattern of small ruminant husbandry. They exert considerable influence on the decision making process of small holders and more research is needed on specifically where and how these factors operate within the total framework of the small holder, small ruminant production system.

SYSTEMS ANALYSIS

Integration of improvements made in individual components of an animal production system by systems analysis techniques is a relatively new field of science which takes into account the interaction of many factors contributing to the function of the production system. Factors having major effects on small ruminant producing systems in Java, Indonesia include: disease and parasite stresses interacting with nutrition and breeding which further interact with management, marketing, and other socio-economic effects.

OBJECTIVES

The long range objective of the Small Ruminant CRSP in Indonesia is to increase the efficiency of production and distribution of small ruminant meat, milk and fiber in order to increase the food supply and raise the income of the small holder. The problems will be addressed by investigating the areas of the production systems which are amenable to modifications leading to improved animal performance and product delivery. All the investigators involved in Indonesia will conduct research to further clarify the present conditions in the productions systems, explore innovations which could improve them, and produce results applicable to Java as well as other areas with similar conditions.

The projects are designed to be compatible with LPP guidelines, interdisciplinary in nature, and have LPP and SR-CRSP personnel collaborate closely with each other on their projects and with the personnel of the other projects. The primary focus of the research will be to define the constraining factors limiting production, in order to increase the population's nutritional levels and optimize productive and economic return. The present quality of the livestock, the current production and marketing systems and available supporting services will be more clearly defined in order to better understand the factors affecting the numbers of sheep and goats kept and marketed, and the potential for animal improvement. Ultimately, the SR-CRSP will ascertain in what manner improvements in productivity and economic return to the farmers could be facilitated by improved breeding programs, feeding systems and animal health practices.

The researchers will train US and Indonesian graduate students, and increase the knowledge and competence of US and Indonesan project participants. The problem of the limited resource farmer engaging in small ruminant production will be better understood, particularly those interactions of the systems' components and constraints which are of critical importance to productivity. Finally, it is important that the research results be accessible to the wide range of people who need to understand and implement them. Seminars and short courses will be conducted. Published research papers and technical reports in English and Bahasa will be made available in the US and Indonesia. In this way a large number of people can derive benefit from the collaborative efforts of AARD and the Small Ruminant CRSP.

ANIMAL BREEDING AND GENETICS

The Breeding project will characterize the performance of major, local sheep and goat types under different levels of feeding (i.e. varying dietary fiber content) and management under both experiment station and village conditions. They will compare exotic, local/exotic crosses and pure local types for fertility, viability and productivity including the effects of varying amounts of wool on animal performance. A plan to more effectively utilize the large existing genetic variability available in the Java small ruminant population will be implemented and organized in order to improve productivity and return. Characterization studies defining local breeds and crosses will facilitate the estimation of genetic parameters, indicate the value of exotic breeds, identify superior and well adapted types and lead to the development of selection and improvement programs which will increase small ruminant productivity under Javanese conditions.

NUTRITION (BY-PRODUCTS)

The Nutrition project will characterize the nutritive value of feedstuffs commonly available to small ruminants on Java, particularly crop by-products and residues. This evaluation will include protein, fiber and mineral composition. This data will then be used to develop guidelines for formulation of balanced maximum profit rations which meet the nutrient requirments of various types of sheep and goats at different levels and stages of their productive life using mixtures of Java's prevalent feed sources. In addition, the reliability of simple feed analyses to predict animal performance will be tested.

ECONOMICS

Using data from all the projects, the Economics project will describe the physical, biological, organizational, and socio-economic aspects of the existing small ruminant production system. They will also undertake long term production economics, farm management studies which:

1. provide input into technology design and evaluation
2. consider resource use problems on small farms practicing intensive crop production
3. model the physical and financial aspects of the various production systems on Java.

Additional long and short term studies which examine the factors constraining the potential contribution of small ruminants to the small farm sector will also be conducted. Long term studies include an investigation of marketing and pricing practices of sheep and goats and their products. Short term studies on the impact of specific production system constraints on the small ruminant producer will be conducted to assess their effect on the relative profitability of small ruminants, and the feasibility of including small ruminant production in various resettlement schemes on the outer Indonesian islands.

SOCIOLOGY

A general sociological constraint of primary importance is that any proposed technical modifications of the present small ruminant production systems in Java do not disturb the cultural fabric of small holder society to the extent that they are harmful rather than beneficial. Such potential dangers will be studied in depth with the objective of defining the small ruminant production systems and then recommending the manner in which needed improvements could be implemented so the changes they bring to the local population remain positive and if possible, within the context of traditional patterns.

SYSTEMS ANALYSIS

Computer simulation models of livestock production systems have been successfully used to increase the effectiveness of research efforts by identifying knowledge gaps and establishing research priorities and needs. In addition, validated computer simulations can be used for baseline simulations. Model applications of specific interest include the evaluation of production systems that incorporate goats and sheep into mixed enterprise production units on Java. This evaluation will include the assessment of traditional and alternative management practices, feed resources and supplementation programs, available breed types and application of research results. As appropriate, small ruminant production systems will be evaluated with primary emphasis on integration of a secondary livestock enterprise into mixed enterprise production units.

APPROACH

A number of the approaches taken by the participants are common to the entire group while others are project specific. Maintaining open lines of communication among all the projects will facilitate the collaborative collection and integration of village survey data, an effort in which all the projects will participate. Cooperation in the villages and at research and field stations include the sharing of animals, expertise, and facilities and the standardization of experimental and analytical procedures and techniques. These village studies set up in association with field stations, will be located in regions of Java which represent the three major ecozones on the island and their attendent cultivation patterns. In addition, all the projects will support US and Indonesian students for graduate study, conduct literature searches on topics relevant to their research area and review the available data in their field for inclusion in the baseline survey. All projects will cooperate to gather data on animal performance, quantity and quality of available feed and other essential inputs, marketing systems and social factors. Specific information which after it is collected will be used by all the participants includes:

1. Rainfall and temperature data.
2. Approximate area and consumption pattern (family vs sale, in or out of village) for the locally cultivated crops.
3. Number, sex, weight and approximate age of animals in each herd or flock.
4. Family labor patterns in the care and feeding of the animals.

The following specific approaches will be employed by the component projects of the SR-CRSP to enable them to fulfill their objectives.

ANIMAL BREEDING AND GENETICS

The effect of many physical and production variables on reproduction and growth will be analysed. All sheep, whether in the villages or at the research stations, will have the following characteristics recorded.

- number of lambs/parturition
- degree and distribution of wool
- ear length
- color pattern
- polled/horned

- presence of obvious defects (jaw)

In addition, sheep on the research stations will have the following variables measured:

- conception rate
- lamb survial by litter size
- body weights
  - -- birth
  - -- monthly intervals to six months
  - -- three month intervals thereafter
- age at puberty
- estrous activity

Sheep in the villages will also have measured:

- frequency of lambing
- age and weight at marketing

The performance of pure fat tailed vs Dormer/fat tailed crosses, fat tailed/heavy fleece vs fat tailed/woolless and fat tailed vs thin tailed sheep will be compared using the same variables as were recorded for the sheep on the research stations. Performance tested research station rams will be progeny tested in the villages to ascertain the validity of ranking groups and rating individual performances of animals which must function in the field, under experiment station conditions.

NUTRITION (BY-PRODUCTS)

A survey of the various types and frequency of feedstuffs on Java will be conducted to catalogue and sample the range and diversity of available feed resources. Feed samples and intake data from a few randomly selected owners will be collected and recorded. The laboratory facilities at LPP Bogor will be strengthened to enable the Nutition project to perform the following analyses on samples of typical small ruminant feeds:

- Dry Matter
- Total Ash
- Total Organic Matter
- Neutral Detergent Fiber (NDF)
  (Total cell wall constitients)
- Acid Detergent Fiber (ADF)
  (Cellulose, lignin and acid insoluble ash)
- Hemicellulose (NDF-ADF)

- Mineral Analyses
  Ca, P, Mg, Mn, Zn, Cu, Co, Fe
- Ether Extract
- In vitro digestibilities

Animal performance data needed for ration formulation will be acquired by studying the body weight response of young sheep and goats at the age of highest growth rate (maximum rate of muscle deposition) to rations with varying energy levels. At least two energy levels will be examined and the diets will be composed of representative feedstuffs commonly used on Java. In vivo and in vitro digestibilities, ad libitum intake and estimates of digestibiligy of dry matter, organic matter, NDF and gross energy will be measured. Feed preference trails will also be run to determine the relative degree of small ruminant preference for various feeds.

ECONOMICS

A baseline survey of the traditional production systems as well as those farms using some aspects of improved technology will be initiated by the Economics project. This information will be used in combination with experimental data, to construct linear programmed physical/financial models of the various production systems. Farm surveys will be used to collect information on resource requirements for various activities and to quantify constraints during each part of the year for the farm management, production economics study. Specialized studies designed to investigate the effects of specific off-farm production system constraints on rural credit and governmental price policies for agricultural products, production risk and farm credit will also be conducted.

SOCIOLOGY

Several types of intensive field work, including in depth observations and survey techniques, will be employed to define small ruminant production systems. Field studies related to key socio-cultural constraints to increased small ruminant production will be conducted from both a small farmer and structural socio-economic perspective. Special emphasis will be placed on examining small holder risk decision making, the role of women and children and how they influence the function of the system, the role of small ruminants in the rural communities' social fabric and production strategies among landless people compared to land holders. In addition, various types of small ruminant husbandry systems will be compared including those found in rice producing and non rice producing areas. The Garut fighting sheep of West Java will also be studied. Finally, the

project will perform evaluation studies on the proposed and implemented production system alterations and interventions designed to increase small ruminant productivity.

SYSTEMS ANALYSIS

Dynamic, comprehensive, mathematical models, based on biological functions, will be developed both for sheep and goat production systems with the individual animal as the modeling unit. Production data collected on Java will be used to validate model input parameters. Input data specific to each location and management system related to forage qualities through time, growth and lactation parameters and management policies, are required for the validation process. The validated simulation will serve as baseline data. Further simulations with varying inputs will then be used to identify the research required to develop techniques to accomplish specific objectives, synthesize alternative and ecozone specific production systems, and supply biological input and output data of traditional and altered production systems for use by the Economics and Sociology projects in such analyses as production efficiency studies. Specific production system components and alternative practices to be examined include:

- improved supplemental feeding
- use of cultivated forages
- disease control programs
- the optimum breeding season
- the value of exotic breeds and crossbreeding
- weaning, culling and marketing at younger ages
- market conditions and social customs

INDICATORS

The major activities which demonstrate that the investigators are engaged in an on-going research effort include:

1. Searching the literature and available records for information pertinent to each component's needs.
2. Gathering data and observations for inclusion in the baseline survey and computer simulation models.
3. Conducting planned experiments using animals located at the field stations and in the surrounding communities.
4. Surveying and defining the important characteristics of the market structure and the social system.
5. Implementing alternatives in the current production system that their research results indicate could improve productivity and efficiency.

ASSUMPTIONS THAT OBJECTIVES CAN BE MET

1. That the US and Indonesia can establish an effective collaborative research support program.

2. That there are sufficient numbers of trained personnel and potential students interested in pursuing research on small ruminants in the context of the limited resource producer.

3. That there is currently an adequate supply of information to successfully launch the initial baseline survey and that active research programs presently in existence will be continued and strengthened.

4. That research and field stations at which basic and applied research can be conducted will be provided, including the provision of adequate land, laboratory facilities and flocks of reasonable sizes.

5. That good relationships will be maintained between the investigators and the local communities so production data and breeding records can be compiled and broadly based, applied research can be conducted and implemented on large flocks in a practical setting.

6. That there are trained project leaders and personnel to oversee the daily operations of the research projects, maintain records, and insure the continuity of the research effort.

7. That the local farmers with whom the investigators work cooperate with field survey and production data gathering efforts.

8. That those components of the small ruminant production system under investigation are able to respond to alterations in a positive manner.

9. That the necessary cultural adjustments and technology transfers to implement the suggested improvements in the small ruminant system can be made.

10. That once research is completed, all those involved in its implementation support extension efforts to institute changes in the husbandry practices of the small holders.

11. That USAID will continue funding the project over a period of time sufficient for data to be collected and integrated, practical applications implemented, and the net effects of the alterations of the production system analyzed.

12. That inflation be adequately accounted for in the allocation of funds to support the SR-CRSP.

13. That political stability in Indonesia and the US government's view of Indonesia continue for the duration of the SR-CRSP.

ASSUMPTIONS THAT MEETING THE OBJECTIVES WILL SOLVE THE PROBLEM

1. That the project participants have chosen to investigate, in an integrated manner, appropriate areas of small ruminant production systems. In particular, that the research will be conducted on those points where constraints operate and junctions at which critical components interact. For example, it is assumed that several scientists obtaining information on the seasonal dietary preferences of grazing animals, the nutritive value of feeds, rumen function, and availability of by products, will lead to formulation of appropriate supplementation practices that when implemented will indeed correct nutritional problems.

2. That presently existing and newly SR-CRSP acquired knowledge and technology could, with further research overseas, be placed in a context appropriate for implementation in tropical, semi-arid areas. For example, in other LDC's there are currently improved native breeds of livestock which clearly demonstrate that sound breeding techniques can be applied to many types of native animals to improve productivity.

3. That students and faculty trained in the SR-CRSP in Indonesia will remain active in their fields and continue to contribute their expertise in an effort to increase the productivity of limited resource, small ruminant production systems.

4. That the Indonesian government provides adequate funding and incentive to implement changes in the limited resource farmers' production methods by supporting grazing control measures, genetic improvement and preventive flock health programs and the establishment of appropriate economic policies with regard to price supports, marketing institutions and reliable credit.

OUTPUTS

The outputs of the Small Ruminant CRSP will be the accomplishment of the objectives stated in the previous chapters and specifically referred to in the original project plans appended to this report. The results of the research will be made available through the publication of progress reports, documents and journal articles written on several levels to suit the people, AARD, scientific researchers, laboratories, extension officers, and local farmers. Extension efforts will include short courses, seminars and discussion, particularly for those people who are directly responsible for transferring new technology and methodology to the limited resource producer. There will be an increase in the number of trained students, and the level of competence of all those involved in the Small Ruminant CRSP.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Genetic Improvement of Small Ruminants for Intensive Production Systems in Indonesia

Status: New Project

Sub-Grantee: University of California, Davis
Davis, California 95616

Principal Investigator: Eric Bradford

Duration: Two year minimum with planned extension of five years.

II. The Problem

Sheep and goats are numerically and economically important in Java. Local breeds or types of both species exist, but current populations show considerable evidence of crossing with exotic breeds. In the case of goats the small Kacang goat has been crossed extensively with the Ettawah, a large goat of the Jamnupari type, imported from India earlier this century. In sheep, both the thin-tailed and fat-tailed types include individuals of the hair or woolless type which is believed to be better adapted to a warm, humid climate. However, crossing with various wool breeds over the years has resulted in a high proportion of animals with wool, which is of low quality and in most cases is not harvested. In neither species is there a segment of the industry devoted to genetic improvement and dissemination of improved stock, although Regioanl Breeding Centers with these objectives have been set up very recently.

There is a real need: 1) to characterize the local types under different levels of feeding and management, 2) to determine how the exotic-local crosses being produced compare with the pure local types in fertility, viability and productivity, and 3) to develop a plan and an organization to utilize the large amount of genetic variability available to improve productivity of these species for Indonesian conditions.

III. Objectives:

1. To characterize the performance of the major types of Indonesian sheep and goats under experiment station and village conditions. The types of sheep to be studied include Priangan (thin-tailed) and fat-tailed, and of goats, Kacang and Ettawah.
2. To compare the performance of sheep and goats on rations varying in fiber or other constituents.
3. To evaluate the effects of amount of wool on performance of sheep in Indonesia.

4. To estimate genetic parameters, and develop programs for the continuing genetic improvement of the most productive types identified under (1).

5. To provide animals of known breeding, age, and treatment for CRSP experiments in other disciplines such as nutrition.

In addition to these research objectives, it is planned to review opportunities available in Indonesia for training in sheep and goat husbandry and data recording, and to offer short term training in these areas. This could take the form of either an internship in California for one or two Indonesians who would then serve as instructors in Indonesia, or a short course in Indonesia for research and Breeding Center personnel.

IV. Approach

The project will be collaborative between U.S. and Indonesian scientists, and among disciplines. It is expected that the work will involve LPP Stations, Universities (Gaja Mada and possibly IPB and Pajajaran), Regioanl Breeding Centers, and cooperating villages.

V. Procedures

Objective 1 will be emphasized during the first year; work on some of the other objectives may also be started during the first year.

1. Sheep

Characterization of breeds of sheep will be initiated at the LPP Station at Cicadas by comparing thin-tailed (Priangan) and fat-tailed types. Fifty ewes and a minimum of 5 unrelated rams of each type will be assigned to a project to measure:

Conception rate
Number of lambs born per parturition (litter size)
Lamb survival, by litter size
Lambing interval
Weights at birth, at monthly intervals to 6 months, and at 3-month interval thereafter

Age at puberty and estrus activity will be recorded if the necessary labor is available for daily checking.

Degree and distribution of wool covering will be recorded on all mature sheep and on lambs at 3, 6 and 12 months of age.

Other characteristics including color pattern, ear length, presence or absence of horns and jaw defects will be recorded on adult sheep and on lambs born in the project, at birth or at weaning.

Assuming a working relationship can be developed with the Margawati Station, data as described above will be recorded on all sheep at the Station. This will be for the purposes of:

a) characterizing the Garut strain of sheep

b) evaluating the effects of inbreeding, by comparing performance of matings between animals coming from the same and from different villages.

c) initiating a selection program to increase growth rate and incidence of multiple births in Garut sheep.

At a later stage, performance-tested rams from the Margawati Station may be progeny tested at Cicadas, and in villages if effective collaboration with sheep owners in villages has been established.

If it is of interest to the management of the Jember Station in East Java, CRSP Breeding Project personnel will collaborate in collection and anlysis of data on the sheep at that Station and in development of a selection program for the flock.

Work at the Pangarasan Breeding Center in Central Java will depend on:

-establishment of defined breeding goals for that Station

-availability of adequately trained personnel resident at the station to supervise a breeding program.

Work at Pangarasan would be directed toward identification of the most productive of the various types of sheep now kept there, and multiplication and improvement of that type. Assuming the Station is capable of supporting 600 breeding ewes on a year round basis with purchase of only a small amount of concentrates, possible

comparisons which could be made there include:

a) fat-tailed vs. Dormer x fat-tailed and Suffolk x fat-tailed crosses

b) heavy fleeced vs. wool-free sheep, within the fat-tailed type

c) fat-tailed vs. thin-tailed

Comparison of such groups could be carried out with multiple sire mating groups if individual sire gorups are not feasible. However, the groups to be compared would have to be maintained as separate breeding flocks.

The objective of work in the villages will be to record numbers of lambs per parturition, frequency of lambing, weight of lambs at intervals of one (or two) months, and age and weight at marketing. All sheep involved in village studies will be scored with regard to amount of wool, ear length, color, horns, and presence of any obvious defects, and the effect of these variables on reproduction and growth evaluated.

In a second phase, dependent on estimated feasibility based on work during the descriptive phase, comparisions of two or more rams via a progeny test within villages will be attempted. This will provide a test of the validity of rankings of groups or individuals under experiment station conditions.

2. Goats

Evaluation of goats will parrallel those for sheep, with the deletion of wool and addition of milk production as variables to be measured.

A major difference between Ettawah and Kacang goats is in size. In addition to measuring the reproductive and feed conversion efficiency of these two types, the effects of size on gross and net income and on producer acceptance will be assessed, in collaboration with those working in the socio-economics area.

Work with goats is tentatively planned for the LPP Station at Cilabut. A desirable resource not yet identified is a Breeding Center for goats capable of supporting 200 or more breeding females, for multiplication and more extensive breed evaluation. If such a unit is not available, it may be possible to expand the

village program.

Following preliminary evaluation of the Ettawah goats available in Java, it may be worthwhile to import breeding males or semen of improved strains of the Jamnupari breed from India, with the objective of increasing either milk or meat production through increasing the genetic potential for milk production. This would probably not be undertaken before year 2 or year 3.

Another breeding objective for the Ettawah goats is to reduce the incidence of jaw malformation (undershot jaw), by selection and outcrossing.

3. General

It is planned that evaluations of sheep and goats at the LPP Stations (and probably also at the Regional Breeding Centers) will be carried out under conditions of predominantly forage diets, with concentrate feeding only if necessary to prevent pregnancy toxemia or excess mortality of young animals. Genetic potential of the types of sheep and goats described has been measured recently on a high plane of nutrition at P3T (Obst, personal communication) and does not need to be repeated. The experiments proposed should complement rather than duplicate the work done at P3T.

Some of the data collected will be suitable for estimation of genetic parameters, and it is planned that this work will be focussed at Gaja Mada University; this phase will probably not begin before the second year. Collaboration with faculty and graduate students at other Universities in specific aspects of the research will be welcomed as opportunities develop.

Work on objectives 2 and 5 may not be initiated until the second year. This work will be collaborative with other projects; for example, objective 5 of the NC State project on Nutrition is very similar to objective 2 of this project.

VI. Personnel

UCD: G.E. Bradford and J.M. Levine

LPP: P. Sitorus, Subandryo, and Endang Triwulanningsih

Gaja Mada University: Maria Astuti

It is hoped that personnel from IPB Bogor and Regional Breeding Center will also participate as the project develops.

VII. Expected First Year Achievements and Outputs

1. Establishment of flocks of thin-tailed and fat-tailed types of sheep at Cicadas.
2. Establishment of breeding groups of the Ettawah and Kacang types of goat at Cilabut.
3. Development of weighing and data recording systems at these two stations, and a procedure for estimating milk production at Cilabut.
4. Establishment of working relationship with one or more of the Regional Breeding Centers (Margawati, Jember, Pangarasan).
5. Collection of base line performance data on sheep and/or goats in two to four villages.
6. A preliminary analysis and report on the effects of degree of wool covering on performance of sheep in Java.
7. Identification of members of LPP staff or other Indonesians for both short term and longer term (M.S.) training, and initiation of training activities.

VIII. Assumptions

Achievement of first year objectives will depend on:

1. Availability of expected funding (section VIII)
2. Availability of expected personnel (section V)
3. Successful organization and implementation of the Village Survey being developed collectively by CRSP participants.
4. Purchase early in the year of project vehicles, and of equipment and livestock described in the project plan.

IX. Funding

1. Items to be funded by UC Breeding Project:

   Salary and travel of Principal Investigator, and Assistant Research Geneticist located in Bogor

Vehicle (jointly supported by U.S. projects)

Needed imported equipment and supplies, including:

scales for each of principal work sites (portable)

ear tags and other identification supplies

A portion of the village survey costs

Data processing

Purchase and transportation costs of any imported animals or semen

Travel and salary for workshop participants or other temporary personnel from the U.S.

One Research Assistantship for an Indonesian student admitted to the M.S. or Ph.D. program at the University of California, plus fee and travel

Specific thesis research costs for an Indonesian or U.S. graduate student doing dissertation research in Indonesia on this project.

2. Items from Indonesian funds (AARD/LPP, Regional Centers, Universities):

Animals

Labor for animal care

Feed

X. Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Sheep and Goat Nutrition and Feeding Research in Indonesia

Status: New Project

Sub-Grantee: North Carolina State University
Raleigh, North Carolina 27650

Principal Investigator: William L. Johnson

Duration: Two year minimum with planned extension of five years.

A. The Problem

Goats and sheep on the island of Java, which comprises the largest small ruminant production area of Indonesia, are raised in very small flocks, usually confined to the backyards of villagers' homes. Their owners may be small landholders or landless, but in either case they have very limited feed production resources. Small ruminants are fed a wide variety of materials, including native grasses, introduced grasses such as *Pennisetum purpureum*, legumes such as *Leucaena glauca* and *Sesbania grandiflora*, and the leaves of trees and food crops, including jackfruit, cucumber, sweet potato, hibiscus, cassava, banana, corn, and bamboo. Seldom are concentrate supplements fed to sheep or goats. Most feeding is in confinement under a cut-and-carry system, although animals may also be allowed to graze native grasses along roadsides or in other unused areas.

With such a wide variety of materials in the diet, severe nutritional deficiencies do not seem to be a great problem and the animals in villages appear in reasonably good condition, at least during the rainy season. However, it is not known whether present productivity levels (growth rate, fertility, lactation yield) are economically optimum or whether interventions in present feeding systems could bring greater economic returns to the farmer. Also, there are known periods of nutritional stress for animals during the dry season, especially in East Java and parts of Central Java, which could be alleviated by improved feeding systems.

There is a scarcity of objective data about the nutritional value of most of the common feedstuffs for Javanese small ruminants. Likewise, little is known about potential animal productivity as influenced by levels and combinations of common or exotic feedstuffs. Rationing systems for sheep and goats in the villages are presently designed very much on an *ad hoc* basis. There is, then, a great need for research data on the availability, nutritive value, and productivity-influencing parameters of all Indonesian feedstuffs presently or potentially used for sheep and goats.

B. Research Objective

The long-term objectives of the North Carolina State University nutrition and by-products project within the SR-CRSP are as follows:

1. To characterize the nutritional value of by-products, crop residues, and other common feedstuffs that are available for small ruminants in the target countries and to determine the relative importance of factors which contribute to variability in nutritive value of such materials.
2. To develop guidelines for the formulation of balanced, maximum-profit rations for various types and classes of sheep and goats, utilizing by-product materials to the economically optimum level, and to determine the expected productivity of animals that would consume these rations.
3. To study methods of storage which will maintain the nutritional value of residue and by-product feedstuffs, and methods of treatment which may enhance their intake and digestibility.
4. To test the reliability of simple feedstuff evaluation parameters for prediction of animal performance.
5. Insofar as permitted by the studies implied above, to generate information on the nutritional requirements and comparative efficiencies of sheep and goats of various types, breeds, and productive life stages.

For the first year of work in Indonesia, the objectives are as follows:

1. By means of survey activities in several villages of Java, to gain more precise information about the feedstuffs which are presently being utilized for sheep and goats.
2. To determine the protein, fiber and mineral composition of feedstuffs commonly used in villages of Java.
3. To study the growth rate response of sheep and goats when fed varying energy levels, with rations composed of feedstuffs commonly available to village smallholders.

4. To evaluate the palatability and relative preference for certain common feedstuffs by sheep and goats.

C. Approach (First year objectives)

Objective 1

Village survey activities are planned as an integrated project of all disciplines of the SR-CRSP. The data collected about feeds and nutrition is hoped to include the following observations in each village:

1. Animal census (all livestock).
2. Numbers, sex, weights and approximate ages of sheep and goats in each herd or flock.
3. Crops grown, approximate areas (or other appropriate measure) and whether consumed by the family or sold, within or outside of the village.
4. Rainfall and temperature data.
5. Family labor use patterns in care and feeding animals.
6. Kinds of feedstuffs being used and frequency. All feeds will be sampled and dried according to standard procedures (to be developed) and retained for laboratory analysis. It is hoped that the cataloguing and sampling of feedstuffs can be extended to several villages not included in the in-depth interdisciplinary production system description.
7. For a few randomly selected sheep and goat holders, to obtain quantitative information on amounts of feed consumed by the animals each day.
8. Subjective observations of any nutrition-related problems observed in the animals, to be follwoed up by blood and tissue analyses, if deemed necessary.

Objective 2

Laboratory facilities must be strengthened at LPP, Bogor, to be able to conduct all desired analyses. It is expected that site development funds available through Management Entity can be obligated for this purpose.

Certain analyses (especially for mineral work) may be accomplished at Gadja Mara University in Jogjakarta, if suitable arrangements can be worked out. Also, the P3T laboratory would hopefully be available for certain less common analyses (e.g. oxalates, tannins, or other possibly toxic elements).

The complete chemical profile of feedstuffs should include the following determinations:

Dry matter

Total ash (and organic matter)

Total cell-wall constituents (neutral detergent fiber)

Cellulose, hemicellulose, lignin and acid-insoluble ash (by acid detergent method)

Ca, P, Mg, Mn, Zn, Cu, Co, Fe

Ether extract (crude fat)

For a selected set of samples, Weende crude fiber may be determined to facilitate comparisons of NDF or ADF values with CF data already accumulated in the literature.

In vitro digestibilities will also be determined by an appropriate method, either that of Tilley and Terry, Goering and Van Soest, or Minson and McLeod. The laboratory at LPP should develop the capacity for all three methods.

Objective 3

Initially, sheep and goat performance trials will be conducted at the two LPP farms near Bogor (Cilabut and Cicadas) in coordination with breed and genotype evaluation studies. Young animals, at ages of maximum muscle tissue deposition rate, will be used. Plane of nutrition levels will be balanced across phenotypic groups; treatment effects and treatment X genotype interactions will be sorted out by least-squares analysis. If possible, more than two levels of energy input will be used in order to allow detection of curvilinear response, if present.

Rations used in these trials will be subjected to *in vivo* digestibility determination, using animals of similar age and phenotype to those used in growth trials. *In vitro* digestibility will also be determined. The *in vivo* trials will be conducted at *ad libitum* intake, and estimates made of digestibility of dry matter, organic matter, total cell-wall fraction, and gross energy, as well as voluntary intake.

Objective 4

At LPP, a series of preference trials will be initiated wherein sheep and/or goats are offered two or more of several feedstuffs. A design will be used which will allow observations of relative degree of preference, as influenced by the presence or absence of other feedstuffs. Samples of feed offered and feed refused will be analysed for content of dry matter, crude protein, and total cell-wall constituents. The possibility of selective intake within a particular feedstuff will also be looked for.

Complementary research at North Carolina and in Brazil

The NCSU nutrition project of the SR-CRSP is also involved in research activities in Sobral, Ceara, Brazil, and on the home campus at Raleigh, North Carolina. Work at all three sites is designed to be complementary toward the efficient achievement of the five-year objectives listed above. This is in keeping with the collaborative philosophy of the SR-CRSP, recognizing that results will be partially site-specific, but will also contain elements of mutuality of benefits for all regions of the world where small ruminants have a present or potentially important role.

D. Personnel

For LPP, the overall coordinator of SR-CRSP activities is Dr. Panjaitan. Mr. Rangkuti is head of the Nutrition Section, and Mr. M.E. Siregar is head of the Forages and Fodder Crops section.

For North Carolina State University, Dr. W.L. Johnson is the Principal Investigator. Drs. Lemuel Goode and W.J. Croom are on-campus collaborators.

It is anticipated that North Carolina State University will place a post-doctoral nutritionist in Indonesia by mid-1980, to assume a co-leadership role for research activities within the country.

Nutrition-related activities at IPB University (Bogor) are under the leadership of Dr. Toha Sutardi. At Gadja Mara University, Jobjakarta, Dr. Soekanto Lebdosoekojo is head of the nutrition section. At Padjadjaran University, Bandung, Mr. Tahjan Usri and Dr. Soeharsono, head of the Nutrition and Physiology sections, respectively, provide leadership for nutrition research.

At a meeting held at LPP in February, 1980, the following co-leadership assignments were tentatively agreed upon for the various research activities:

Research Activity	Indonesian Co-leader	Year of Implementation
1. Animal feeds and nutrition survey at village level	Rangkuti, Soemanto	1980
2. Laboratory development and management (LPP)	Andi Djajanegara	1980
3. Animal performance trials	Leo Batubara	1980
4. Animal preference trials	Budi Haryanto	1980
5. Protein requirements and utilization	Toha Sutardi (IPB) Andi Djajanegara (LPP)	1980 or 1981
6. Mineral requirements and utilization	Soekanto (Gadja Mara)	1980
7. Fiber and energy utilization	Hamzah Puluman	1981
8. Marginal lands, plantation and forestry areas	M.E. Siregar Bambang Prawiradiputra	1981
9. Environment/Nutrition interactions	Soeharsono (Padjadjaran)	1981
10. Village level testing and flock demonstration	?	1982

In keeping with the training objectives of the SR-CRSP, the participation of Indonesian, American, and third-country students will be encouraged to the maximum extent possible. These may be students at the Baccalaureate, Master's,

or Doctoral level in Indonesian Universities, or Ph.D. candidates at NCSU or other U.S. universities. Appropriate portions of the research to be conducted in Indonesia may be used as thesis projects for any of the above. Indonesian M.S. candidates in the United States will be encouraged to work on a research problem related to the overall objectives of the nutrition project in Indonesia. Ph.D. candidates from Indonesia, the United States, or other countries, will be encouraged to complete their course work in the U.S. and then undertake thesis research in Indonesia. The participation of Ph.D. candidates from neighboring Asian countries is seen as a practical way to extend the influence of the SR-CRSP within the South and Southeast Asian region.

E. Indicators and Outputs

The first year of work in Indonesia will coincide with the second subgrant budget year, which extends to September 30, 1981. By that time the following outputs are anticipated (subject to the assumptions set forth in the next section):

1. Cataloguing of feedstuffs commonly used in Javan villages and preliminary nutritional information about their nutritive value.
2. Upgrading of laboratory facilities at LPP for nutrition and forages research.
3. Protocols in place for routine chemical analyses, *in vitro* and *in vivo* digestibility, preference trials, and voluntary intake measurements, as steps in the nutritional evaluation of feedstuffs.
4. Protocols in place for animal performance trials.
5. Collaborative procedures worked out among LPP, the several Javan universities, and participating universities of the SR-CRSP, to maximize training opportunities and to promote efficient inter-institutional cooperation.
6. Appropriate publication of information that is ready to be reported,

either as bulletins, abstracts, theses, or as popular or scientific articles. Proper acknowledgement will be made of all participating institutions; joint authorship will be encouraged, seniority of authorship to be determined by the degree of participation in the work reported. Bahasa Indonesia and/or English will be used as appropriate.

7. On-going access to computerized literature search services will be maintained in Raleigh.

F. Assumptions

The timely achievement of first-year objectives and the above listed outputs will depend on several factors:

1. Requested budget levels will be granted and maintained, for the NCSU subgrant and for LPP counterpart funds.
2. The requested research associate position will be approved, funded, and satisfactorily filled.
3. Other personnel associated with the project, both American and Indonesian, will be maintained.
4. Satisfactory working relationships can be effected among the several collaborating institutions.
5. The anticipated improvements to existing laboratory facilities at LPP can be financed mainly with Site Development funds available to Management Entity, supplemented by NCSU subgrant and Indonesian counterpart funds.

G. Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Economic Analysis of Small Ruminant Production and Marketing Systems in Indonesia

Status: New Project

Sub-Grantee: Winrock International Livestock Research and Training Center
Petit Jean Mountain, Morrilton, Arkansas 72110

Principal Investigator: A. John De Boer

Duration: Two year minimum with planned extension of five years.

II. Scientific Program in Indonesia

The core program in agricultural economics will concentrate in using economic analysis to examine means by which limited resource farmers can increase farm income and levels of human nutrition through the use of small ruminant within systems of intensive crop production. The major thrust will be on farm management/production economic problems associated with resource use problems on small farms practicing intensive crop production. Within this major thrust, efforts will be divided between (a) research on how existing small ruminant producers can more fully utilize their resources for small ruminant production and (b) research aimed at identifying specific farming situations where the introduction of small ruminant production systems would have the highest benefit-cost ratios.

The core program will be supplemented by additional studies of factors constraining the potential contribution of small ruminants to the small farm sector. These studies would include long-term studies of marketing and pricing practices and shorter studies of specific constraints such as rural credit, government price policies for agricultural products and inputs as they affect the relative profitability of small ruminants, government efforts to promote various types of livestock enterprises and their profitability, and the feasibility of small ruminant production on various resettlement schemes on outer islands of Indonesia.

To fulfill these objectives, the Title XII Economics program will require long term collaboration with the Agency for Agricultural Research and Development, particularly the Central Research Institute for Animal Husbandry, the Center for Agro-Economic Research and the Center for Statistics and Agro-Data Processing. Additional studies on specific topics could be carried out by Indonesian post-graduate students at Bogor Agricultural University, Bogor and the Department of Economics, Gajah Mada University, Yogyakarta.

The cheif collaborating institution will be the Animal Husbandry Research

Institute in Bogor and the chief collaborating scientist would probably be Mr. Sabrani who is currently the Agricultural Economist at this institute. Collaborative projects with other Center within the Agency for Agricultural Research and Development and with Universities would be under the day-to-day direction of Mr. Sabrani. Dr. Joel Levine will initiate the economics project on a part-time (25%) basis at least through May, 1980. The Principal Investigator, Dr. De Boer, plans to spend three months (June - August 1980) in Indonesia during the next project fiscal year as well as making a 2 week trip during March or April, 1980 to set up more clearly the project working relationships.

III. Cross Collaboration With Other Title XII Small Ruminant CRSP Principal Investigators.

1. Modelling small farm crop-livestock production systems and gathering information on animal productivity (U.C. Davis, Texas A&M) crop by-products and residues (N.C. State), forage crops (Ohio St. Univ.), animal health (U.C. Davis) and sociological characteristics of various farmer groups and farmer organizations (Missouri).
2. Collaboration on marketing studies and technology transfer studies with U. of Missouri.

IV. Regional Applicability of the Research Beyond Indonesia

Direct application to areas where intensive production of meat goats and hair sheep in conjunction with intensive cropping is practiced. Relevant to most systems practicing full or semi-confinement of small ruminants. The economic models of wide application where feeding of crop by-products and residues practiced and where intensive forage cropping is practiced or has potential.

V. Project Description

A. The Problem

Declining farm size, limited capital resources and a lack of well organized

systems for producing and marketing sheep and goats have all combined to limit the ability of small ruminants to supplement farm income on Java. Declining farm size has often resulted in the sale of cattle and water buffalo formerly utilized as draft animals. However, increased crop yields and higher cropping intensities are producing more crop by-products and residues per ha. In addition, tree crops provide a wide range of ruminant livestock feeds. The major problem to be tackled by the economics program is to examine the economic payoffs to various sheep and goat production systems and production practices which could make better use of crop-based feeds. Supplementary problems associated with increased demand for inputs and increased marketings of animals would be examined as the need arises.

B. Project Objectives

1. Describe existing small ruminant production systems in physical, organizational and socioeconomic aspects.
2. Initiate baseline surveys of traditional production systems as well as those farms using some aspects of improved technology and utilize this data to construct representative models of the various production systems.
3. Initiate long-term production economics/farm management studies to assist in technology design and evaluation and to model the physical and financial aspects of the various production systems represented.
4. Initiate some long term studies on the marketing of sheep and goats and their products.
5. Initiate some specialized studies of specific off-farm production constraints on one or more of the following topics - pricing, production risk, or farm credit.

C. Research Approach

The farm management/production economics research will utilize farm surveys to collect information on resource requirements for various activities and to quantify constraints during each part of the year. Experimental research will provide nutrient composition of feeds available on the farm and off the farm as well as nutrient requirements of sheep and goats at various stages of growth and reproduction. A linear programming approach is probably the most suitable for modelling purposes, at least during initial stages of research.

Supplementary studies may be initiated in the second half of 1980 or early 1981.

D. Indicators That Objectives Have Been Achieved

1. Development of working relationship between the project economist and Bogor and the institutions mentioned earlier.
2. A completed baseline survey report and a continuing series of farm management data collection visits to selected farms on Java.
3. Preliminary development of a physical/financial model based on farm survey data and the collection of experimental data appropriate for running in the model.
4. Establishment of an interdisciplinary research program in sheep and goat production which incorporates economic analysis as a vital component of research planning, design and analysis.

E. Assumptions That Objectives Can Be Met

1. Co-investigator (Dr. Joel Levine) will take up residence in Indonesia as scheduled.
2. Host government and collaborating institution will allow researchers reasonable access to small ruminant producers and assist in getting producers cooperation.
3. The collaborating institution and other Small Ruminant CRSP projects

will cooperate fully on field survey work to allow all necessary physical and economic information to be gathered.

4. Adequate availability of and access to counterpart staff to assist with the economic research program, to interact with other research programs, and help design and test improved production technologies at the farm level.

F. Assumptions That Meeting the Objectives Will Solve the Problem

1. The Government of Indonesia will support the research and implementation of research results.

2. That implementation of improved systems of production and marketing practices does not prove impossible from a social, legal, administrative or political standpoint.

3. The research capability developed by counterpart staff and other Indonesian collaborating institutions will be recognized and utilized for practical problem solving and the development of investment programs to raise income generated by small ruminants in the Northeast.

G. The Outputs

1. Development of field survey questionnaires.

2. First year publications on research methodology employed, preliminary results of survey work, and development of modelling framework.

3. A functioning farm management and product marketing data collection system

VI. Technical Feasibility

The production and marketing studies planned for Indonesia make use of known research techniques used with small farmers in developing countries. Staff from AARD must assist in gaining local farmer acceptance and cooperation. Collaboration among participating Indonesian institutions will be required to carry out the full list of planned research activities and this inter-institutional cooperation has been promised by the Indonesian institutions involved.

VII. Personnel

1. A. John De Boer, Principal Investigator
2. Joel Levine, Co-Investigator (part-time)
3. Mr. Sabrani - Principal Collaborator

VIII. Implementation

Dr. Levine is planning to begin residency in Indonesia in early 1980 and will begin to make contact with collaborators. When Dr. Levine has established working relationship with Indonesian scientists, John De Boer will spend 2 weeks in Indonesia in March or April developing the detailed work plans, questionnaires, and research methodology. Fieldwork can then begin in mid-1980. Dr. De Boer will then spend June - August 1980 in Indonesia carrying out fieldwork and writing up descriptive details on production systems and marketing practices. Following this visit, a decision will be made as to long-term staffing of the economics project in Indonesia.

IX. Annual Review and Planning

During the visit in March or April, 1980 a 5 year program plan will be prepared. Planning will also proceed during the summer period (June - August, 1980). Towards the end of this period, a conference or seminar will be held and comments solicited from Indonesian economists to help in review and planning of the project. Close liaison will also be maintained with the Planning Department, Ministry of Agriculture and with the National Planning Agency (BAPENAS).

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Sociological Analysis of Small Ruminant Production Systems in Indonesia

Status: New Project

Sub-Grantee: University of Missouri
Columbia, Missouri 65211

Principal Investigator: Michael F. Nolan

Duration: Two year minimum with planned extension of five years.

II. Scientific Program in Indonesia

The sociology program in Indonesia has the general objectives of (1) describing goat and sheep production systems in the intensive farming areas of Java; (2) conduct a number of field studies related to the key socio-cultural constraints to increased small ruminant (SR) production in Indonesia and (3) performing evaluation studies of production interventions.

The programs initial thrusts are oriented toward the descriptive objective above which should establish a framework for initiating subsequent studies under objective II. The establishment of priorities for later projects will be the joint responsibility of the U.S. project staff and Indonesia counterparts.

III. Cross-Collaboration With Other SR-CRSP Projects

A. System Description:

Field observation will include data relevent to animal health and genetics (University of California at Davis, UCD); economics (Winrock International Livestock Research and Training Center, WI); systems analysis (Texas A&M University, TAMU); and Nutrition (North Carolina State University, NCSU). In the planned production systems survey, sociology will be a full collaborator.

B. Close collaboration is expected with the economics and the systems analysis projects in the areas of livestock production, marketing, consumption, farm decision making and similar variables which overlap. Joint field work is likely in many instances.

IV. Regional Applicability Beyond Indonesia

Although there are local differences, much of the socio-cultural studies done in Java would have some applicability to the rest of the lowland tropical regions. The usefulness to other areas elsewhere in the world is uncertain.

Project Description

The Problem

There is a well established axiom in agricultural development that changes

in agricultural production systems have wide ranging impacts on the societies as a whole. The history of the Green Revolution suggests that the burden of change falls disproportionately on small producers, often to the extent of making it impossible for them to stay on the land. Simply put, technological solutions to production problems have often worsened rather than improved the lot of the small farmer. The overriding objective of this project is to minimize the possibilities of that situation occurring in Indonesia.

In Indonesia most small ruminants production is carried out by small producers on private land holdings or by landless people. In order for production interventions to succeed, the interrelationships between the components of production system will have to be taken into account. The system is organized around the principle of "zero grazing" and the animals can best be considered as a cash crop as they are marketed rather than consumed by the producing unit. In addition, attention will have to be given to the differences within the system as, for example, between East and West Java.

Throughout, two broad questions will guide our activities; (1) who will benefit from proposed production interventions?; and (2) what are the likely problems one can anticipate in trying to implement the interventions?

Objectives

I. Obtain an accurate description of the current system of small ruminant production in Java.

II. Determine the key constraints to increased productivity both from the perspective of the small farmers and from a structural socio-economic perspective.

III. Initiate a number of intensive field projects designed to provide in depth understanding of the precise nature of the key social constraints to production. Early studies will focus on decision making; role of various family members (especially women and children) in small ruminant

production; small ruminant production strategies among landless people as contrasted with land holders; and the role of small ruminant in the social fabric of Javanese communities. The selection of later topic areas will be made following the completion of Objectives I & II and in collaboration with our Indonesian counterparts. It is anticipated that studies will be undertaken on topics unique to Java, for example, those involving a comparison of rice producing with non-rice producing villages and studies of the Garut fighting sheep of West Java.

IV. Develop, or participate in the development of alternative strategies for increasing productivity in accord with the local socio-cultural patterns. This will probably not occur until after year three, at the earliest.

V. Enhance the capacity of Lembaya Penelitian Peternaken (LPP) to perform sociological analysis through training of staff and collaborative projects. Further, through other training efforts, it is hoped to generally increase the Indonesian human resource base in the area of rural sociology, particularly at the university level.

Project Approach

During the life of the project in Indonesia, we propose to utilize a variety of approaches to accomplish our stated objectives. Initially we intend to participate in the production system survey planned by all projects. It is also our intention to propose a conference or symposium in order to begin to involve Indonesian social scientists in the project. This would also produce a series of working papers on Indonesian rural social structure which will be of great value to us and our U.S. collaborators.

Prior to, and during the time this work is being done, we will be conducting an extensive review of the literature relevant to a project on SR production. The results of this literature review, along with the descriptive studies of the

current production system, will form the basis for setting priorities for future research activities as well as providing the necessary background for a report on the social aspects of SR production in Java. It is our intention to attempt to obtain maximal Indonesian social science participation in studies initiated after this descriptive phase has ended.

Data collection methods will include both in-depth field observations and survey techniques. The choice will depend on the nature of the problem to be studied and the type of data desired. It is our intention that the two methods will interface with each other in the sense that the observational reports may guide the development of survey instruments and surveys may suggest areas for future field observations.

In addition to working closely with Indonesian social scientists, we anticipate to build on the close relationship we enjoy with other projects which anticipate working in Indonesia. We expect to collaborate closely with the economics project as our interests and theirs overlap in several areas. In the production area we will closely work with the systems analysis project, and reinforce close lines of communication with the nutrition, health and breeding projects. Throughout we will try to accomodate their requests for information.

Indicators and Outputs

For the first and second year of effort in Indonesia we expect the following outputs. They are as follows:

1. Establish a project reference center composed of published and unpublished reports related to the role of socio-cultural factors in livestock production.
2. Participate in a study of the current system of SR production in Indonesia. The report of this study should be available in the summer of fall of 1981.

3. Begin the development of studies on decision making and role of women in agriculture.

4. Establish firm counterpart relations with Indonesian social scientists by involving them in project planning activities, conferences and other activities.

Assumptions for this Time Table

1. That a site coordinator is hired and working by June 1, 1980.

2. That sufficient logistical support (e.g., Vehicles) is available to allow field work to begin by June 1, 1980.

3. That no difficulties are encountered at any level in establishing scientist to scientist contacts.

4. That the current political system in Indonesia doesn't change to the point that work becomes impossible.

5. That sociological research activities are not restricted through official action.

Assumptions That Achieving the Objectives Will Solve the Problem

This project is unique in that it is a non-production component of what is at the core of production oriented research programs. As such, the achievement of its objectives will in no way guarantee the success of the total program. At the same time, failure to meet the objectives may well doom the entire program.

One of our principal goals is to determine the appropriateness of production intervention to the socio-cultural situation and institutional arrangements in Indonesian society. It is assumed this kind of analysis will provide guidance in the selection of a strategy from among the alternatives available.

While the goals of SR-CRSP is to increase SR production and productivity, it is only to be done if large numbers of small producers can benefit. Thus, the beneficiaries of the SR-CRSP are people. It goes without saying that increased

SR production will ultimately effect people. Whether that effect in Indonesia is positive, rather than negligible or negative, will hinge largely on the abilities of the "people sciences" (sociology and economics) to meet their stated objectives.

Technical Feasibility

This project makes use of established observational and survey techniques. Field enumerators will be hired on a short term basis from communities and/or institutions near the study site.

Inputs (See Budget Section)

Personnel

University of Missouri

Michael F. Nolan, Principal Investigator

Rex R. Campbell, Co-PI

Research Associate

Graduate Research Assistant

Lembaga Penelitian Peternaken (LPP)

Muhummad Sabrani

In addition it is hoped to involve social scientists at one or all of the following institutions:

Gajdah Mada University (Dr. Sartono)

Satya Wacana University (Dr. J. Ihalauw)

IPB University (Bogor) (Dr. Sayogo)

Agro-Economic Survey Unit (Bogor) (Dr. Rudy Sinaga)

Implementation

The Principal Investigator visited Indonesia in January for discussions with LPP staff and other potential collaborators. During the summer of 1980, we expect to participate in the launching of a baseline production systems survey in which all projects will participate. In addition, during 1980 we intend to provide a mechanism

for starting the process of involving Indonesian social scientists in our activities.

Annual Review and Planning

The first planning session with Indonesian collaborators will be held in January, 1980. It is our intentions to involve the key U.S. staff in meetings with the Indonesians who will participate in the project so that the next period of work can be planned with as broad a base of input as possible.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Systems Analysis and Synthesis of Small Ruminant Production in Indonesia

Status: New Project

Sub-Grantee: Texas A&M University
College Station, Texas 77843

Principal Investigator: Thomas C. Cartwright

Duration: Two year minimum with planned extension of five years.

Proposal Abstract

Systems Analysis And Synthesis Of Small Ruminant Production

Generalized, comprehensive, biologically based, mathematical models for simulating sheep production provide a systematic method for bringing knowledge relating to isolated production components together for the entire production system. These models, and simulations from them, organize available knowledge, identify knowledge voids, and provide a basis for determining critical research needs and for establishing priorities for technical assistance and development. Also, model simulations provide a method for examining or predicting the effect of new practices and determining optimal combinations and sequences of implementing practices and especially to avoid implementing practices which would be counter productive in production systems of a particular area.

The broad objective is to increase productivity of small ruminant production systems in Indonesia and other LDC's in order to improve the standard of living and increase nutrition in these countries. This objective will be addressed by providing a method for increasing the effectiveness of research by establishing research priorities and by providing a method of effectively evaluating application of research results and other recommended practices in Indonesia as well as the U.S. The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.
2. To characterize production systems in Java and other appropriate ecozones of Indonesia to validate the model and input parameters; and to use these validated simulations as baseline simulations.
3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Indonesia.

4. To supply input-output data of dairy and dual-purpose goat production systems for use in economic analysis and sociological assessment.
5. To evaluate, through simulations, the response of sheep or goat production systems to alterations or interventions requested or agreed upon by AARD and LPP.

I. Project Description

A. Description of Problem

Generalized, comprehensive, biologically base, mathematical models for simulating sheep production provide a systematic method for bringing knowledge relating to isolated production components together for the entire producing unit in an equilibrium or dynamic state (Joandet and Cartwright, 1975). These models organize available information, identify knowledge voids, and provide a basis for determining critical research needs and for establishing priorities for technical assistance and development (Cartwright, 1978; Spedding, 1978).

Since the possible number of combinations for production practices is greater than can be studied experimentally, simulations provide a method for examining the effect of new practices and determining optimal combinations and sequences of implementing practices (ILCA, 1978). With complex input-output animal interactions, it is important to examine the effects of an intervention throughout the entire production system in order to avoid unanticipated effects which could be counterproductive on final biological or economic efficiency (Cartwright, 1970).

Factors having major effects on small ruminant producing systems in Indonesia include disease and parasite stresses interacting with nutrition and breeding which further interact with management, marketing and other socio-economic effects. Techniques developed in operations research are designed to systematically organize and describe the dynamics of such complex systems through mathematical models (Van Dyne, 1978). These models may be constructed at various levels of refinement and generality (Joandet and Cartwright, 1975). The models, which will be developed as a component of this project, will be based on biological functions, applicable to each species in general, so that sets of input coefficients peculiar to a geographical area, breed or type of sheep or goats, management procedure or feed resource can be conveniently applied to the general model. Thus, these models are adaptable for simulating production systems in Indonesia as well as the U.S.

Model applications of specific interest include the evaluation of production systems that incorporate small-holder sheep and goat production systems into mixed-enterprise production units in Java. This evaluation will include the assessment of alternative management practices, feed resources and supplementation programs, and available breedtypes. As appropriate, production systems will be evaluated with primary emphasis on the integration of secondary livestock enterprises into small-holder mixed-enterprise production units.

B. Objective Of Project

The broad objective is to increase productivity of small ruminant production systems in Indonesia and other LDC's in order to improve the standard of living and increase nutrition in these countries. This objective will be addressed by providing a method for increasing the effectiveness of research by establishing research priorities and by providing a method of effectively evaluating application of research results and other recommended practices in Indonesia as well as the U.S. The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems with the individual animal as the modeling unit; and to develop a similar model for goat production systems.
2. To characterize production systems in the Java and other appropriate ecozones of Indonesia to validate the model and input parameters using these data and information; and to use the validated simulations as the baseline simulations.
3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures, which more effectively accomplish specific objective functions of the CRSP in Indonesia.
4. To supply simulated input-output data small-holder sheep and goat production systems for use in economic analysis and sociological assessment.
5. To evaluate, through simulations, the response of sheep or goat production

systems to alterations or interventions requested or agreed upon by AARD and LPP.

C. Project Approach

Building the required models will be an active process involving interaction with all collaborating projects for gaining input information and for feedback to them concerning information which is needed but is lacking or poorly understood and which the other CRSP projects can direct their efforts toward determining. That is, to aid in direction of research and setting priorities. The feedback process will begin early during the first year. The sheep model is expected to be ready for preliminary runs during the second year.

Objective B1

The models will be developed similar to the TAMU Cattle Production Systems Model (Sanders and Cartwright, 1979a,b).

1. The first step in the development of a sheep production systems model is to search out and evaluate available data and research results relevant to model construction, including consultation with experienced specialists. The uniqueness and utility of the cattle model results from its conceptual structure; the driving variables are quantity and quality of nutrient resources; biological responses are conditioned by animal genotype, management practices and other environmental variables; this simulation model closely emulates real world processes.
2. The information is then described by appropriate mathematical functions, fit into the model structure using difference equations and programmed for computer processing (Van Dyne, 1978). The mathematical functions are based on biological processes and are not simply curves fitted to a set of input-ouput data as is the case with normative models (Cartwright, 1978).
3. A similar model of goat production will be initiated following development of the sheep model. The goat model is expected to follow comparable stages

of the sheep model at about a one-year interval.

4. Even though the proposed form of the model has proven useful with beef cattle, major additional components are needed. One is an interacting, dynamic forage component; a second is a quantitative interacting disease-parasite component. Inputs from these areas are essential from the outset even though they will not initially be modeled as interacting components; that is, there will be no feedback of animal performance to forage or to disease-parasite components. This extension of the models would be anticipated to begin about the fourth year when more information has become available and wide experience obtained throughout the CRSP.

Objective B2

1. The available feed resources and breedtypes of sheep and goats in Java will be characterized through the use of data collected through the efforts of other CRSP projects. The data collected by LPP and other CRSP projects will be the primary source of information necessary to characterize the traditional production systems and to refine and validate the sheep and goat models.

2. After the working model is completed, it will be subjected to validation tests which will consist of simulation of the traditional production systems. Sequences of simulation, validation, model modification and new simulation are necessary. This recurrent process is tedious and time consuming but absolutely essential. These validation runs also serve as baseline documentation against which recommended changes are to be compared. The sheep model is expected to be validated during the second year and production simulations initiated. Simulations would continue during successive years.

Objective B3

1. The process of gathering, organizing and collating existing information and modeling production systems will identify knowledge voids of deficiencies.

The model can also be used to examine the importance of these parameters by varying them through a logical range and determining if these changes have important effects on the predicted outcome of a production system. This type of sensitivity analyses will help establish research priorities. Thus, by identifying knowledge voids or deficiencies and their importance, the systems analysis project will assist the collaborating projects in coordinating their research activities (Byerly, 1977).

This coordinating process and the function of bringing information from other CRSP project together to fit into the total production systems will be continued throughout the project tenure.

Objective B4

1. This objective, which is closely collaborative with the economic and sociology projects, will be to simulate small-holder sheep and goat production systems for Java utilizing the baseline (validation) simulations to compare against simulations with some changes imposed. The changes imposed will consist of practices recommended from collaboraing projects, practices suggested by detailed examination of the simulation outputs to determine at what point production efficiency suffers the greatest, practices suggested by Indonesian researchers, and other types of changes. The changes examined would include such practices as supplemental feeding, disease control, marketing at younger ages breeding seasons of different lengths at different times of the year, introduction of exotic breeds, and crossing.

2. These simulations would include effects on the total production systems and the input-output data would provide the base data required for economic analysis and for analysis for sociological feasibility and impact. These analyses will begin during the third year, intensify during the fourth, and continue throughout the project.

Objective B5

1. This objective will emphasize working cooperatively with Indonesian counterparts to examine bottle necks and constraints to present production systems and to formulate logical interventions and eventually synthesize technologies and/or production systems for settings in various Indonesian locations. Simulations will be designed to examine the effect of various interventions such as altered management practices, or new government policies on specific production systems and will begin after the models are completed an validated. The close consultation of AARD, LPP researchers, livestock officers, and other appropriate Indonesian personnel will be essential. Input data peculiar to each location and management system are required; these data relate to forage qualities through time, growth and lactation parameters, and management policies. Existing conditions will be simulated for validation, to instill confidence, and to serve as baseline. Biological efficiency will be evaluated through examination of effects on each production component across time. In this manner the constraints to efficiency can be more readily detected and analyzed, and prescriptive measures developed (Cartwright *et al.*, 1977; Davis *et al.*, 1976). These simulations will begin after validation during the third year.

D. The Indicators

The major conditions, in sequence, that will indicate objectives have been achieved are:

1. Development of sheep and goat models which are comprehensive, general, biologically based, dynamic and programmed for computer use.
2. Validation of these models against data collected on traditional production systems; those data may be collected by LPP other CRSP projects and/or other projects in Indonesia.

3. Synthesis of sheep and goat production systems which meet objective functions specified by the AARD, LPP researchers and livestock officers in consultation with other CRSP project leaders.

A number of additional, less critical or less objective criteria, include development of feedback information and research priorities to help coordinate collaborative projects; interfacing economic and production systems models; and extending the production systems model to include feedback interactions with forage and veterinary components. The latter two objectives are long term, depend on development of information from collaborative projects and are not expected to be completed during the five year period.

E. Assumptions That Objectives Can Be Met

The major assumption is that sufficient knowledge exists in the world, and is available to the project, to permit construction of quantitative models of sheep and goat production systems. Another assumption is that the available knowledge can be incorporated into adequate models and that these models will closely predict the outcome of production systems alternatives. A large-ruminant model has been developed (Sanders and Cartwright, 1979a,b) and successfully applied in LDCs (Cartwright *et al*., 1977; Davis *et al*., 1976; ILCA, 1978). This success suggests that similar small-ruminant models can be developed; however, research data for small ruminants are not as extensive and sensitivity, especially in earlier versions, may be reduced. Data for consumption of browse and for high milk yield by goats are probably the areas of least knowledge.

F. Assumptions That Achieving Objectives Will Solve Problem

The modeling objective can be attained and will be availabel for use in Indonesia and the U.S. regardless of the participation or capabilities of Indonesia. However applications to specific locations by synthesizing systems and conducting economic analysis depends on the cooperation of Indonesian personnel. Requirements of expertise level and personnel commitment from Indonesia are minimal. Data will be collected

by project personnel if not already available. No physical requirements are essential although transportation and guides to remote areas would be helpful; it is assumed that transportation can be obtained by hire through project funds if necessary. Personnel from LPP have devoted their time to explain their perception of constraints and of their plans for development. Their continued cooperation is anticipated and will be essential; their willingness to utilize simulation results as appropriate to improve their decision and policy making process is also anticipated.

G. Outputs Of Project

Scientific agricultural knowledge has been said to be exportable from the U.S. to Indonesia and other LDCs, but effective application of such knowledge to livestock production (that is, the development of viable technologies) have been minimal and at times counterproductive. A principal, general objective of this project is to make use of available research knowledge, optimally integrated into production systems where physical, financial and sociological constraints may be formidable. After model development, there will be two principal applications or outputs:

1. To simulate production systems incorporating anticipated research results for the cost/benefit analyses and other uses in guiding research priorities.
2. To simulate production systems for specific areas in order to predict the effects of implementation of new practices on various components of the system, or to determine optimal order and timing for establishing a series of proven practices.

The objective function, or goal, of small-ruminant production systems may vary among locations. Goals may be examined through model simulation in terms of biological efficiency, economic efficiency, energy, protein and hide production, export potential, financial returns to producer and other criteria. Thus, information critical to decisions of producers and policy makers will be more readily available.

The general models and the techniques and expertise developed will be applicable and available for use in any LDC and the U.S.

H. Technical Feasibility

The technical feasibility of this project is divided into two phases: (1) model development and validation and (2) simulation of Indonesian production systems and synthesis and examination of new systems.

The first phase consists of organizing knowledge about small ruminants into comprehensive, biologically based, dynamic, mathematical models and validating the accuracy of the model against real life experience. The techniques of modeling have been adapted to livestock production systems by the Texas A&M systems analysis group and widely validated and used in LDCs (Cartwright et al., 1978; Davis et al., 1976; ILCA, 1978; Ordonez, 1978). Therefore the techniques, methods, and expertise are available.

Two basic models will be developed; one for sheep and one for goats and will include functions for accomodating parameters associated with fiber production (or lack thereof) and milk production (or lack thereof for uses other than suckling young) by various breeds and types in various environmental settings. All of the data and understandings required for model development are not presently available. Some of this information which is lacking will be developed by other projects of the Title XII Small Ruminants CRSP. Other information will have to come from estimation by experienced ruminant nutritionists, physiologists, and other scientists. Regardless of this incomplete nature of available information, the models will be developed and are expected to represent the best understanding of total small-ruminant producing systems possible at this time.

Validation of this model remains the only point of doubtful outcome. That is, restructuring and refining the model may have to continue for two or three years in order to obtain satisfactory correspondence between simulations of production systems and outcome of the actual production systems. The probability of attaining this

first phase of the project at least in substantial amounts is almost certain.

The second phase is that of simulating and synthesizing production systems in Indonesia, that is, examining present systems and new recommended practices or methods. Since this phase depends on data collection and/or data already collected in Indonesia and cooperation of Indonesian research collaborators, the probability of accomplishing these objectives is good because of their expressed interest and support. However, minimal cooperation would still yield useful studies or reports. The level of attainment of this second phase depends on the interest and cooperation of AARD and LPP personnel and on inputs generated by the other projects of the CRSP. Because of the interest and the expected good data base from research in Indonesia, the outputs of this project should help form the basis for development of policies and programs of AARD.

I. Inputs (See Budget Section)

J. Personnel

1. Texas Agricultural Experiment Station

   T.C. Cartwright, Professor
   J.W. Bassett, Professor
   G.M. Smith, Visiting Associate Professor
   C.R. Long, Associate Professor
   J.O. Sanders, Assistant Professor
   T.C. Nelsen, Research Scientist
   H.D. Blackburn, Research Associate
   G.W. Hawariat, Graduate Assistant
   G.L. Brenni, Graduate Assistant

2. Indonesia Agency for Agricultural Research and Development (AARD)

   Lembago Penelitian Peternahan (LPP)

   M. Sabrani

K. Implementation

The implementation of this project occurs in three phases:

1. Model development, validation, and refinement.

2. Simulation of small-holder sheep and goat production systems for Java.

3. Applications of systems analysis to small ruminant production systems for Indonesian locations.

The first phase will actually continue throughout the project and require input from other collaborating projects as well as data and information collected on the projects in Indonesian and in other LDCs.

The second phase is the application phase and depends heavily on data collected at the dairy goat research station and the cooperation of the collaborating projects and the Indonesian counterparts. The simulations will be the basis for examining alternative production practices and synthesizing production systems to most effectively integrate dairy and dual-purpose goat production into small holder agronomic enterprises.

The final phase will involve utilization of data from other projects in Indonesia as well as from the dairy goat research station. The interests and desires of AARD and LPP personnel will determine the scope and direction of these efforts which could be initiated as soon as the sheep and goat models are developed and appropriate input data identified.

L. Annual Review And Planning Processes

This project is somewhat unique in that progress or status is clearly indicated by stage of model development, degree of closeness of validation between actual and simulated production, and the production systems synthesized. Also, this systems analysis project contributes to the coordination of the biotechnical aspects of the other collaborating projects. An annual report will be written for review. The annual report will be reviewed by the Head of the Animal Science Department, the Committee of Professors of the Animal Science Department, the Office of the Director of the Texas Agricultural Experiment Station, the Small Ruminant CRSP Program Director, the PI's of the Small Ruminant CRSP, and the cooperating Indonesian scientists.

A model of production systems is an organization of knowledge and provides a logical basis for planning each step in systems analysis and synthesis. The review feedback is the primary basis for planning.

Specific planning with respect to Indonesia will be coordinated with the Program Director of the CRSP, the Technical Committee of PI's, AARD and LPP.

M. Literature Cited

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Sanders, J.O. and T.C. Cartwright. 1979a. A general cattle production systems model. I. Structure of the model. Agricultural Systems 4:217.

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Spedding. 1978. The effectiveness of animal production systems. Proc. IV World Conf. on Animal Production (in press).

Van Dyne, G.M. 1978. Systems analysis in animal production systems. Proc. IV World Conf. on Animal Production. (in press).

INDONESIA - SIGNED

MEMORANDUM OF UNDERSTANDING

ON

THE ADMINISTRATIVE ARRANGEMENTS

BETWEEN

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

AND

AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT,

JAKARTA, INDONESIA

WITH REGARD TO THE ESTABLISHMENT OF A

SMALL RUMINANT - COLLABORATIVE RESEARCH SUPPORT PROGRAM

MEMORANDUM OF UNDERSTANDING
ON THE ADMINISTRATIVE ARRANGEMENTS
BETWEEN THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
AND
AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT
JAKARTA, INDONESIA
WITH REGARD TO THE ESTABLISHMENT OF A
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

Within the framework of Title XII International Development and Food Assistance Act of 1975, the University of California, Davis (UCD) acting for and on behalf of The Regents of the University of California and being the competent United States authority under the provisions of Grant No.AID/DSAN/XII-G-0049, and Agency for Agricultural Research and Development (AARD), Ministry of Agriculture, Republic of Indonesia, have entered into the following understanding:

I. DEFINITIONS - For purposes of this understanding, the following definitions shall apply:

A. "CRSP" means the Title XII Small Ruminant Collaborative Research Support Program established by joint action of the Agency for International Development (AID) and the Board for International Food and Agricultural Development (BIFAD), and funded by a grant from AID to The Regents of the University of California, and in Indonesia supported by funds from the Government of Indonesia through AARD.

B. "AARD" means Agency for Agricultural Research and Development of the Ministry of Agriculture, Republic of Indonesia. The appropriate collaborating institution of this Agency is Lembaga Penelitian Peternakan, Bogor.

C. "Participating Institution" means a university or other research institution which has been awarded an active sub-grant by The Regents of the University of California under the authority and provisions of the referenced AID grant to conduct a component project of the CRSP.

D. "Management Entity" means the University of California at Davis which has been designated by AID and BIFAD as the legal and responsible institution for conducting the fiscal affairs and program of the CRSP.

E. "Program Director" means the person appointed by the University of California at Davis to serve as the chief executive officer of the CRSP.

F. "Site Co-ordinator" means an individual with administrative responsibility for the in-country co-ordination of CRSP activities. The site co-ordinator will be an Indonesian scientist who shall have authority for all Indonesian contributions to the CRSP. The site co-ordinator will have a project specialist as a counterpart called Liaison Officer.

G. "Liaison Officer" means an employee of the Management Entity who shall be an Academic Administrator of the University of California and shall be responsible for all US contributions to the CRSP.

H. "Consortium of Agricultural Sciences" means all those institutions in Indonesia that are members of the Consortium of Agricultural Sciences in the Department of Education and Culture.

II. SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

A. The major understanding shall be the intention to establish a CRSP the goals of which shall be to conduct a research development and training program in support of small ruminant production and marketing by the most limited resource producers and small holders and thereby to:

1. expand the body of knowledge and extend its application to the solution of specific problems;

2. expand the level of competence of US and Indonesian scientists to conduct research;

3. develop and test appropriate technologies to improve food, fiber, and hide production;

4. improve small ruminant food, fiber and hide production capabilities by small holders in the US and Indonesia.

To assist in program planning, the Parties wish to set forth a brief statement of their intention to undertake

collaborative work as part of the CRSP sponsored by the United States of America through AID pursuant to Title XII of the International Development and Food Assistance Act of 1975. Title XII has as one of its major objectives developing programs to attack the problems of food production and food utilization in developing countries by bringing together the resources and expertise of universities and other research institutions in the United States and the developing countries.

B. The current Plan of Operation of the research program is described in Annex 1 which constitutes an integral part of this Memorandum. The plan will be revised from time to time in consultation between the Program Director and Site Co-ordinator and as agreed by the Head of AARD.

C. If mutually deemed desirable by the Management Entity and AARD, individual members of the Consortium for Agricultural Sciences may be used in support of CRSP work in association with one or more US Principal Investigators. In such cases Indonesian obligations as specified in Section IV below shall apply to the aforementioned consortium institutions.

D. Research results from CRSP work conducted in Indonesia shall be published jointly and be freely available to the

scientific community.

E. The agreement shall commence on the date of the signing of this Memorandum and shall continue to remain in force for five years if the aforementioned grant continues to be provided to the Management Entity by AID, and may be extended for a longer period if funds continue to be available.

III. THE MANAGEMENT ENTITY CONTRIBUTION

The Management Entity shall extend to AARD, manpower and resources in accordance with the mutually agreed program as described in Annex 1. The costs of resources and manpower will be met by CRSP funds awarded to the Participating Institutions for the component projects of the CRSP, expended by or under the authority of the Program Director.

A. Direct Costs: The Management Entity contribution shall include funds which will pay the following direct costs incurred under this understanding:

1. Salaries, wages and benefits of US scientific staff and administrative personnel in Indonesia; supplies and expenses; and equipment necessary to conduct the work of the CRSP.

2. US travel of all US and Indonesian persons for the work of the CRSP.

3. Management Entity approved international travel by US persons for the work of the CRSP, and of Indonesian trainees and scientific and administrative staff working in the US for the CRSP.

4. Travel in Indonesia. At the discretion of the Program Director, travel costs for Indonesian counterparts may be borne by the Management Entity or Participating Institutions.

5. Costs of training and traineeships.

6. Other direct costs approved by the Management Entity.

All requisitions for purchase of supplies, equipment and travel of any kind and other expenses must be approved and signed by the Program Director at UCD or his designee regardless of whether the cost is incurred in the US or in Indonesia.

B. Manpower: Management Entity shall make available through the Participating Institutions the following manpower resources to AARD:

1. US scientists of the highest competence who shall be the Principal Investigators and co-investigators from the institutions with which the Management Entity has sub-grant agreements under this CRSP.

2. Advanced personnel at the post-doctoral or immediate pre-doctoral level for work in Indonesia.

3. Technicians with particular skills to solve specific problems as the need arises.

C. Training: The following kinds of traineeships for Indonesian students may be available:

1. Traineeships to study in the US to the MS or Ph.D. level to the extent determined by the Management Entity and AARD.

2. Short term training as deemed necessary by the Principal Investigators for other Indonesian personnel.

D. Administration: The chief executive officer of the CRSP shall be the Program Director appointed by the Management Entity. The Program Director shall provide direction to the mutually agreed program in the US and Indonesia as defined in Annex 1.

IV. AARD CONTRIBUTION

AARD being the competent authority in Indonesia shall provide:

A. Office and laboratory space and facilities, and land and agricultural facilities for both Indonesian scientists and US scientists to do their work.

B. All the direct costs associated with this work in Indonesia including: the costs of electricity, water, secretarial staff, local technicians, cleaning and maintenance of facilities procurement of livestock and their husbandry.

C. All the costs of travel in Indonesia by Indonesian scientists, but none of the travel of US scientists as they work for the CRSP.

V. TAXES, DUTIES AND CLEARANCES

The CRSP in Indonesia will require that the following exemptions be available under the provisions of the existing bilateral agreements between the United States and Government of Indonesia.

A. All costs for the clearance and handling and transportation from the port of entry, for vehicles, equipment, supplies, and livestock provided by the Management Entity and the Participating Institutions.

B. Exemptions from all Indonesian duties, taxes or like charges of all materials solely for the use of the CRSP whether purchased locally, in the US or in other countries.

C. Exemption for all US staff from Indonesian taxation and provision to such staff the same conditions, privilages and other exemptions as are applicable under the bilateral agreement between the United States Government and the Government of Indonesia.

VI. PROGRAM FUNDS

A. As stated in Article III hereof, direct expenditures in support of the CRSP work in Indonesia will be made by or under the authority of the Program Director from funds awarded in sub-grants to the Participating Institutions.

B. If mutually deemed to be desirable by the Management Entity and AARD, CRSP funds may be provided to AARD to be

expended in support of CRSP work by or on behalf of one or more US Principal Investigators, or to be expended in support of work conducted by AARD as part of the CRSP. Any such funding shall be through a separate agreement between the Management Entity and AARD, executed as a subgrant under the AID grant for CRSP work. Such a subgrant shall specify the work to be conducted and the terms and conditions for the use of the funds.

VII. INTERPRETATION AND MODIFICATION

This Memorandum of Understanding in English shall constitute the full agreement of the Parties hereto with respect to the CRSP and supercede any and all other prior agreements or understandings of the Parties regarding the CRSP and no modification of the Memorandum unless in writing and signed by authorized representatives of each of the Parties shall be valid.

Approved for the Regents of the University of California

By: _____

David W. Robinson
Program Director
University of California
Davis, CA 95616

Date: _____

Approved for the Agency for Agricultural Research & Development

By: _____

Sadikin, S, W.
Head, Agency for Agricultural Research and Development
Jalan Ragunan 29, Jakarta

Date: _____

Witnesses: