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# **SMALL RUMINANT**

**COLLABORATIVE RESEARCH**

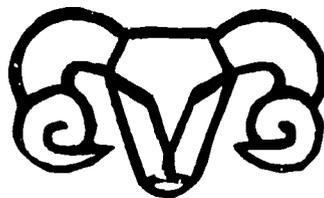
**SUPPORT PROGRAM**

# **INTEGRATED PROGRAM PLAN**

## **PART II**

## **BRAZIL**

**Prepared by the Management Entity**



PART II

REGIONAL SUB PROGRAM

BRAZIL

TITLE XII

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

## BACKGROUND

Northeastern Brazil is a semi-arid, tropical region with a population of 37 million people. Six million live in the coastal capitals, 18 million live in the rural areas of the humid coastal zone, and 12 million live in the semi-arid, interior Sertao zone, an area encompassing approximately one million square km. The climate of the Northeastern region is characterized by distinct wet and dry periods each lasting approximately 6 months, and relatively little seasonal variation in temperature. Caatinga, the vegetation typically found in the semi-arid area, consists mostly of brush, small trees and native grasses and legumes. Rainfall ranges from 300-900 mm, with an average of 500-700 mm for the caatinga and 700-800 mm around Sobral. The entire annual precipitation occurs from January to June. The months July through December are virtually dry. The period October through December is the hottest portion of the year, with a high temperature average of 35° C and a low temperature average of 28° C. May and June are the coolest months with high temperatures averaging 26° C and low temperatures averaging 22° C.

Both crop and livestock production provide the rural people with food and agricultural commodities for home use and cash income. Major agricultural produce includes corn, cotton, beans, rice and cassava, the first three of which are the primary crops of the semi-arid Northeast. In traditional farming systems near Sobral, beans and corn are planted as annual crops between the rows of perennial (5 year) cotton, during the first year only. Beans are harvested at the beginning of the dry season (July); corn is field dried and harvested several weeks later; the cotton harvest begins in September. At least five varieties of beans are commonly grown. Corn, in addition to its use for home consumption, is an important source of revenue for the farmer. Cotton is grown almost exclusively as a cash crop. Sheep and goats are the predominant livestock species although there are some cattle confined primarily to the wetter regions closer to the coast.

There are approximately 6 million sheep in the Northeast region, concentrated in the states of Piaui, Ceara, Pernambuco, and Bahia. These animals represent only about 18 % of Brazil's total sheep population and they are the smooth hair type rather than the traditional wool type commonly found in the more temperate areas of Southern Brazil.

The whole region has about 9 million goats, most of which are found in the arid and semi-arid areas of the interior. Their proportion of the total livestock population increases as one moves away from the coast and rainfall decreases. The goats in the Northeast region constitute approximately 92 % of the country's goat population with more than one third of them in Bahia State and more than one million head distributed

throughout the states of Piauí, Ceará, Pernambuco, and Paraíba.

Sheep and goats in Northeast Brazil provide a major source of animal protein and cash income. They are raised primarily to produce meat for home consumption, but the animals themselves, and their hides and skins, are also important generators of revenue. Cattle, in the areas where they are raised, also contribute an important share to rural income.

Although sheep are apparently never milked, goats are, and most of the milk is used on the farm. Except for the use of goats for dairy production, sheep and goats serve a similar function. It is not known to what extent they are competitive for the same limited resource base and if each species is being raised in the numbers and proportions most advantageous for the optimum management and utilization of the caatinga. Despite the fact that goats appear to be:

1. better adapted and more suited to the rigorous semi-arid environment
2. are generally in better condition
3. are more numerous than sheep

possibly because sheep are more easily herded and confined and their meat is more popular than the goats, the farmers in Northeastern Brazil seem to have a preference for keeping sheep rather than goats.

## INTRODUCTION

A number of long term programs for the purpose of raising the standard of living of Northeast Brazil's rural and urban sectors are currently being undertaken by the Brazilian government. Small ruminants make significant contributions to the food supply and cash economy of this region and the government has placed a high priority on the improvement of sheep and goat performance. Because these animals are a vital component in the mixed crop/livestock subsistence farming systems most commonly found in the interior, the government is particularly emphasizing development programs which view the role of livestock within the context of all the agricultural activities of each farmer. One agrarian reform program being initiated is the creation of 300-ha units to provide land for raising subsistence food crops (corn and beans), limited cotton production for cash income, and very likely, the development of small to medium sized sheep and goat flocks.

The government regards efforts to increase the production of small ruminants, particularly goats, as a means of improving the nutritional level and earning capacity of the people of the Sertao, especially the most deprived and impoverished of that group, the subsistence level Class I farmer. In addition, an integrated program of research, extension, credit and market development will aid the economies of both the rural and urban sectors by increasing the supply of livestock products (hides and skins) upon which Northeast Brazil's regional industries depend. The urban sector will directly benefit by the increased meat supply available to city dwellers and the alleviation of the migration pressure caused by the flow of rural people into the already overcrowded urban areas.

Conducting research on the problems of the small ruminant production system in Northeast Brazil could lead to the improvement of local animal performance, the lives of individual farmers, Brazil's regional and national economies, as well as the productivity of small ruminants in other areas of the world. The form and function of goats in this region are representative of goats found worldwide. The hair type sheep found in Northeast Brazil, although not as widely distributed or numerous as the wool or fat tailed types, play a critical role in fulfilling man's survival needs in areas where they are in high concentrations.

Knowledge derived from studying these animals could be applied to small ruminant production systems in other arid/semi-arid areas which have climate and soil ecosystems similar to those found in Northeast Brazil. Such areas are found in Central and South America, Mexico, the Caribbean, Africa, the Near and Middle East and South Asia. Specifically, the north coast of Chile, the Lambayeque-Piura region of Peru, the Guajira

region of Colombia, the Dominican Republic, Central and South Central India, and Pakistan have small ruminant production systems which exhibit a high potential for applying the knowledge gained in Brazil.

The Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) is the government agency responsible for coordinating all the agricultural development and improvement programs throughout Brazil. They have recognized that currently existing technological improvements for sheep and goat husbandry, which for the most part were developed in the temperate regions of Europe, North America, Australia, and New Zealand, cannot be transferred directly to the Brazilian Northeast. Only technologies appropriate for and adapted to semi-arid tropical environments can be effectively implemented and achieve positive results. Research must be conducted to develop these new technologies in situ so they are responsive to the actual conditions in which they are intended to function.

EMBRAPA, a new organization, is in the unique position of being able to initiate an original research program to meet this challenge, with the benefit of the best worldwide experience in research organization at their disposal. In response to the dynamic and complex manner in which physical, biological, economic, and social factors interact in agricultural systems, EMBRAPA's leadership has emphasized the formation of multidisciplinary teams to focus on the entire production system. The Small Ruminant Collaborative Research Program (SR-CRSP) was designed to employ exactly this approach in its efforts to improve the small ruminant production system of the limited resource producer.

In December 1978, USAID approved Brazil as a potential overseas research site. The Latin America site visit team travelled to Brazil in January 1979 and, after making extensive contacts in the Northeast region, returned with the strong recommendation that this area be considered for a primary overseas work site. The Technical Committee concurred with this recommendation in February 1979, and the Board of Institutional Representatives accepted Brazil as a site in May 1979. The Program Director and Chairman of the Technical Committee immediately travelled to Brazil to discuss the details of an administrative arrangement between EMBRAPA and the Management Entity (ME) and to finalize the selection of the scientific components of the program.

In September and October 1979, scientists travelled to Brazil to confer with EMBRAPA administrative and technical personnel at two of EMBRAPA's National Research Centers in Northeast Brazil; Centro Nacional Pesquisa en Caprinos, in Sobral, Ceara (CNPC) and Centro de Pesquisa Agropecuaria no Tropico Semi-Arido in Petrolina, Pernambuco (CPATSA). Located at these centers are the Brazilian counterpart investigators with whom the SR-CRSP researchers currently intend to actively collaborate on

their projects. At some point in the future, other Brazilian research centers (state or university) may join the collaborative network, with the CNPC maintaining the responsibility for overall program coordination. Following these visits and another Technical Committee meeting in November 1979, a packet containing a general statement about the SR-CRSP project in Brazil, along with the individual work plans of the projects located there, was sent to Brazil and reviewed by scientists at CNPC in Sobral.

The collaborative research program on the production and socio-economic problems related to goat and hair sheep enterprises in Northeast Brazil initially consists of projects in seven subject matter areas, each directed jointly by US and Brazilian investigators. In addition, projects in two other subject matter areas are in various stages of development: a range management project is actively being developed and a sociology project may materialize in the future.

There will not only be collaboration between EMBRAPA and the SR-CRSP to define and investigate problem areas, but also among the projects themselves. The Animal Breeding and Genetics, Range Management, Nutrition, Reproduction, Animal Health, and Management projects will cooperate closely to examine all the aspects of the small ruminant production system in the caatinga in an integrated and collective manner. The Breeding project intends to use the large Morada Nova sheep flock engaged in on-going grazing studies to acquire performance, production, and pedigree data and to provide rams with the appropriate characteristics for their selected lines of ewes. The Reproduction project will evaluate the reproductive performance of native and exotic genotypes of goats and sheep under the improved management schemes devised by the other EMBRAPA/SR-CRSP projects. Meshed within the main treatment groups of different breeding systems that the Reproduction project is investigating, will be nutrition subtreatments that will test the effects of supplementation sources and levels on animal performance.

The Systems and Economics projects will cooperate closely with each other and with the other disciplines to produce a systematic evaluation of the complex interactions of the entire production system. This will facilitate the identification and application of the most effective and appropriate alternatives to current production practices. The Economics project will incorporate data collected by the Breeding, Range Management, Nutrition, Management, and Systems projects on physical resources; and data collected by the Breeding, Reproduction, and Health projects on animal resources into their baseline production system description. Their production economics/technology evaluation research on constructing physical and financial models of various production systems will require input and data from the Breeding, Range Management, Nutrition, Management,

and Systems projects. The results of specific experiment station, farm management research conducted by the Breeding, Nutrition, Health, and Management projects, will be used by the Economics project on technology evaluation studies.

Research will be conducted at several sites in Brazil and the United States. Technical coordination of the program will be the joint responsibility of the Chief of the CNPC, the Chief of CPATSA, and the Program Director of the SR-CRSP. These institutional leaders will be guided by the recommendations of the SR-CRSP Technical Committee in the United States, and the Associate Technical Directors of CNPC and CPATSA and their respective scientific staffs in Brazil. Day to day coordination of research in Brazil will be the joint responsibility of the Associate Technical Chiefs of the CNPC and CPATSA and a Site Coordinator to be hired by the SR-CRSP Management Entity.

The following table (see Table 1) is a glossary of the acronyms used to identify the Brazilian institutions with which the SR-CRSP is collaborating. Table 2 lists the projects and their investigators which form the core of the research program to be conducted in Brazil over the next five years. Because of the complex nature of the problems in Northeast Brazil, it is clearly recognized by the SR-CRSP that many of the project objectives stated in these programs will require more than five years to be satisfactorily completed.

## Glossary of Brazilian Acronyms

Table 1

<b>EMBRAPA</b>	<b>Empresa Brasileira de Pesquisa Agropecuaria</b>
<b>CNPCOT</b>	<b>Centro Nacional Pesquisa en Caprinos e Ovinos Tropical</b>
<b>CPATSA</b>	<b>Centro de Pesquisa Agropecuaria no Tropico Semi-Arido</b>
<b>EPACE</b>	<b>Empresa de Pesquisa Agropecuaria Ceara</b>
<b>EMEPA</b>	<b>Empresa de Pesquisa Agropecuaria Paraiba</b>
<b>EMATER</b>	<b>Empresa de Assistencia Tecnica e Extensao Rural</b>
<b>BNB</b>	<b>Banco Nacional do Brasil</b>

Table 2

<u>Project Area</u>	<u>Participating Institutions</u>	<u>Project Co-Leaders</u>
Animal Health	CNPCOT	Carlos Costa
	University of California, Davis	Blaine McGowan Nancy East Norman Baker Robert BonDurant
Range Management	CNPCOT	Luiz Vale Roberto Mesquita Augmar Ramos Helenira Vasconcelos
	CPATSA	Severino Alburquerque Martiniano Oliveira
	Utah State University	John Malechek Brien Norton Don D. Dwyer Philip J. Urness James T. O'Rourke
Nutrition (By-products)	CNPCOT	Claudio Bellaver Ederlon Oliveira
	CPATSA	Luiz Mauricio Salviano
Reproduction	North Carolina State University	William L. Johnson
	CNPCOT	Aurino Alves Simplicio Jose Ferreira Nunes Simon Riera
	California State Polytechnic University	Edward A. Nelson
Animal Breeding	Utah State University	Warren C. Foote
	CNPCOT	Elsio Figueiredo
	EPACE	Francisco Ferreira Machado Francisco Rocha Macedo
	CPATSA	Severino Alburquerque
	Texas A&M University	Maurice Shelton Charles Long Darrell Ueckert

**Table 2 (cont.)**

<u>Project Area</u>	<u>Participating Institutions</u>	<u>Project Co-Leaders</u>
	Texas A&M University	James Sanders Gary Smith C.W. Livingston
Animal Management	CNPCOT	Elsio Figueiredo
	EMEP A	Paulo Leite Aldomario Rodriguez
	CPATSA	Terezinha Padilha
	Tuskegee Institute	Doris Oliveira Om P. Verma Edward Braye
Economics	CNPCOT	(Position vacant)
	CPATSA	Luiz Corsino Freire
	EMBRAPA, Brasilia	Victor Palma Adilson Barreto Vivas
	Federal University of Ceara	Iziarton Martin de Campos
	ETENE/BNB	Pedro Sisnando Leite
	Winrock International Livestock Research and Training Center	A. John DeBoer Nestor Gutierrez
Systems Analysis	CNPCOT	Claudio Bellaver Elsio Figueiredo
	CPATSA	Martiniano Oliveira
	Texas A&M University	T. C. Cartwright J. W. Bassett G. M. Smith C. R. Long J. O. Sanders T. C. Nelsen G. L. Brenni H. D. Blackburn G. W. Woldehawariat
Sociology	University of Missouri	Michael Nolan

## PROBLEM

The primary animal husbandry system encountered in the semi-arid interior of Northeast Brazil is extensive range production of goats and hair sheep. The low, highly seasonal rainfall characteristic of the Sertao results in a pronounced seasonal vegetation pattern and the drastic decline of available dry season feed on the range presents a major constraint to animal productivity. The prolonged period of nutritional inadequacy causes the caatinga livestock severe nutritional stress, particularly during the post-weaning, late gestation, and early lactation stages of their productive cycle. They have great difficulty maintaining acceptable rates of growth and reproduction, indeed even surviving during the dry season.

This problem is reflected in their small size, low yield and dressing percent, and depressed offtake, which is estimated at less than 20% compared to an average of approximately 100% in many other areas. There is currently a lack of understanding of the caatinga's capability to support livestock and insufficient knowledge about the management of this resource and the sheep and goats which depend upon it for sustenance. Without more information about the following factors relating to the caatinga, it will be difficult to devise management schemes which mitigate the problem of the dry season feed deficit and enhance animal performance.

1. Amount and quality of available forage related to soil type and water availability.
2. Effect of grazing pressure on nutrient availability of both natural and improved caatinga.
3. Interaction of breeding season and annual climate cycle, and its effect on:
  - Reproductive efficiency of the male female
  - Slaughter age of kids and lambs.
4. Effect of supplemental feeding of does and ewes on:
  - Disease and parasite manifestation
  - Reproductive parameters
  - Growth of suckling young.
5. Effect of length of suckling period on nutritional needs of the dam for:
  - Lactation
  - Subsequent gestation.
6. Interaction of weaning age and supplementation level on kid and lamb

performance.

7. Effects of species (sheep vs. goat) breed within species, and the individual animal on growth and reproductive efficiency under nutritional stress or with supplemental feeding.

Some of the more specific problem areas which the individual projects intend to investigate include:

#### ANIMAL BREEDING AND GENETICS

There are few distinct breeds of sheep or goats in the Northeast region. Most of the animals on the caatinga are non-descript varieties with the Crioulla sheep and the Sem Raça Definida (SRD) goat the predominant types. Because there is inadequate animal identification, poor record keeping, and unrestricted breeding in the native flocks, it has been difficult to measure individual animal performance and the genetic potential of the native stock.

#### RANGE MANAGEMENT

The lack of knowledge of the genetic potential of the local animals is complicated by the difficult environmental conditions under which they must live. A project is being developed by Utah State University and EMBRAPA to address the range management problems which were identified as critical in a meeting of SR-CRSP and CNPC personnel in October, 1979.

#### NUTRITION (BY-PRODUCTS)

Even in years of higher than average rainfall during the wet season, the livestock on the caatinga cannot maintain acceptable levels of productivity during the dry season. In addition, the nutrient requirements of the type of small ruminants found in the Northeast have not yet been accurately determined.

#### REPRODUCTION

The reproductive rates in native flocks are low as evidenced by the low total weight of offspring per female bred and the small numbers of animals per flock. Factors which contribute to this problem include low fertility and prolificacy, the maintenance of non-productive males and females in the flocks, high embryo losses, high mortality losses from birth to weaning and throughout the growing phase, and an extended time to reach maturity.

## ANIMAL HEALTH

The effects of inadequate nutrition are compounded by disease and parasitism which deplete the animals' resistance to environmental stress and further hamper their performance. The sheep and goats of NE Brazil are affected with a number of poorly classified infectious and contagious diseases of unknown prevalence as well as internal and external parasites. In addition, caseous lymphadenitis is of economic importance, because it mars the animal's hides and decreases the monetary value of this major cash generating commodity

## MANAGEMENT

The Class I farmer in Northeast Brazil has great difficulty raising goats profitably because the animals are subject to high mortality rates and advanced slaughter ages. The period of time necessary for goats to reach the size at which their hides are the most valuable (20-25 kg) is so extended (20-24 months), that they are not nearly as profitable as they would be if they attained the proper slaughter weight at younger ages. These problems are a reflection of poor breeding, nutrition, reproduction and management practices.

## ECONOMICS

In addition to the physical and biological constraints on animal productivity in the semi-arid Northeast, the lack of knowledge about various production and marketing mechanisms and demand characteristics for small ruminant products further limits potential production system improvements. More specifically, on-farm problems of resource productivity, in addition to several off-farm problems of marketing, pricing, credit, and general government policy, compound the economic hardship of the farmers in the Sertao.

## 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 Northeast Brazil 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 Brazil 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 Brazil will conduct research to further clarify the present conditions in the production systems, explore innovations which could improve them, and produce results applicable to Northeast Brazil as well as other areas with similar conditions.

The projects are designed to be compatible with EMBRAPA guidelines, interdisciplinary in nature, and have EMBRAPA 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, identify the most promising technologies to increase offtake (net reproduction) and meat yield (size and growth rate), optimize return, and analyse the farm-level problems encountered in implementing experimental results.

The development of economical drought feeding strategies including feed storage and forage production will be complemented by the improvement of grazing management, breeding systems, herd health measures and management practices. Although improving the genetic base of an animal population proceeds slowly, it is a method which has continuing, long term benefits.

The researchers will train US and Brazilian graduate students, and increase the knowledge and competence of US and Brazilian 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 Portuguese will be made available in the US and Brazil. In this way a large number of people can derive benefit from the collaborative efforts of EMBRAPA and the Small Ruminant CRSP.

In addition to the broad, long range goals, the individual projects of the SR-CRSP will fulfill their short range goals by focusing their research on specific objectives, which are:

#### ANIMAL BREEDING AND GENETICS

In their effort to up-grade the genetic base of the small ruminants in Northeastern Brazil, the Breeding project will serve as consultants and provide assistance to EMBRAPA in their on-going study to characterize and evaluate the genotypes of local sheep and goats. One genotype of each species will be identified for the initiation of a long term selection program. The object of this program will be to produce animals, ideally of a single genetic type, which maintain their adaptability to the environmental and nutritional conditions in the tropics, as defined by optimum growth, fertility, and resistance to caseous lymphadenitis. The selected lines will be used to determine the interrelationships among these critical survival and production traits. There will also be active involvement in the collection and analysis of data from cross breeding studies on sheep conducted at Quixada. In addition to the work in Brazil, flocks of Merino, fat tailed, and hair sheep will be propagated and maintained in Texas to compare form, function, adaptability and productivity among these sheep types, particularly with regard to unique traits. Similar measurements will also be made to compare meat and Angora goats.

#### NUTRITION (BY-PRODUCTS)

The intention of the Nutrition project is to accumulate data to better understand the nutrient requirements of native and improved goats and sheep in the semi-arid tropics so that experiment station tested rations can be more successfully adapted to field use. In order to effectively meet nutrient requirements (especially during the dry season) the project will develop guidelines for supplemental feeding systems, and study the interaction with breeding season. In addition, the availability and nutritional value of local crop residues and by-products will be studied for their potential use as dry season supplements. Finally, laboratory analyses will be conducted on the widest possible range of feedstuffs to study the predictability of animal performance based on feed composition.

#### REPRODUCTION

The reproductive performance of both sheep and goats indigenous to the Sertao region will be characterized under natural conditions and improved management

programs to improve reproduction will be developed and tested. The reproduction project will also aid EMBRAPA in the accumulation, interpretation, and application of research results from continuing and newly initiated projects in order to develop management components which optimize reproductive performance. Both currently available and acquired data will be collected for inclusion in the Small Ruminant Production Data Bank.

### ANIMAL HEALTH

The intention of the animal health project is to identify, define and rank, using both prevalence and economic impact, the health constraints which depress the meat and hide production of sheep and goats in Northeast Brazil. Research will be conducted on various strategies to control, decrease or prevent high priority health problems within the economic constraints of the region.

### MANAGEMENT

In order to examine the effectiveness of improved management to decrease kid mortality, lower their slaughter age, and increase lactation in does, the Management project will measure the production and reproduction of goats under intensive and semi-intensive management. This evaluation will be conducted by continuing the on-going management studies at Tuskegee, and establishing a management research facility and support laboratory to study alternative management programs in Brazil. The project will also assist Brazilian research and extension personnel in their efforts to evaluate current small holder husbandry methods and develop management techniques for transfer to the local farmers.

### ECONOMICS

Using data from all the projects, the Economics project will describe the existing 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 research planning and design
2. consider national economic policy
3. provide guidelines for extension program implementation of improved technologies.

In addition, these studies will ensure the continuity of the economics research component by facilitating (for future use in Northeast Brazil) the development of a fully implemented, verified, and well understood model of sheep and goat production systems. Short term studies on the effect on the small ruminant producer of specific production system constraints will be conducted to assess their importance relative to the introduction, adaptation, and adoption of alternative technologies.

#### 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 simulation models can be used for baseline simulations. Model applications of specific interest include the evaluation of production systems that incorporate goats and sheep into agronomic production units in Northeast Brazil. 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, hair sheep and meat goat production systems will be evaluated with primary emphasis on integration of the livestock enterprise into small holder agronomic production units.

## APPROACH

A number of the approaches taken by the participants are common to the entire group while others are project specific. Good communication among all projects and a high level of cooperation is considered essential to the SR-CRSP. Collaboration among the Brazilians and SR-CRSP will be enhanced because projects are designed to intermesh with EMBRAPA's current priorities.

All the projects will support US and Brazilian graduate students, provide training for in-country Brazilian scientists and technicians, conduct literature searches on topics relevant to their research area, and review the available data in their field for inclusion in the baseline survey.

The following specific approaches will be employed by the component projects.

### ANIMAL BREEDING AND GENETICS

This project will pursue a three phase breeding improvement program, the segments of which can, to some degree, be conducted simultaneously.

1. Sheep and goat genotypes will be characterized and identified for further study.
2. The genetic parameters of desired traits and their compatibility will be estimated and determined.
3. Selection programs for the following lines, each consisting of at least 100 females, will be initiated.
  - Rate of growth
  - Fertility
  - Resistance to caseous lymphadenitis
  - Index selection involving growth rate and fertility

Large numbers of animals used only for genetic studies will be required for parts 1 and 2. After these portions have been completed, several types of sheep and goats under a variety of local conditions can be integrated into a common selection program. Trends in other variables will also be observed as the selection proceeds and the Breeding project will cooperate closely with CNPC personnel to design useful, standardized, data collection formats and record forms. The Texas work (comparing the fat tailed, hair, and Merino sheep) will employ fecal analysis to measure grazing habits, slaughter studies in which carcass composition and value are measured on partitioned body parts, and physio-

logical measures of adaptability and reproductive efficiency, particularly in relationship to fat deposition sites. The Spanish, meat type goats will be studied particularly in an attempt to develop a laboratory procedure to identify animals harboring caseous lymphadenitis and improve selection criteria for resistance to the disease.

#### NUTRITION (BY-PRODUCTS)

The Nutrition project will evaluate the components of Northeast Brazil's feed base: native caatinga (browse and native legumes) crop residues, and cultivated forages, in order to devise a rational feed and dry season supplementation system for small ruminants including pre and post partum females and growing stock in different stages of their production cycle. Representative samples of corn, bean and cotton crop residues from several areas of Ceara, Pernambuco, and Bahia will be collected over the course of the dry season and analysed for protein, fiber, lignin, calcium, phosphorous, dry matter, and in vitro digestibility. Rations of varying concentrations of crop residue will be fed to castrated lambs and goats to measure intake and conduct digestibility determinations of the various supplements available in the area. At Raleigh, North Carolina, rations with corn plant residues will be fed in intake and digestibility trials and evaluated using in vitro digestibility techniques. This data, combined with similar laboratory analyses from Brazil, will be used to run regression analyses on the chemical composition, in vitro and in vivo digestibilities and animal intake and growth rates of grazed and harvested forages, browse plants and crop residues. This statistical data will be used to determine how well animal performance can be predicted from nutrient analyses of livestock rations.

#### REPRODUCTION

The Reproduction project will study the reproductive performance of 3 genotypes of sheep and 5 genotypes of goats under natural conditions using animals on existing field trials at Sobral. After natural mating, the following parameters will be measured.

##### FEMALES

- Body weight at breeding
- Percent pregnant of those exposed
- Fertility (percent parturient of those exposed)
- Prolificacy (number of young per parturition)
- Percent live births
- General maternal ability (ease of parturition and

and behavior)

- Adequacy of lactation
- Postpartum interval
- Age of puberty in replacements

#### MALES

- Physical examination
- Fertility tests
  - Semen evaluation

#### YOUNG

- Incidence and time of death from birth to weaning
- Birth weight
- Monthly body weight from birth through weaning and slaughter

Three of the 5 genotypes of goats will be identified as low, medium and high ovulators. Two management levels will be imposed on these genotypes: natural EMBRAPA conditions and an optimum management level. The females will remain unbred and be kept with teaser rams. The following parameters will be measured.

- Estrous period and cycle length
- Annual estrous incidence (establish seasonal or environment related anestrus)
- Postpartum interval (time from parturition to first post partum estrus)
- Ovulation incidence and rate (using laparotomy)
- Endocrine profiles (progesterone and LH) during:
  - estrous cycle
  - anestrus periods
  - late prepartum
  - early postpartum

The males will have semen production and libido measured at two week intervals for the length of their productive life to establish the influence of natural environmental changes. Semen freezability and testosterone and LH endocrine profiles will also be measured at selected times of the year.

The data from all the sections of the project will be analysed to establish esti-

mates of reproductive capability or potential.

### ANIMAL HEALTH

The health project will define and investigate the causes of the health problems in Northeast Brazil, particularly the high abortion rates and kid and lamb mortality, and the incidence of endo and ecto parasites. They will collect data on the cyclic nature of parasite burdens, screen anti-helminthics for efficacy, develop strategic worming practices and study how to protect sheep against Corynebacterium psuedotuberculosis, the bacteria which cause caseous lymphadenitis. Serological survey, bacterial and viral isolation and histopathological techniques will be employed in combination with necropsy and clinical treatments to better understand and combat the problems in this region. In addition to the formal collaborative ties with EMBRAPA, they will establish informal cooperative arrangements with several small holder in the Northeast area to monitor animal health on a yearly cycle.

### MANAGEMENT

The adaptation, production, and reproductive capabilities (including factors affecting kid mortality) of three breeds of goats will be measured under current management conditions at the Pendencia Station. The performance of two exotic dairy breeds, the Anglo Nubian and the Parde Alema, and one native breed, Sem Raza Definida (SRD), will be examined and compared to facilitate designing a management system to study goat performance in the 200-400 mm rainfall zone. This work will also be done on native goats at Bahia College of Agriculture in Cruz das Almas, an area with 800-1000 mm of rainfall a year.

Production measurements will include:

- Periodic body weights to assess gain from:
  - birth to weaning
  - weaning to slaughter
- Mature body weight
- Dressing percentage
- Weight of weaned kid (kg)/doe/year
- Total milk production/lactation
- Mean daily milk production (total kg milk/total days of lactation)
- Lactation curve

Reproduction measurements will include:

- Incidence of estrous throughout the year
- Length of estrous period and cycle
- Age of puberty
- Ovulation rate
- Fertility (percent of exposed does that kid)
- Prolificacy (number of kids/doe/kidding)
- Birth weight
- Postpartum interval (period from kidding to first estrous/ovulation)
- Kidding interval

Kid loss measurements will include:

- Percent of kids born alive
- Age and cause of death from birth to slaughter
- Relationship between each mortality and management practices

Work to be conducted at Tuskegee over the course of the project will include, in addition to the measurements listed previously, subtreatments for testing such common management practices as weaning, castration, dehorning, animal identification, and vaccination. As the work in Brazil progresses from assisting the investigators at Pendencia with their current research project to actually establishing a complementary management research facility, these factors relating to kid management will also be examined under the conditions at the station. When a sufficient quantity of data on present goat production and management practices has been acquired from the research at Tuskegee and Brazil, practical management alternatives will be field tested on selected farms in the Pendencia region. Management procedures which will improve meat, milk and hide production on a level compatible with local conditions will be recommended, and Tuskegee will cooperate with extension efforts to implement changes in the husbandry practices of the region's limited resource producers.

## 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. With this as a basis, they will build a simple, interdisciplinary model of sheep and goat production for Northeast Brazil, incorporating both technical and financial aspects, which can be updated and revised as new data becomes available. Using current research results, the model will be used to simulate traditional and improved production system

performance, and identify potential high return areas of research and promising technologies for intensive farm level testing. Farm level testing will identify technical and socio-economic problems faced by farmers in implementing technologies, quantify the impact of production practices separately and in combinations, and aid in the development of programs to overcome identified constraints. Future use of the model will include an analysis of government pricing and credit policies. The following series of short term studies designed to investigate the effects of specific production system constraints on output, productivity, marketing, pricing, credit and general economic policies will be conducted to complement the development of the model.

### 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 from both moderate and low rainfall areas in Brazil 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-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 Brazil 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 Brazil and the US government's view of Brazil 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 Brazil 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 Brazilian 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, EMBRAPA, 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: Evaluation of Meat Goats and Hair Sheep in Brazil

Status: New Project

Sub-Grantee: Texas A&M University  
San Angelo, Texas 76901

Principal Investigators: Maurice J. Shelton

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

#### A. The Problem

The arid or semi-arid region of Northeast Brazil has a population of over 5 million head of sheep (5,289,935) and over 6 million head of goats (6,094,586). This number constitutes over 92% of the goats in the entire country, but only approximately 18% of the sheep. These animals are concentrated in the states of Piaui, Ceara, Pernambuco and Bahia. The remainder of the sheep in the country are found in the more temperate regions of the South of the country. In the South the sheep are of the more traditional wool types, whereas those of the Northeast are of the non-wool producing or hair types. The goats of the Northeast are similar in form and function to those found throughout much of the world. Thus data collected on these would be applicable to a high percent of those found throughout the arid regions. The hair type of sheep found here are comparable to many found in the tropics or semi-arid tropics. Although hair sheep are found (worldwide) in much less numbers than others such as the Merino or Fat-Tail types, they are often found in critical areas relative to man's need. The sheep and goats of this Northeast region are of small size with low yields of meat. The two species serve a similar function in terms of meeting man's needs, but it is not clear to what extent they are competitive in resource utilization. The offtake from these flock are low. Although the data for calculation of offtake is not readily available it appears to be below 20%, whereas, similar values for other areas or other countries may approach 100%. The industries based on these species contributes to a subsistence type of agriculture in which any improvement would not only benefit the individual producer and his family, but would improve regional and national economics as well. Any means or methods which can be developed to accomplish this would have widespread interest in similar areas throughout the world. These animals are produced largely for meat, but a large part of this is used for local consumption.

Under these conditions hides or skins may make the most important contribution in terms of cash flow. Sheep are apparently never milked, and it is not clear to what extent goats are utilized as a source of milk for household use. Goats appear to be better adapted and in better condition in the region, but in much of the area there appears to be a preference for sheep. The only immediate explanation given for this is that sheep are easier to handle or control than goats.

It seems apparent that the greatest need to improve production in Brazil is to improve the nutrition available to the animals, especially during the dry season. With the 500-700 mm of rainfall which is concentrated during one season of the year there appears to be some real opportunities to accomplish this through grazing management, stored feeds or forages, etc. As this can be accomplished the appropriate management and breeding practices need to be developed. There does appear to be some real opportunities to make genetic improvement based on or utilizing genetic resources available in the region, but the possibility of introducing exotic gene sources should not be ruled out. Although gains through genetics are slower to be accomplished, it tends to be more permanent, and does not require repetition annually or seasonally. Most of the sheep of the Northeast appear to be of the small nondescript Crioula type. A majority of the goats are of the type known as SRD (Sem Raza Definida). Adaptability is a predominant or necessary feature of both species. However, both species are characterized by low offtake and low yield (small size and low dressing percent). It seems obvious that nature has selected for survivability. Selective breeding efforts would need to attempt to increase offtake (net reproduction) and meat yield (size and growth rate). There is an important need to determine how these traits are related to each other, and to the ever present need for adaptability. Answers to these questions will have important worldwide application.

## B. Project Objectives

These are long term objectives as currently viewed, and the first year will consist of planning and initiating the appropriate studies with as much progress as can be accomplished in one year.

1. To characterize or to assist Brazilian workers to characterize major genetic types of sheep and goats and to identify local or available types for use in long term improvement programs.
2. To initiate and collaborate with Brazilian scientists in studies to determine or clarify the relationship of traits such as growth rate, fertility, disease resistance and adaptability to the nutritional and environmental conditions of the tropics and the possibility of obtaining all of these traits with a single genetic type.
3. To initiate and collaborate with Brazilian scientists to design and initiate long term selection or improvement programs with selected genetic types.
4. To assist local staff in Brazil to obtain experience and/or advanced training adequate to carry on long term genetic improvement programs after Small Ruminant CRSP is no longer functional.
5. To assist the local staff on cooperating stations in both U.S. and Brazil to develop appropriate production systems to maximize offtake and return.

## C. Research Approach

### Brazil

#### Objective No 1.

Initial efforts in relation to this objective will consist of a simple description of the available types of sheep and goats in the Northeast. This should facilitate communication between project personnel, visitors to the site as well as wider audiences.

Researchers at CNPC, Sobral, are currently conducting more basic breed evaluation or characterization studies with several types of goats and sheep. The work with goats involve and encompasses most or all of those likely to be found of interest, but the number (of types) is far too great to attempt to initiate long term improvement programs with all these. The data currently being collected should be adequate to provide a basis for reducing the number of types involved. In addition the various breeds or types of goats are being evaluated in crossing programs at EPACE, Quixada, Ce. Characterization work with sheep at present involves only the three types (Morada Nova, Santa Inez and Somali). It is doubtful if any of these should be eliminated from future programs, but there is a need to characterize the types to determine their future use. In addition to these types some consideration is being given to the addition of others such as the Crioula, Bergamacia or Rabo Largo. The Texas project will contribute to the effort at Sobral primarily through providing assistance and consultation in decision-making relative to the breeds to be included or deleted from long term efforts. Plans call for more direct involvement in the data collection and analysis of the crossing studies at Quixada with a view to obtain the maximum benefit from available resources. These data will be combined with similar studies to be conducted in the U.S. to provide an early estimate of the genetic parameters for meat type goats.

A large portion of the world's sheep population, at least those found in the arid or semi-arid regions consist of some type of Merino, some type of Fat-tail or some type of Hair sheep. These no doubt differ widely in form, function, adaptability, etc., but they have seldom been compared in these traits. The latter two have received relatively little study involving potential unique traits. Flocks of each of these types, as well as meat type and Angora goats will be established and maintained by the Texas station. They will be compared as to their grazing habits utilizing the fecal analysis techniques. Later studies will explore differences within types and the possibility of altering

these through selection. Samples of each type will be slaughtered to partition body parts and to determine carcass composition and value. In subsequent years physiological measures of adaptability and reproduction will be obtained, particularly as related to site of fat deposition.

## Brazil

### Objective No.2

Most animals which have evolved in or adapted to tropical environments tend to be small in size and slow growth rate. They may or may not have a high lambing rate depending on the degree to which environmental stress favors or penalizes multiple births. It seems to be important to determine to what extent the traits of reproductive rate, adaptability, growth rate and disease resistance are interrelated, and if it is possible to develop an animal which excels in all of these. One disease of near worldwide importance with sheep and goats is Caseous Lymphadenitis (*Corynebacterium pseudotuberculosis*). This is a particularly important disease in Brazil. Preventative or therapeutic measures have not been identified. Thus the possibility of developing genetic resistance to this condition should be investigated. Questions relating to the interrelationship of the above traits might be answered through analyses for the appropriate genetic parameters from a well collected and adequate body of data. However, these types of analyses do not always provide the desired results, and the maintenance of large flocks for this purpose alone might be questioned. Interpretation would be enhanced by establishing selection lines involving these traits and observing trends in the other variables. This would provide for simultaneous selection for the desired traits while the studies are underway. Ideally this would be done with one type of sheep such as the Morada Nova and one type of goat such as the SRD or Moxoto. Present plans call for establishment of selection lines with sheep at Quixada. If this is not possible work of this type will be delayed until

more land area can be made available at Sobral. If neither of these are feasible the possibility of working at another site will be explored.

Current plans call for preparing a sub-project which would permit establishment of selection lines of Morada Nova sheep at Quixada. The tentative selection lines would be as follows:

1. Rate of growth
2. Fertility
3. Resistance to Caseous Lymphadenitis
4. Index selection involving growth rate and fertility

When established each line would consist of a minimum of 100 females. In addition plans call for collection of pedigree and performance type data on the larger flock of Morada Nova on the grazing studies with a view of having access to these animals and data to select males for the selection lines.

Within the first year little more can be accomplished than preparation of project documents and establishing flocks and data collection routines.

#### U.S.

A large flock of Spanish or Meat type of goats and smaller number of other types will be maintained in the U.S. with a view to calculation of appropriate genetic parameters. The results of these studies will be combined with those from Brazil to aid in interpretation and to improve in the extrapolation of the results to other parts of the world. Work will be initiated in the U.S. to attempt to develop laboratory procedures to identify animals harboring an infection of Caseous Lymphadenitis to improve selection for resistance to this condition.

#### Brazil

##### Objective No. 3

Improvement programs for sheep and goats might be approached through three phases, ie, a. characterization of genetic types and identification of those

deserving further study, b. determination or estimation of genetic parameters and the compatibility of selection for the desired traits, c. initiation of selection programs. To a limited degree these phases can be pursued simultaneously. It is important that appropriate long term selection programs be initiated. Throughout the world these efforts may be conducted by private producers or research organizations or a cooperative program involving both. The limited resources available to most sheep and goat producers in Northeast Brazil suggest that government agencies should take an active role in animal improvement, and in order that this can best be accomplished it is suggested that research workers should take the lead. In order to have a very great likelihood of success selection programs should involve a large number of animals. These may be obtained in one large flock or involve a network of a number of smaller flocks. Until phase b. has been completed, animal breeders need a significant number of animals devoted entirely to genetic studies. Following this a number of flocks from different locations, different management schemes, etc., can be integrated into a common selection program. In order to accomplish this, record forms and data collecting schemes should have at least some common components throughout the region. In this connection it is proposed that workers involved in the Texas Project will assist workers at CNPC in developing data collection and recording forms, the design of appropriate selection programs, and if possible, contribute to data collection and recording at least one location. This would be an effort to be conducted over a period of years, and little can be expected from one year's work other than initiating the desired programs.

#### U.S.

Selection flocks for hair sheep, finewool sheep, meat type and Angora goats will be established or maintained in the U.S. Any superior types identified in these studies will be available for distribution to LDC areas as warranted and permitted.

#### Objective No. 4.

Within the first year the principal collaborating scientist at CNPC will be brought to the U.S. for a period of study and orientation. During this stay detailed work plans or project statements for the animal breeding section will be completed. In addition budget and support will be provided for one graduate to study at Texas A&M University. Initially this will be a U.S. student working on problems of international significance. However, if or when appropriate students can be identified this support will be shifted to a U.S. student who will do his research work in Brazil or a Brazilian student who would do research work in Brazil and classwork at Texas A&M University. Once subprojects have been prepared and approved the location of a student at Quixada would receive high priority. Until this can be accomplished the work should proceed with periodic visits at critical times by workers from U.S. and CNPC. It would appear that the present animal breeder at Sobral would make an excellent candidate for advanced study, but his absence from CNPC at this time would be disruptive. However, workers would look with great favor on his initiating advanced study in the period 1981 to 1983 utilizing data collected in Brazil.

During or throughout the project, personnel from the Texas Project will be available for assistance in training sessions or short courses as requested by Brazilian co-workers as organized by the overall CRSP effort.

#### Objective No. 5.

The most efficient production system is a goal of the entire project. However, some type of production system is necessary from the outset not only in commercial practice, but with research flocks as well. Thus design and testing of alternatives in the production system should be a continuous process. Workers in the Texas Project are actively involved in goat production in the U.S. and will attempt to provide counsel and assistance in developing the most efficient system at test sites in Brazil. The results from these efforts should provide a base of infor-

mation and experience for application over a much wider area. Initially these efforts will concentrate on sheep, but a similar need exists with goats as well.

D. Assumptions That Objectives Can Be Met

Animal breeding or animal improvement is a continuous process and thus objectives in this area are never completely accomplished or finalized. The objectives as stated are to place in motion programs which will be carried forward over a period of years. Within the first year the major accomplishments expected are to outline projects and work plans and to develop personnel capability. The prospects that this can be accomplished are reasonably good, but are dependent in a large degree on the support and efforts of collaborating institutions or agencies in Brazil.

E. Assumptions That Meeting Objectives Will Solve The Problem

Animal improvement is only one of a number of approaches to be taken to improve sheep and goat production. Other approaches may have higher priorities, and the final result would be the integration of a number of approaches. As pointed out earlier, animal improvements will be slow to progress unless superior types can be identified and introduced. The training of people and initiation of programs will provide the most salient results in the early years.

F. Project Outputs and Indicators That Objectives Have Been Achieved

1. Preparation of a manuscript describing genetic types of sheep and goats in Northeast Brazil.
2. The preparation and clearance or approval of a sub-project within EMBRAPA to provide support for a sheep breeding project at Quixada.
3. The completion of a training and orientation program for the senior animal breeding scientist at CNPC Sobral.
4. The development of recommendations by workers in the Texas Project for goat production systems in the region.

G. Technical Feasibility

The studies or approaches outlined would be based on known techniques.

Therefore the technical feasibility of accomplishing the goals are good. The primary limitations are personal support and animal resources over the period of time necessary to collect animal breeding data and to effect changes in genetic resources.

H. Inputs (See Budget Section)

I. Personnel

The personnel involved in the project have been indicated earlier. Within the first year those involved in Brazil would be primarily the Project Leader, Animal Breeder and Brazilian Collaborators.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Investigation of Nutritional Requirements and Crop Residue  
Utilization of Small Ruminants in Brazil

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.

## The Problem

The feed base for small ruminant production in Northeast Brazil is the native Caatinga vegetation. The biggest problem in maintaining acceptable growth and reproduction rates in goats and sheep is the seasonality of herbage growth, a result of the semi-arid climatic pattern. Even in years of higher than average rainfall, the extended (six months) period with no rain causes a severe nutritional stress, particularly for animals at post-weaning, late gestation, or early lactation stages of the productive cycle. In years of most severe drought (such as 1979) the nutritional stress becomes intolerable, and if animal numbers are not greatly reduced or supplementation provided, a severe malnutrition will ensue, to the point of causing high mortality losses.

One of the first priorities for small ruminants nutrition research, then, is to design feeding systems which will help alleviate the nutritional stresses of the dry season. The design of economically feasible feeding systems requires knowledge not yet available about native forage plants of the Caatinga, as well as the effect of several management variables, including both Caatinga management and sheep and goat management. Knowledge about the following factors is essential, and presently insufficient:

1. Forage availability from the Caatinga, both amount and quality, in relation to soil type and water availability.
2. The effect of grazing pressure on nutrient availability from the Caatinga, both natural and improved.
3. The interaction of breeding season with the yearly climate cycle in determining reproductive efficiency of females and slaughter age of kids and lambs.
4. The effects of supplemental feeding of the does and ewes on disease and parasite manifestation and reproductive parameters, and on the growth of suckling young.
5. The effects of length of suckling period on the nutritional needs of the

lamb for lactation and for subsequent gestation.

6. The interaction of weaning age and level of supplementation on kid and lamb performance.
7. Species (sheep vs. goats), breed within species, and individual animal effects on efficiency of reproduction and growth under nutritional stress or with supplemental feeding.

Research in nutrition of goats and hair sheep will be conducted jointly by scientists from EMBRAPA (CNPQ and CPATSA) and North Carolina State University. Those aspects of the above problem areas that are related to range and native pasture management will be investigated in detail by the range management group. At all times, close collaboration will be maintained among the nutrition, range, reproduction, and other disciplinary groups of EMBRAPA and the CRSP, in defining and investigating the above problem areas.

#### Objectives

The Collaborative Research Support Program for nutrition and feeding studies is designed to achieve the following objectives over at least a five-year period which could possibly be extended.

1. Study the availability of various crop residues and by-products for use in dry season supplemental feeding, and to determine their nutritional value.
2. Develop guidelines for dry season feeding systems for does and ewes (pre- and post-partum), and study the interaction of breeding season with supplementation requirements.
3. Develop practical guidelines for supplemental feeding of weanling kids and lambs.
4. Develop recommendations for crop residue storage and treatment methods, to maintain or enhance nutritive value.
5. Study the predictability of animal performance from laboratory analyses of grazed and harvested forages, browse plants, and crop residues.
6. Accumulate data which will lead to a better understanding of the nutrient

requirements of native and improved goats and hair sheep in the semi-arid tropics.

### Project Approach

The following paragraphs summarize the work plan that was agreed upon by the NCSU Principle Investigator and the nutrition research leaders at the CNPC, Sobral, in October 1979, for work to be conducted in Sobral and in Raleigh. Initial contacts have also been made with a nutritionist at the CPATSA, Petrolina, and it is expected that complementary activities will be agreed upon early in 1980 for implementation at Petrolina.

### Objective 1

#### At Sobral

The main crops produced in the sheep and goat regions of the Semi-arid Northeast are cotton, beans, and corn. In traditional farming systems near Sobral, beans and corn are planted as annual crops between the rows of perennial (5-year) cotton, during the first year only. Beans are harvested at the beginning of the dry season (July); corn is field-dried and harvested several weeks later; and the cotton harvest begins in September. At least five varieties of beans are commonly grown.

For the first phase of nutritional evaluation of crop residues, arrangements will be made for representative sampling of residues from these three crops, plus others that may be encountered, from several areas of the states of Ceara, Pernambuco and Bahia, at several periods of time during the dry season. These samples will be analyzed for protein, fiber, lignin, calcium and phosphorus content, and for dry matter and fiber digestibility (in vitro).

The second phase will be to conduct digestibility and intake trials using rations formulated with crop residues at various levels. Castrated male lambs and goats will be placed in metabolism cages or fitted with fecal collection harnesses and confined to pens, for controlled intake measurement and digestibility determinations. This phase of work is expected to be fully underway by July 1981.

### At Raleigh

A literature review on the nutritional value of crop residues for small ruminants will be carried out. Also, intake and digestibility trials and in vitro evaluation of rations with corn plant residues will be conducted.

### Objective 2

#### At Sobral

The work conducted under this objective will be part of a long-term nutritional study which will evaluate the entire feed base and its use in rational feeding systems for sheep and goats in various stages of the productive cycle. In addition to crop residues, the use of cultivated forages, browse plants, and native legumes will be considered.

Ideas for a central, long-term nutrition experiment at the CNPC have been discussed. While at this writing the details of the experiment have not been finalized, it will have as its central objective the evaluation of supplementary feeding systems to fulfill the animals' requirements for optimum productivity during the dry season. Supplementation pre- and post-partum will be tested for does and ewes. Supplementation levels and sources will probably be tested as treatments nested within main treatment groups, which are expected to be different breeding systems or seasons.

A wider range of treatments may be tested in short-term trials with separate groups of animals.

### Objective 3

#### At Sobral

Also nested within main treatment effects of the above-described central experiment will be sub-treatments for testing supplementation sources and levels for weanling kids and lambs. As above, a wider range of treatments may be tested in separate short-term trials.

### Objective 4

#### At Sobral

The hot, dry climate allows for rapid dehydration of crop residues in the

field. Storage in situ may be the most economical system, rather than incurring labor and transport costs for harvesting crop residues. However, for certain specialized uses the cost may be justified. Also, harvesting may prevent excessive field losses; or harvesting and storing small quantities may permit the entry of cattle to consume the remaining material while a portion is set aside for goats and sheep.

The investigators will keep an open mind about possible storage and treatment methods to test. However, it is expected that this objective can easily be met by adapting known information from other locations.

#### Objective 5

##### At Sobral and Raleigh

The approach to meeting this objective is essentially statistical. Regression analysis of in vitro digestibility, chemical composition, in vivo digestibility and intake, and animal growth rates will be undertaken. The widest possible range of feedstuffs will be included in these tests.

The results can become the basis for extrapolation and prediction of animal performance based on analysis of farmers' samples, as might be conducted by a feed analysis service lab.

#### Objective 6

##### At Sobral and Raleigh

The nutrient requirements of small ruminants of the type found in the Northeast have not been precisely estimated. This basic information for animals in various productive classes will be important, in order for extension agents and producers to successfully adapt station-tested diets to field use.

The feeding trials for achieving objectives 2 and 3 will yield data which over the long run can be used in the estimation of nutrient requirements. In order for such estimates to have a reasonable degree of precision, many trials will have to be conducted with similarly classed animals. By the fifth year of the project, enough data is expected to be available to allow preliminary esti-

mates for certain production classes.

#### Assumptions That Objectives Can Be Met

1. Budgetary and personnel commitments from the CRSP and EMBRAPA to this project will be adequate to carry out planned work.
2. Nutrition facilities at the CNPC, Sobral, can be devoted partly to the collaborative project. This includes land, animals, animal housing, metabolism units, and laboratory facilities.
3. Collaborative arrangements with EMATER can be worked out for sampling crop residues in farmers' fields.
4. Sufficient quantities of crop residues and other feedstuffs to be tested can be purchased and transported to the CNPC.
5. Collaboration can be maintained with range, health, reproduction, animal management, herd improvement, economics and systems specialists, in order to properly design and implement a discipline-integrated central nutrition experiment.

#### Assumptions That Meeting the Objectives Can Solve the Problem

1. Animal response to dry season supplementation will be sufficient, in terms of added growth, lactation and/or reproduction rates, to offset the added costs incurred through more intensive management. Record-keeping in the central nutrition experiment must be sufficiently detailed to allow this kind of economic analysis (marginal analysis and partial budgeting).
2. Extensionists and producers can test recommended supplementary feeding systems on the farm, and provide critical feedback to the research team about the efficacy of their recommendations.
3. Marketing incentives and education programs will be adequate to insure widespread adaptation of new recommended feeding systems to individual farm situations.

#### Project Outputs and Indicators That Objectives Have Been Achieved

1. Appropriate popular and scientific publications, in English and Portuguese.

2. Trained research leaders and technicians, able to continue work toward long-term objectives.
3. Demonstrated interest and enthusiasm among producers and extension personnel in Northeast Brazil, for adaptation and application of research results.
4. Creation of a continuing mechanism for communication among appropriate research and extension agencies of Brazil and other Latin American countries where goat and sheep production is carried out in semi-arid environments similar to Northeast Brazil.

#### Technical Feasibility

The research methods to be used are standard to the field of animal nutrition, and can be adapted to the facilities projected for second-phase construction at the CNPC.

The use of crop residues and by-products in feeding systems for ruminants has been well-documented in recent scientific literature. The specific crop residues available in Northeast Brazil are known to have residual feeding value. A challenging problem will be to provide an economically feasible protein source to balance dry season supplemental rations. However, a number of alternatives exist which can be tested, including leaf-meals from local leguminous shrubs and trees.

#### Personnel

Project leaders have been identified as follows:

CNPC, Sobral - Claudio Bellaver

Ederlon Oliveira

CPATSA, Petrolina - Luiz Mauricio Salviano

North Carolina State University, Raleigh - William L. Johnson

Lemuel Goode

W. J. Croom

At the technician level, four technicians will be working part-time at Raleigh in support of the collaborative project for Brazil. Also, the CNPC is expected to

provide technician services as soon as the new nutrition laboratory and metabolism unit are ready for operation.

A graduate assistanship in Raleigh is currently assigned in part-time support of the Brazil project. As the project expands in years 2 - 5, funds from the CRSP and from EMBRAPA will be sought for support of additional graduate students.

Labor needs in Raleigh will be provided through CRSP and NCSU regular budgets. Labor needs in Sobral will be provided by EMBRAPA.

Inputs (See Budget Section)

Implementation Plan

Year 1

1. Literature review to be ready for publication.
2. Initiation of work toward objectives 1 and 5 (Raleigh).
3. Detailed planning for work toward objectives 1, 2, and 3 (Sobral).
4. Planning for work to be conducted at Petrolina.

Year 2

1. Crop residue and by-product classification, sampling, and chemical evaluation (Brazil).
2. Initiation of central nutrition experiment (Sobral).
3. Initiation of animal digestibility and intake trials (Sobral and possibly Petrolina).
4. Continuation of work toward objective 5 (Raleigh).

Year 3 - 5

1. Continuation of work from Year 2.
2. Initiation of dry season supplementation experiments for late gestation and early lactation does and ewes, and weanling kids (Sobral).
3. Preliminary on-farm testing of recommended supplemental feeding systems (Brazil).
4. Intensification of emphasis on objective 5 and 6, possibly through Ph.D. dissertation research (Brazil and Raleigh).

5. Planning for future collaborative research, including sources of financial support.
6. Regionalization of results, through appropriate publications, workshops, or collaborative adaptive research in third countries.

Notes from Meeting of Forages and Soils Group

Centro Nacional de Pesquisa en Caprinos e Ovinos (CNPQ)

Sobral, Ceara, Brazil

October 16, 1979

Participants:

Don Burzlaff (Texas Tech), Jim Sanders (Texas A&M Systems project), Augmar Ramos (Soils), Roberto Mesquita (Forages), Luiz Vale (Forages), and Helenira Vasconcelos (Soils).

The group identified range management inputs critical to the Small Ruminant CRSP. These inputs are particularly critical to the success of the modelling or systems program. They are essential for improvement of goat production for Level 1 and 2 production schemes as defined by EMBRAPA for the Northeast.

1. Characterization of range sites--To identify soils and vegetation for specific kinds of rangeland that have similar climate, soils, vegetation and production potential. This is most essential in attempting to transfer information from the experimntal areas to the surrounding regions.
2. Such characterization involves soil data, species composition, current production levels, and specific management needs dictated by relief or soil type or some other controlling factor. Seasonal production and quality of forage for goats and sheep must also be known.
3. Need to develop seasonal species preference data for goats and sheep under various levels of animal and range improvement. This involves adding a dimension to existing research with the use of technologies no possible with current personnel. This would include fecal analysis, in vitro digestion and possibly use of fistulated animals for more refined diet work (including the nutritional evaluation of desirable or preferred species).
4. When plant preferences at various seasons are established, selective removal of undesirable species will be possible--through the use of basally applied herbicides suspended in used motor oil or in diesel fuel or other appropriate methods.
5. The nutrient requirements of goats and sheep by sex and by stage of physiological development must be determined.
6. There must be evaluation of ways to correct deficiencies in small ruminant diets when they exist, through supplements to the grazing diet. This might include crop residues, seeded forages for grazing, or harvested forages fed as hay. Included for consideration are various legumes (both forbs and shrubs), cactus, various grasses, or crops.

Current staff are cognizant of the above needs and within limits are willing to change current research direction. I see no need in this and steps should be taken to increase station capability by adding more range management expertise to the staff. There should be strongly worded request for appropriate contribution of the small ruminant CRSP made to the Technical Committee. I, for one, will do this.

I believe EMBRAPA could have two more range scientists here and that the CRSP should send 1 research scientist and 2 graduate students to work at this site.

October 16, 1979

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Investigation of the Reproductive Physiology of the  
Small Ruminants in Northeast Brazil

Status: New Project

Sub-Grantee: Utah State University  
Logan, Utah 84322

and

California State Polytechnic University  
Pomona, California 91768

Principal Investigators: Warren C. Foote

and

Edward A. Nelson

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

## A. Statement Of Problem

Research with small ruminants in northeast Brazil offers unique opportunities for generation of information because of organizations such as EMBRAPA with highly developed infrastructure including well trained research personnel working on small ruminants and the high priority that the Brazilian government has placed on improvement of the standard of living of its rural population through improvement of animal agriculture. Research in northeast Brazil also has wide application because (1) its semi-arid conditions are representative of environments in parts of Asia and Africa and also other countries of South America and (2) there are a large number of native and some imported genotypes of goats and hair sheep available for study.

Reproductive performance of both the male and female is a major factor in determining the usefulness of the different genotypes of these small ruminants because it directly affects level and efficiency of production.

Pertinent reproductive traits which can be objectively measured in the female include age and weight at puberty and at first parturition; levels of fertility; prolificacy; incidence of estrus and ovulation and rate of ovulation throughout the year, reproductive phase, or environmental periods; postpartum periods to estrus and conception; parturition intervals; birth weight; and endocrine profiles. In the male such reproductive traits include age and weight at puberty, seasonal and/or environmental changes in semen production and libido, freezability of semen, and endocrine profiles.

The best single measure of reproductive performance in the female is the weight of young weaned per female or as a function of her body weight. Also postnatal as well as prenatal factors contribute to this performance. This measure includes the influence of lambing rate (prolificacy), survival, and growth rate and size.

Basic information on reproduction is required for each genotype under consi-

deration before valid comparisons can be made and selection of genotypes to improve production can be completed.

Similarly differential reproductive responses of genotypes to varying environments (genetic-environment interactions) should also be included in selection of genotypes for particular or unique environments.

Reproductive performance influences generation interval and the selection pressure that can be applied in a genetic selection program and thus directly influences the rate and efficiency with which genetic improvement can be achieved.

Reproductive efficiency of small ruminants in northeast Brazil is low. The intent of the reproduction components of the SR-CRSP is to identify the limiting factors, the relative influence of genetics and environment, and to cooperate with other CRSP components in developing improved breeding and management programs to remove these barriers and to provide useful, practical ways to improve reproductive performances as a means of increasing production offtake.

#### B. Objectives

1. To measure the reproduction capabilities of indigenous genotypes of small ruminants under environmental conditions of northeastern Brazil.
2. To identify and propagate flock from those genotypes (indigenous and exotic) judged to have superior reproducing ability under improved environmental and management conditions.
3. To measure reproductive response to management practices required to improve reproductive performance or to management imposed by other Title XII SR-CRSP components.
4. To assist EMBRAPA scientists in the accumulation, interpretation and application of research results including development of required management components to optimize reproductive performance.
5. To assist EMBRAPA scientists and technicians to continue their formal

education and obtain special training by providing appropriate opportunities.

6. To compile information from genotypes of sheep and goats as it becomes available for inclusion in the Small Ruminant Production Data Bank.

### C. Project Approach

#### General Considerations

The objective will be achieved by combining resources available directly through the Title XII Small Ruminant-CRSP components dealing with reproduction and including research already underway by EMBRAPA scientists. Initially the research will involve a minimum of 2 genotypes each of sheep and goats selected on the basis of existing information on their genetic diversity (least related) and on their potential in food, fiber, and pelt production. The actual number of genotypes compared and related research and resources will be determined by EMBRAPA needs and resources.

#### Specific Considerations

##### Objective 1

To measure the reproduction characteristics of indigenous genotypes of small ruminant under environmental conditions of northeastern Brazil.

As many genotypes of sheep and goats as possible will be studied. Two experimental groups for each breed will be developed under optimum conditions; (a) females and males for use in measuring reproductive performance, and (b) females and males for measuring specific reproductive processes. All animals will be maintained under management conditions typical of the EMBRAPA program except where modifications are required to obtain data.

(a) Measurement of reproduction performance. The females will be bred during the usual breeding season. The breeding period will be approximately equal to the length of two estrous cycles. All males will be fertility tested (semen and physical examination) during the week prior to the initiation of breeding. Data

obtained on the females will include body weights at time of breeding, the proportion that breed of those exposed for breeding, fertility (proportion parturating of those exposed for breeding), prolificacy (number of young born per female parturiating). proportion of young born alive, general observations on mothering ability (ease of lambing and behavior), and adequacy of milk, length of the postpartum interval, and age at puberty in replacement animals. Data obtained on young will include the incidence, time and cause of death from birth to weaning, weights at birth, and at monthly intervals from birth to weaning and from weaning to slaughter.

(b) Measurements of specific reproductive processes. Measurements of specific reproductive processes are basic for determining reproductive potential. The following information will be obtained where feasible in the female. The females will remain unbred but kept continuously with teaser males. Data will include length of estrous period; length of estrous cycle; annual incidence of estrus (to establish period of seasonal or environment related anestrus); incidence and rate of ovulation (measured monthly or quarterly using laparotomy); endocrine profiles (progesterone and LH) during the estrous cycle, periods of anestrus, and late prepartum and early postpartum (measured in ewes on reproductive performance research); length of postpartum interval (period from parturition to the first postpartum estrus measured in ewes on reproductive performance research). Information obtained in the males will include semen production and libido at two week intervals throughout the year (to establish the influence of natural environmental changes) for the period of their reproductive life, freezability of semen, and endocrine profiles (testosterone and LH) at selected periods of the year.

The data obtained under objective 1 will be analyzed to provide measures of the different reproductive processes and of reproduction performance and of their interrelationships. These will be used to establish estimates of reproduction capability or potential.

## Objective 2

To identify and propagate flocks of those indigenous genotypes (and possibly exotic genotypes) judged to have superior reproducing ability under improved environmental and management conditions. Decisions concerning genotypes and environment-management conditions will be made with consultation and agreement of CNPCOT and SR-CRSP personnel working in those disciplines.

At least one genotype each of sheep and goats will be identified on the basis of reproductive performance and a flock developed and managed using improved practices outlined in Objective 3 to optimize level and efficiency of reproduction under the environmental conditions existing in northeastern Brazil. Measurements similar to those obtained from reproductive performance ewes in Objective 1 will be obtained and used to evaluate their performance. As data are reviewed the need to introduce additional germ plasm (either indigenous or exotic) will be determined.

## Objective 3

To measure reproductive response to require management practices to improve reproductive performance or management imposed by other Title XII SR-CRSP components.

Required management components for increased level and efficiency of reproduction will be developed. Their value will be determined using the genotype(s) of animals used in Objective 2 with the management program described in Objective 1 as a control. Information used in developing these improved management components will be taken from all available appropriate sources including previous experience and research at EMBRAPA, results of other Title XII-CRSP components in Brazil dealing with management, nutrition, animal health and breeding.

Management practices imposed by other CRSP research components that relates to reproduction as a part of their research will be evaluated on their research animal in terms of reproductive response as a part of this objective.

#### Objective 4

To assist EMERAPA scientists in the accumulation, interpretation and application of research results including development of required management components to optimize reproductive performance.

A significant amount of reproduction related research has previously been conducted or is currently being conducted by EMBRAPA scientists that is not an integral part of the research planned for the SR-CRSP. This objective will be achieved by assisting these scientists in the accumulation, interpretation and application of the results of this research as well as to cooperate in a similar manner in terms of the data obtained directly from the SR-CRSP. A major emphasis will be placed on the application of results to aid the livestock producer, including the small producer, in northeastern Brazil and in LDCs with similar environmental conditions.

#### Objective 5

To assist EMBRAPA scientists and technicians to continue their formal education and obtain special training by providing appropriate opportunities. Achievement of this objective will include the following programs.

- (a) Aurino Alves Simplicio will enter the Ph.D. program at Utah State University under the direction of W.C. Foote and E.A. Nelson. It is anticipated that research for the degree will be conducted as a part of the SR-CRSP reproduction component in Brazil.
- (b) Other Brazilian scientists will receive training for advanced degrees and/or special training at Utah State University or California State Polytechnic University, Pnomia, as required to strengthen the research program and for professional improvement.
- (c) Graduate students from Utah State University and California State Polytechnic University will conduct research for their degree at Sobral to strengthen the reproduction related programs at CNPCOT.

- (d) Short courses, special training programs and other related programs dealing with reproduction will be held at the EMBRAPA Station, Sobral, Ceara, Brazil to provide necessary training to those involved in research or to disseminate information to other scientists or small ruminant producers.
- (e) Semi-annual visits to Sobral will be made by scientists from Utah State University and/or California State Polytechnic University, Pomono. During these visits the U.S. and EMBRAPA scientists and other CRSP personnel will be involved in all phases of the research including data collection, analysis, interpretation, evaluation, application, and planning of continuing research. In addition special training programs such as workshops will be conducted as required to increase the capability of personnel and to disseminate information. An integral part of the visit will be the evaluation of progress toward meeting objectives. The visiting U.S. scientists will also cooperate where need is indicated to strengthen and support other components of the CRSP or related research.
- (f) Management plans to increase reproductive performance, particularly for the small producer, will be developed cooperatively.

#### Objective 6

To compile information from genotypes of sheep and goats in Brazil and other South American countries as it becomes available for inclusion in the Small Ruminant Production Data Bank.

This objective will be achieved by compiling all relevant data generated in the SR-CRSP or from other sources on the genotypes of sheep and goats in Brazil and neighboring countries in the Small Ruminant Production Data Bank. Achievement of this objective does not require research in addition to that outlined in the other objectives. It will be achieved by compiling data generated by reproduction research, some other CRSP research and information from other credible sources in

South America.

D. Conditions That Indicate Objectives Have Been Achieved (Indicators)

1. Estimates of reproduction potential of selected genotypes will be established and available for use.
2. Estimates of influences of selected management conditions on reproduction will be available for us.
3. Management plans for improved reproduction will have been developed and tested and recommendations based on results made available for use.
4. Production of flocks judged to have superior reproducing ability will have been completed under improved management conditions.
5. At least one EMBRAPA scientist will be assisted in obtaining an advanced degree. Short courses (one per year) will be held for training EMBRAPA scientists and other personnel and disseminating acquired information and recommendations.
6. Papers will be published relating to the research conducted.

E. Assumptions That Objectives Can Be Met (Externalities outside control of P.I.).

1. That AID funds will be made available on time and in amount requested.
2. That resources from USU will be made available on time and in amounts requested.
3. That animals, facilities and other resources and management control are available in foreign work sites.
4. That capable scientists and supporting personnel at foreign work sites are available for conduct of cooperative programs.
5. That personnel at foreign worksites cooperate in planning and conduct of training programs.

F. Assumptions That Achieving Objective Will Solve The Problem

1. Achievement of objective 1, 2, 3 and 4 will provide information on reproduction performance from selected genotypes under selected manage-

ment conditions. This will contribute to improved level and efficiency of production by providing alternative programs for increasing reproduction performance.

2. Completion of training programs (Objective 5) will improve the research and management capabilities of foreign work site personnel.
3. Achievement of Objective 6 will provide useful information to scientists and producers in northeast Brazil and others throughout the world with similar climatic conditions on adaptation and production capabilities of genotypes suitable to such environments.

G. Outputs Of Project

1. Provide estimates of reproduction capabilities of selected genotypes under existing and improved management conditions.
2. Provide alternative management programs for improved reproduction.
3. Establish and make available a data bank of information on reproduction and selected performance for small ruminants.
4. Train scientists and supporting personnel to improve their professional capabilities.

H. Technical Feasibility

1. The scientists involved in this project are well trained.
2. The facilities at U.S. universities and at CNPCOT, EMBRAPA (Sobral) are adequate for the research planned.
3. The cooperative effort with EMBRAPA has the full support of administrators at U.S. universities and CNPCOT, EMBRAPA.
4. Requested resources are adequate to accomplish the programs planned.

I. Inputs (See Budget Section)

J. Time And Scope Of Work

Work for each objective will be initiated according to the following schedule. Objectives 1, 4, 5 and 6. First year of program and continue throughout

project. Objective 2 and 3. Third year and continue throughout project.

K. Project Monitoring

1. All programs will be initiated by or under the direct supervision of the P.I. with full cooperation of counterpart scientists at the foreign work site.
2. Programs will be monitored through approval of funds and other resource transactions, research participation, supervision, data and summaries, planned meetings, seminars and reports dealing with both quantity and quality of results and compared to time schedule expectations.

L. Annual Review And Planning Process

1. Annual evaluations of programs and personnel will be held at appropriate levels and locations.
2. Annual reports will be analyzed for project strengths and weaknesses and procedures developed and required resources requested to maintain or achieve planned level of achievement.
3. In all reviews and planning both quantity and quality of results will be evaluated and compared to time schedule expectations.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Small Ruminant Flock/Herd Health Program in Small Holder  
Systems in Brazil

Status: New Project

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

Principal Investigator: Blaine McGowan

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

## First Year Work Plan

The January, 1979, five year project document contains a detailed discussion of the overall program. The following is primarily limited to a concise treatment of the first year's activities.

In April, 1979, this project was assigned to develop animal health programs in Northeast Brazil and Indonesia. This document will treat only the Brazil project.

### A. The Problem - Project Objectives

A simplified listing of the basic elements of the project objectives are as follows:

1. To define and prioritize the health constraints which are depressing production of meat and hides from sheep and goats.
2. Through research, develop economically and sociologically acceptable strategies to control or prevent animal health constraints.
3. To strengthen the competency of the animal health personnel in Brazil to identify and to control or prevent animal health problems limiting production of meat and hides.

### B. Objectives for Year One

1. To identify overseas collaborating scientists and initiate collaborative research.
2. To initiate identification of diseases occurring among sheep and goats in Northeast Brazil.
3. To assign research priorities among the most seriously constrained animal diseases.
4. To establish informal cooperative arrangements with several small holder farmers in Brazil for the purpose of monitoring animal health problems on a yearly cycle.
5. To initiate research projects in the following areas:
  - a. identify the causes of kid and lamb mortality

- b. identify the most serious endo and ecto parasites; begin screening anthelmintics for efficacy; collect data on the cyclic nature of parasite burdens.
  - c. a long term study aimed at developing methods of protecting sheep and goats against infections of Corynebacterium pseudotuberculosis, the bacteria causing caseous lymphadenitis.
6. To identify professionals and paraprofessionals in Brazil and the US for advanced training.

C. Project Approach, Year One

- 1. Work to be conducted at University of California, Davis.
  - a. literature review and summary of caseous lymphadenitis and of causes of kid mortality
  - b. diagnosing and cataloguing the causes of kid mortality on a large goat operation.
  - c. initiate, on a modest scale, a long term study aimed at developing methods of protecting sheep and goats against infections of Corynebacterium pseudotuberculosis, the bacteria causing caseous lymphadenitis.
  - d. continue the development of a catalogue of diseases of sheep and goats suitable for international use. (This work was initiated in 1978-79 with planning grant monies).
- 2. Work to be conducted in Brazil.
  - a. identify and catalogue, to the extent possible, the causes of illness and mortality on several typical small holder farms on a yearly cycle. This work will be the major on-site responsibility of a professional research assistant (Nancy East, DVM).
  - b. identify the most serious endo and ectoparasites and initiate studies to determine the cyclic nature of parasite burdens.

#### D. Assumptions That Objectives Can Be Met

1. Satisfactory working agreements can be established with appropriate institutions and agencies in Brazil and Indonesia.
2. Collaborating animal health personnel can be identified in each country who are both able and willing to participate in this project and work toward meeting its objectives. Of the necessary professional counterparts, CNP Caprinos currently has only a parasitologist. A pathologist is to be hired very soon but a bacteriologist, a virologist, and a clinical pathologist are somewhat farther off. Diagnostic services at Recife and Salvador will be used in the interim. This arrangement is helpful, but the animal health program will be handicapped until these professional counterparts are in place and operating at Sobral.
3. Collaborating overseas institutions can allocate suitable laboratory and field facilities to support the project activities. There is a current need for experimental animals and facilities to be assigned specifically for parasitology research. In the near future, the same need will arise for research on contagious and infectious diseases.

#### E. Assumptions That Meeting Objectives Will Solve the Problem

Animal production short fall stems from several major causes: a) adult infertility, b) abortions and stillbirths, c) lamb and kid deaths and debilitating diseases, from birth to yearlings, and d) adult mortality and debilitating diseases. Currently available figure of losses from the above causes vary from 25% to 60% annually.

Assuredly, nutrition, husbandry, and management practices exert a significant influence on these production losses. Beyond that, however, there remains a largely unexplored area wherein gastrointestinal parasites and infections and contagious diseases also take a significant toll. The objectives

of this project are to determine what diseases are involved, assess their impact on production, and develop strategies to reduce this impact. These strategies (animal health programs) must interface with all other CRSP projects. Additionally, somewhat more independent strategies such as vaccine development will be pursued.

F. Outputs and Indicators That Objectives Have Been Met

1. A preliminary assessment of the major animal health production constraints in Brazil will be completed.
2. Initial herd health programs will be formulated.
3. Workable and hopefully productive collaborative counterpart relationships will be established and on-going.
4. A significant compilation of the causes of kid mortality on a large goat operation in California will be accomplished.
5. Literature review and summary of caseous lymphadenitis and of the causes of kid mortality will be completed.
6. A modest research project on the prevention of caseous lymphadenitis will be in progress.
7. A detailed work plan for Year Two will be prepared. Training needs for overseas professionals and paraprofessionals will receive major attention in this plan. Collaborating scientists at participating overseas institutions will have a major role in developing this plan.

G. Technical Feasibility

Disease identification may fall somewhat behind schedule during Year One, depending upon how soon the new laboratories for pathology, bacteriology, virology, and clinical pathology at Sobral are completed, staffed and functioning. Diagnostic support in laboratories at Recife and Salvador will be used in the interim to the greatest possible extent. It is anticipated that most of the diagnostic activity will fall within currently known techniques. The

only deterrants are readily available laboratories and qualified personnel.

Dr. East is already involved in an animal health surveillance program with all sheep and goats on the experiment station at Sobral and with local farms. No problems are anticipated in gaining access to sufficient animals and farms to initiate a disease survey.

H. Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Expansion and Intensification of Goat Production in  
Northeast Brazil

Status: New Project

Sub-Grantee: Tuskegee Institute  
Tuskegee Institute, Alabama 36088

Principal Investigator: Doris M. Oliveira

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

## A. The Problem

The principal technological constraints to goat production in Northeast Brazil are inadequate year-round food supply, non-selective breeding and low rates of reproduction and parasiticism.

Nutrition is the overriding problem of goat production with poor management practices coming second. There is a prolonged dry season which may vary from 6-8 months. During this time most trees (shrubs) lose their leaves and grasses are no better than standing straw. Therefore there is need to provide a year-round forage system that will provide hay, silage or cut feed to supplement the dry season feeding.

In addition to the problem of nutrition, non-selective breeding and low rates of reproduction rank high among problems encountered by goat producers. Non-selective breeding and low rates of reproduction are natural sequelae of the free roaming manner in which they are managed. Because animals are frequently bred when immature and herds often have too many males, many of whom are unproven breeders, there is no opportunity to provide advantages for superior animals.

Parasiticism is a world-wide problem in small ruminants because of their grazing habits, however it is even more acute during the rainy season in Brazil because of the stress they place on the production cycles of already poorly nourished animals.

Fortunately the arid conditions of this area minimize the spread of infectious diseases, especially when they are managed extensively; which is the usual way they are cared for. Greater background detail for Brazil is presented in Appendix #1.

The Title XII Small Ruminant CRSP by definition must direct its efforts toward solving the problems of the "poorest of the poor." In most countries these people are rural, unable to communicate in written word, and women constitute the major

component of this group.<sup>1</sup> Opportunities offered by the improvement of small ruminants will capitalize on the inventiveness of farmers and women thereby conserving capital and/or time for more urgent needs of the family.

Farmers will generate their own technology with the assistance of personnel from Tuskegee Institute and other members of the CRSP. The surest test of our success will be the extent to which we can improve traditional technologies, encourage the participation of women, and make proper selection of appropriate foreign technologies to decrease the mortality and slaughter age of goats.

## B. Objectives

The Tuskegee Institute project will examine the effectiveness of management in decreasing the mortality, the slaughter age of kids and increasing the milk production of does. The objectives can be grouped into five categories:

### 1. Expanded Knowledge Base (Research)

- a. To measure the production and reproduction of goats under intensive and semi-intensive management.
- b. To assist in the establishment of a laboratory at Pendencia Station, Paiba, Brazil to support the health components of management research.
- c. To establish a separate complementary management research facility at Pendencia to demonstrate and evaluate alternative management programs.

### 2. Advisory and Consultation Services

- a. To assist the extension personnel of EMATER/PB in collection of baseline data from goat farmers to evaluate their management procedures.
- b. Assist in the operation of the Pendencia research and outreach programs.

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<sup>1</sup>The Human Gap. The Learning Report to the Club of Rome Pergamon Press, May, 1979.

### 3. Education and Training

- a. To assist EMEPA and EMATER/PB personnel in their training and professional programs.
- b. To provide training and seminars in Tuskegee and Brazil.
- c. To provide language training for Brazilian and Tuskegee participants.

### 4. Information Capacity

- a. To acquire books, journals and other library materials on goat production for use at Tuskegee Institute and Pendencia.
- b. To publish important findings reported at conferences in Portuguese and English.
- c. To publish leaflets, brochures, and booklets for farmers in English and Portuguese.

### 5. Linkages and Networks

- a. To provide Tuskegee Institute personnel to the Brazilian site for at least two month periods to offer on-site assistance in collecting and evaluating data in ongoing research and outreach programs.
- b. To keep all CRSP members apprised of the development of the project.
- c. To hold periodic meetings with CRSP and Brazilian Scientists for planning, evaluating and upgrading the management program.
- d. To provide for the interaction of small ruminant experts from around the world with Tuskegee Institute personnel at Tuskegee.

## C. Project Approach

### Objective 1. Expanded Knowledge Base

- a. To measure the production and reproduction of goats under intensive and semi-intensive management.

#### (1) To be done at Pendencia Station, Brazil

An EMBRAPA approved diary goat research program is already underway at Pendencia. Tuskegee Institute will not alter this

program. Tuskegee's primary thrust during the first year will be directed toward assisting the Pendencia staff in designing a management system in which to study goat performance in the extreme environment of 200-400 mm of rainfall a year. It is expected that with proper management of available food and animal production cycles researchers will be able to determine production performance of different types of goats under local conditions.

The project is designed to compare production and adaptation of two breeds of exotic dairy goats (anglo-nubian and Parde Alenena) and the native sem Raza Definida (SRD).

Using the management system already in use at Pendencia several reproductive parameters will be studied; these include but are not limited to the following:

- Incidence of estrus cycle
- Length of estrus cycle
- Age of puberty
- Ovulation rate
- Fertility rate (% of does exposed for breeding that kid)
- Prolificacy (number of kids born per doe kidding)
- Birth weight
- Dam weight at breeding
- Post partun interval (period from kidding to first estrus/ovulation)
- Kidding interval

In accordance with standard measurements of production, this study will include the following parameters:

- Body weight
- Body weight gain (birth to weaning, weaning to slaughter)
- Mature body weight
- Kilogram of kid weaned per doe per year
- Lactation curves (kilogram of milk produced at different periods of lactation)
- Mean total milk production (total milk per lactation period)
- Mean dairy milk production (total kg of milk/total days of lactation)
- Feed conversion ratio if possible.

Factors affecting kid loss will be determined by measuring the

proportion of kids born alive, by measuring the time and cause of death, age and the relationship to management. This study will be conducted jointly by the staff at Pendencia Station and the collaborating investigators from Tuskegee investigators. The extent of the research will be determined by funds available.

(2) To be Conducted at Tuskegee Institute

On-going research at Tuskegee Institute which has been designed to measure reproduction and production under various management regimes will continue; however, interventive measures in Brazil are not envisioned until late 1981.

The management program will be evaluated and improved to the maximum (optimum or practical) achievable by local goat producers. Such a management program will be standardized during the evaluation of management of goat farmers in Brazil with the same production and reproduction measurements recorded for the research herd at Pendencia.

These data will provide information on the production and reproduction responses for at least one genotype used at Pendencia (Nubians). Data collected under the Tuskegee designed management scheme should substantiate the important role management plays in goat production.

Pasture-forage areas will be prepared with the idea of totally nourishing animals non-competatively on year-round forage and byproducts without resorting to the purchase of concentrates.

At Tuskegee Institute whether goats are managed under total or semi-confinement, there will be additional subtreatments for testing common management practices such as weaning, castration, dehorning, animal identification, vaccinations for kids. These

are being tested in short-term trials at Tuskegee Institute and will be tested similarly in Brazil once demonstration work begins there late in 1981.

Detailed plans of research at Tuskegee are included in Appendix #2.

- b. To Assist in the Establishment of a Laboratory at Pendencia Station, Paraiba, Brazil.

Dairy goat research has a number of needs that require the support of a diagnostic unit. Within the limits of available funds Tuskegee Institute will assist in the development and operation of a general laboratory and in the training of laboratory personnel.

The immediate purchase of microscope, a centrifuge for blood analysis and selected diagnostic kits are planned for Pendencia. More detailed equipment lists will be prepared during the on-site research period June-August, 1980 in Brazil.

- c. To Establish a Separate Complementary Research Facility at Pendencia To Demonstrate and Evaluate Alternative Management Programs

An assessment of the feasibility of intensifying goat production in Brazil that will optimize the seasonal nature of the food supply is needed. Tuskegee Institute in cooperation with the Pendencia staff will design a facility for animals in 1981 that will be equipped to systematically examine management effects on goats.

Presently research at Tuskegee Institute is aimed at intensive goat production for small farmers with the ultimate goal of feed-lots for their surplus stock. Capital from meat and hide sales is also a goal of Brazilian farmers; economical production means must be found to support this.

#### Objective 2. Advisory and Consultative Services

- a. To assist the extension personnel of EMATER/PB in collection of

baseline data from goat farmers, to evaluate their management procedures.

This objective would be approached by Tuskegee Institute in cooperation with the EMATER/PB extension personnel by becoming acquainted with no fewer than 10 goat farmers in Paraiba and by describing and monitoring their management procedures through various seasonal changes. An assessment of the reasons for the procedures used will also be made. It will also include a determination of why these procedures are used.

Our efforts will not be primarily directed toward changing procedures already in place, but designed to obtain complete information for development of management recommendations for implementation by extension personnel. Further, this work will assist in developing the ability of the Tuskegee staff to work effectively with farmers and other personnel.

The target date for initiating this objective will be late 1980, at which time it is planned that our language skills will permit us to interact effectively with the Brazilian people.

b. Assist in the Operation of the Pendencia Station Research Station Research and Outreach Programs

During the first year, 1980, Tuskegee Institute staff will have the opportunity to assist the Pendencia staff's efforts in the collection of data and evaluation of their plan of work. Since this program is relatively new, Tuskegee Institute will be able to play a key role in assisting in its development.

Objective 3. Education and Training

- a. To assist EMEPA personnel to develop and expand management techniques, for transfer to small farmers.

Tuskegee Institute will provide a research person to Brazil-EMBRAPA

and EMEPA for two or three 8-12 week periods, within the limits of funding, who will finalize research protocols with Pendencia personnel. During this time it will also be possible to assist in the designing of their laboratory and milking facilities.

- b. To provide training and seminars in Tuskegee and Brazil.

Short courses and seminars will be held at EMEPA, EMBRAPA and Tuskegee Institute as required, to train technicians and to provide valuable information regarding their management and research responsibilities. The short courses would be a cooperative effort between EMEPA, EMBRAPA and Tuskegee personnel.

It is planned that this objective will begin this year in order to obtain personnel immediately needed to operate the laboratory and collect data. It will continue until the end of the program.

This will assist the Brazilian personnel in developing and expanding management techniques for transfer to small farmers. All educational materials will be prepared in Portuguese and English.

- c. To provide language training for Brazilian and Tuskegee participants

Dr. A.M. Walker, Professor of Spanish and Portuguese, has agreed to teach Tuskegee participants Portuguese. Even though there is no formal English as a foreign language course at Tuskegee, Dr. Walker has again offered to assist in teaching English to Portuguese or Spanish speaking participants.

#### Objective 4. Information Capacity

- a. To acquire books, journals, etc. for use at Tuskegee and Pendencia.

A constant search will be in effect to locate books, journals, and other materials on goat production and related topics. The material will be collected, catalogued and made accessible for use at Tuskegee or Brazil.

- b. To publish important findings reported at conferences.

Periodic conferences will be held at Tuskegee Institute and in Brazil. The findings reported at these conferences will be published. Additionally noteworthy research reports will be jointly published in English and Portuguese by members of the research team.

- c. To publish leaflets, etc. for farmers.

To appeal to the lay public and target Brazilian groups various types of publications (leaflets, brochures, and booklets), slides and posters will be produced in Portuguese and English.

#### Objective 5. Linkages and Networks

- a. To provide Tuskegee Institute personnel to Brazilian site for two month periods to offer on-site assistance in collecting and evaluating data in ongoing research and outreach programs.

- b. To keep all CRSP members apprised of the development of the project.

Through regional groups and technical committee meetings, conferences and consultation assistance will be freely sought and given to maintain the collaborative spirit of this program.

- c. To hold periodic meetings with CRSP and Brazilian scientists for planning, evaluating and upgrading the management program.

Specific research projects will be selected in collaboration with the Brazilian Government, CRSP and AID personnel. In general, the research will be of an applied nature and will address specific problems of Brazil.

- d. To provide for the interaction of small ruminant experts around the world with Tuskegee and Brazil at Tuskegee.

There will be an effort to have our Brazilian counterpart scientists to work with us at Tuskegee and to have others share these occasions. This will, of course, be in conjunction with other CRSP members so that

the Brazilians will get the widest possible experience whenever they come to the United States.

D. Assumptions That Objectives Can Be Met

1. Personnel and budget commitments from the CRSP, EMBRAPA and EMEPA to this project will be adequate to carry out the planned work.
2. The goat facilities at Pendencia can be partially devoted to the collaborative project. This includes animals, land, and laboratory space.
3. Collaboration can be maintained with range, health, reproduction and economics specialists to properly design and implement an integrated management project.

E. Assumptions That Meeting Objectives Will Solve The Problem

1. That it will be possible to develop a safe and remunerative market for goats and goat products that will make farmers willing to pay more attention to good management practices.
2. That there will be close constant supervision of participating farmers to insure correct breeding, feeding and management practices.
3. That it is possible to resolve the major constraints to dairy goat production through dry season supplementation and increased management.

F. Indicators and Outputs

1. Development of health and management surveillance forms for use at Tuskegee Institute and Pendencia.
2. Systematic sampling procedures of management techniques will be established at Tuskegee Institute and Pendencia.
3. Summary reports of current literature will be searched and a limited number abstracted.
4. Development of a demonstration management facility at Tuskegee and Pendencia.
5. Publish scientific reports in Portuguese and English.
6. Training of Pendencia personnel and others in management techniques for

extension to farmers.

G. Technical Feasibility

The multidisciplinary team at Tuskegee Institute and the CRSP members are able to analyze and plan improvements over a large number of disciplines, using techniques that are known. The additional assistance of the Brazilian scientists and extension personnel will be essential in the testing of techniques off the station.

H. Inputs (See Budget Section)

I. Personnel - Project leaders have been identified as follows:

CNPC, Sobral - Elsio Figuerido

EMEPA, Pendencia - Paulo Leite

- Aldomario Rodriquez

University of Utah - Warren Foote

California Polytechnic University - Edward Nelson

Tuskegee Institute - Doris Oliveira

A technician will be working full-time at Tuskegee in support of the project aimed at Brazil. Labor needs at Pendencia will be provided by EMEPA and Tuskegee.

J. Implementation Time Table

Year 1 - October 1, 1978 - May 31, 1980. Planning Stage - Designation of collaborating scientists, research plans.

Year 2 - June 1, 1980 - September 30, 1981. Introduction of research at Tuskegee.

- Literature review with summaries for the use of graduate students and to prepare for publication of data - Tuskegee - Sobral.
- Initiation of work toward objectives a(1,2), b(1,2), c(1,2,3), d(1), e(1,3) - Tuskegee.
- Detailed planning working toward objectives a(3) at Pendencia.
- Preparation of pasture forage areas for management studies, Tuskegee.

Year 3 - October 1, 1981 - September 30, 1982

- Continuation of management project, Tuskegee.
- Initiation of on-farm experimentation, Tuskegee.
- Initiation of pasture forage collection, Tuskegee.
- Initiation of on-farm collection of data and research data from Pendencia.
- Initiation of laboratory preparation to support research.
- Finalizing of detailed planning work for Pendencia, Pendencia.

Year 4 - October 1, 1982 - September 30, 1983.

- Continuation of work from Year 2, Tuskegee and Pendencia.
- Incorporation of recommendations from range, nutrition, and reproduction projects into research efforts, Pendencia.
- Regionalization of results through appropriate publications, workshops, or collaborative adaptive research in other countries.

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 Northeast Brazil

Status: New Project

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

Principal Investigator: A. John De Boer

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

### Scientific Program in Brazil

The agricultural economics program in Brazil will consist of a core program in production economics/farm management supplemented by studies of specific constraints on output and productivity such as marketing, pricing, credit and general economic policy. The program thus requires development of a long-term program with EMBRAPA scientists as well as other institutions in the Northeast such as the Bank of Northeast Brazil (BNB) and its agriculture branch (ETENE), the Northeast Development Agency (SUDENE), the Federal University of Ceara, the Research Center for the Semi-Arid Tropics (CPATSA) in Petrolina, and the Ceara state extension agency (EMATERCE).

The first year program in Brazil will concentrate on establishing the long-term program in production economics, initiating a limited range of supplementary studies, and establishing the institutional linkage with institutions in the Northeast necessary for the long-term success of the program. The establishment of a long-term program of research and institutional collaboration will require the continuous presence of an agricultural economist at CNPC and a Ph.D. candidate from Purdue University (N. Gutierrez) is scheduled to begin a 14-16 month assignment early in 1980.

The chief collaborator in Brazil will be the Agricultural Economist who will be employed by EMBRAPA in the near future to fill a vacant position. Other collaborators during various stages of the program may include:

- a. Pedro Sisnando Leite, ETENE/BNB on demand/consumption studies.
- b. Iziarton Martin de Campos, Head, Department of Agricultural Economics, Federal University of Ceara on Master's thesis projects undertaken by his department and supported by Title XII funds.
- c. Luis Corsino Freire, Agricultural Economist, CPATSA, collaborating on studies of farming systems and Catinga management.
- d. Victor Palma and Adilson Barreto Vivas, EMBRAPA, Brasilia, to provide

periodic project evaluations and logistical support for central computing facilities and systems modelling inputs.

- e. Francisco Bernardone Teles Pinto, Sheep and Goat Extension Specialist, EMATERCE, Sobral to help organize fieldwork along with CNPC Extension Specialist, Jose Ubiraci Alves.

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

1. Production systems description by multi-disciplinary teams gathering information on physical resources (Texas Tech, Texas A&M (both projects), Tuskegee), animal resources (U.C.D., Texas A&M, Cal Poly) and socio-economic characteristics (W I, Missouri (tentative)).
2. Production economics/technology evaluation research on constructing physical-financial models of various production systems (Texas A&M (both projects, Tuskegee, N.C. State, Texas Tech).
3. Technology evaluation studies using farm management research on specific experiment station research (N.C. State, Texas A&M (breeding), Tuskegee, U.C. Davis).

### IV. Regional Applicability of the Research Beyond Brazil

Directly applicable to drier areas of the semi-arid tropics where the majority of the world's goat population resides, including Central and South Central India, Pakistan, and extensive areas of Mexico and the Middle East. The production economics model will be purposely made general enough to permit ready adaptation to physical and financial conditions in these other areas.

### V. Project Description

#### A. The Problem

The physical and economic problems facing Northeast Brazil have been well documented. A major source of animal protein and cash income is sheep and goat production. Increasing the level of production and resource productivity for

small sheep and goat producers is justifiably a high priority for the Northeast. The problem is to define the most limiting factors constraining production and returns and the most promising technologies on the production side and then analyze farm-level problems encountered in implementing experimental results. The economics problems are centered around on-farm problems of resource productivity plus several off-farm problems with marketing, pricing, credit, and government policies in general.

#### 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.
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 specialized studies of specific off-farm production constraints on one or more of the following topics - marketing, pricing, production risk, or farm credit.

#### C. Research Approach

The farm management/production economics research will utilize a combination of field survey data and experimental data to build the models of each production system. The modelling work will be carried out in conjunction with CNPC staff, Title XII SR-CRSP scientists and EMBRAPA staff in Brasilia and Petrolina. It is not anticipated that the modelling stage will be well developed by the end of the first year of the project, however, and that field data collection and analysis will be the major effort during year 1.

The supplementary studies of off-farm constraints should be in an advanced stage of project design and literature review by mid-1980. In addition, close collaboration with CNPC staff will result in the economic analysis being carried

out on several station research projects.

D. Indicators That Objectives Have Been Achieved

1. Development of working relationship between the project economist at Sobral and the institutions mentioned earlier.
2. A completed baseline survey report and a continuing series of farm management data collection visits to selected farms in Ceara State.
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. The initial agro-climatic information will be adequate for sampling of farms for farm survey.
2. Host government and collaborating institution will allow researchers reasonable access to small ruminant producers and help 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 Governments of the State of Ceara and Brazil 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 Brazilian 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, description of traditional and improved production systems.
3. Progress reports by Winrock field staff.
4. A functioning farm management data collection system.
5. If Consultants used, Consultants Reports.

#### VI. Technical Feasibility

The various studies planned make use of known research techniques used with small farmers in developing countries. Problems of gaining farmer acceptance can be alleviated through the intervention of local extension agents and contacts have already been made with sheep and goat extension officers who have promised cooperation. Several sources of short-term field enumerators have been identified. Contacts with EMBRAPA scientists have helped to design production oriented experiments capable of economic analysis. The supplementary studies may require the services of a short-term consultant and a well qualified U.S. agricultural economist has been contacted to serve, if the need arises.

#### VII. Inputs (See Budget Section)

#### VIII. Personnel

1. A. John De Boer, Principal Investigator
2. Mr. Nestor F. Gutierrez A., Graduate Research Assistant

3. EMBRAPA Agricultural Economist (to be appointed)

4. Consultant (if required)

#### IX. Implementation

Following the visit to Sobral in mid-October by De Boer and Gutierrez, the plan is to establish Nestor Gutierrez in Sobral to begin fieldwork as soon as possible. EMBRAPA also plans to hire a counterpart agricultural economist at the soonest possible date. A vehicle will be purchased soon after Gutierrez's arrival. A list of supplementary studies will be drawn up and discussed with the Chief of the Sobral station to ascertain priorities. One or two of the highest priority projects will then be carried out, most probably with Brazilian M.S. candidates in Agricultural Economics at the Federal University of Ceara in Fortaleza. Preliminary work on these projects could begin on a part-time basis in March - April with full-time work beginning in July.

#### X. Annual Review and Planning

A draft of the 5 year program plan was prepared during the site visit in October and discussed with the Chief and the Assistant Chief (Technical) as well as the EMBRAPA scientists from Brasilia. The requested revisions were made in the long-term plan as well as the Project Proposal covering N. Gutierrez's work plan. An additional planning session is scheduled upon Gutierrez's arrival in Brazil and the arrival of the EMBRAPA agricultural economist assigned to Sobral. Another planning and review session will be scheduled during De Boer's next visit. An annual progress report will be prepared in May, circulated to CNPC staff and among EMBRAPA economists in Brasilia and also critically reviewed by a project consultant. An annual planning session will also be required with Brazilian SR-CRSP principal investigators in April or May 1980.

## Long-Range Program Plan

### Introduction

The economics research component of the Title XII Small Ruminants CRSP consists of an overall program plan to cover the entire planned period (5 years) and a series of individual projects designed to carry out the program in coordinated manner. The development of the research programs at Sobral require long-term planning and this program plan for economics provides part of that input. In addition, the economics program must be compatible with EMBRAPA guidelines, be interdisciplinary in nature, work closely with EMBRAPA and CRSP scientists, provide inputs into research planning and research design, be able to consider national policy parameters such as pricing and credit, and provide guidelines for extension program implementation of individual technologies or packages of technologies.

### Objectives of Long-Term Economics Program

Many research projects fail to achieve their desired impact because a) the researcher who finishes the problem is not in a position to implement the results or b) the research project is able to provide only part of the solution to a much larger problem. The overall objective of this long-term program plan is to ensure continuity of the economics research component and to leave a fully implemented, verified, and well understood model of the economics of sheep and goat production in Northeast Brazil. This model must realistically provide answers to a broad range of research questions that may be asked by the various disciplines at CNPC, Sobral. Model development must proceed in stages as more and better information becomes available from the Station Research and as the socioeconomic nature of sheep and goat producers is better defined.

Specific objectives are as follows:

1. Build a simple interdisciplinary model of sheep and goat production for the Brazilian Northeast incorporating both technical and financial aspects.

2. Using current research results, simulate the performance of traditional and improved production systems to identify potential high return areas of research and identify promising technologies for farm-level testing.
3. Carry out intensive farm-level testing of a limited number of the promising technologies identified in 1) and 2) above to identify problems of a technical and socio-economic nature faced by farmers in implementing these technologies.
4. Use the farm-level testing phase to quantify the impact of each production practice separately and jointly and develop programs to overcome the constraints identified.
5. Following the farm-level testing phase, modify and update the simulation model developed in 1) and 2) above to reflect more accurately the levels of performance expected to be achieved at the farm-level.
6. By extending the results of (5) above to the Northeast region, perform a cost-benefit analysis of improved sheep and goat production technology by region, farm type, income class and quantify the expected benefits to producers, consumers (meat and hides), to the Northeast, and to the nation. This includes analysis of government policies for pricing, credit, etc.

These objectives represent the main stream effort of the production economics-farm management program. In addition, a number of constraints will undoubtedly influence the economic viability of the production systems. A series of complementary studies will be needed to study the effect of these constraints on the sheep and goat farmer to determine their importance relative to the introduction and adoption of improved technologies. These studies will be individual projects focusing on a specific topic as opposed to objectives 1) - 6) which represent a series of continuous studies. The objectives of these complementary studies are as follows:

7. Define the marketing channels for sheep and goat meat, analyze the pricing efficiency of the markets, and examine alternative marketing

- arrangements in terms of capital and institutional requirements.
8. Define marketing systems for sheepskins and goat hides in the Sertao, the pricing efficiency of these products, and the influence of the products on decision-making within the production system complex.
  9. Examine the role of risk (climate, price, and epidemiology) in farm management strategies, the effectiveness of these strategies, the social cost of risk to sheep and goat producers, and policies to alleviate risk, including insurance or price support policies.
  10. The Banco do Brazil has initiated a supervised credit program for sheep and goat producers. A study using this data and other survey data is needed to monitor the importance of credit as an instrument of technical change, the repayment ability of various classes of farmers, and income distribution effects.
  11. Characteristics of demand for sheep and goat meat within a framework of total red meat demand with a rural-urban breakdown by income class needed. Preliminary work on this project has begun at RTENE/BNB by Dr. Pedro Sisnando Leite using 1975 Census data and this project would complement this work.
  12. Examine the potential for inter-Brazilian trade in sheep and goat meats, the current and projected demand in each state in Brazil, and define the most efficient distribution pattern of sheep and goat meat from the Northeast to the rest of Brazil using a spatial equilibrium model for Brazil.

### Research Plan

The research plan is divided into two sections - one for the continuous core program in production economics (objectives 1-6) and one for the complementary studies (objectives 7-12).

The core program will concentrate on interdisciplinary research on a variety of production systems with an emphasis on economic analysis and studies on the

socioeconomic acceptability of EMBRAPA - generated technologies at the farm level. The research is programmed for three agricultural economists, one for each of the three phases where Phase I concerns objectives 1) and 2), Phase II works on objectives 3) and 4), and Phase III concludes these studies with objectives 5) and 6). The tenure in Sobral of the Phase I and Phase II economists should overlap by several months as should the tenure of the Phase II and Phase III economists. Since the Phase III research concentrates on the overall evaluation of the project and on the development of research planning models and farm management aids, it is hoped that the Phase III research would be the Brazilian economist assigned to the project in late 1979 who could carry out the Phase III research program as his Ph.D. thesis research program.

Personnel scheduling would be approximately as follows:

<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
<u>Phase I-N.Gutierrez</u>				
	<u>Phase II-Economist</u>			
			<u>Phase III-Economist</u>	

The complementary studies will be carried out according to the availability of researchers, availability of Title XII Small Ruminants CRSP funds, availability of supervisors, and the priorities assigned these projects by the Director of CNP-Caprinos. These projects would be carried out in collaboration with Universities in the Northeast, ETENE/BNB, and perhaps SUDENE in Recife. It is hoped that the first complementary study will be underway by March/April, 1980 using one or two M.Sc. Candidates from the Federal University of Ceara in Fortaleza with Title XII CRSP funding.

The complementary studies would be under the primary supervision of the Brazilian counterpart agricultural economists.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

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

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 and goat 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 provide 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 Northeast Brazil as well as the U.S. The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep and goat production systems.
2. To collect production data and characterize production systems of Northeast Brazil in moderate rainfall areas (as represented by Sobral and Quixida, Ceara) and in lower rainfall areas (as represented by Petrolina, Pernambuco); to validate the model and input parameters; and to use validated simulations as baseline simulations.
3. To examine, through modelling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Northeast Brazil.

4. To supply input-output data of goat and sheep 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 personnel of the Brazilian National Goat Research Center (CNPC).

## II. Project Description

### A. Description of Problem

Generalized, comprehensive, biologically based, mathematical models for simulating sheep and goat 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 of 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 Northeast Brazil 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 goat, management procedure or feed resource can be conveniently applied to the general model. Thus, these models are adaptable for simulating production systems in Brazil as well as the U.S.

Models applications of specific interest include the evaluation of production systems that incorporate goats and sheep into agronomic production units in Northeast Brazil. This evaluation will include the assessment of alternative management practices, feed resources and supplementation programs, and available breedtypes. As appropriate, hair sheep and meat goat production systems will be evaluated with primary emphasis on integration of the livestock enterprise into small-holder agronomic production units.

#### B. Objective of Project

The broad objective of this project is to provide 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 Northeast Brazil 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 collect production data and characterize production systems in both moderate rainfall areas and lower rainfall areas of Northeast Brazil; to validate the model and input parameters using these data and information; and to use the 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 Brazilian CRSP.
4. To supply simulated input-output data of goat and sheep 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 of interest to personnel of CNPC.

### C. Project Approach

Building these 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; both the sheep model and the goat model are 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 variable; 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-output data as is the case with normative models (Cartwright, 1978).
3. A similar model of goat production systems will be initiated during the first year following development fo 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 models 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 goats and sheep will be characterized at CNPC, EPACE, and CPATSA by personnel of these stations as well as through the efforts of other CRSP projects.
2. After the working model is completed, it will be subjected to validation tests which will consist of simulation of the production systems introduced at CNPC, EPACE, and CPATSA. A sequence of simulation, validation, model modification and new simulation will be 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 ready for validation during the second year, and validation completed and production simulations initiated during the third year. Respective dates for the goat model are expected to be about one year later than for the sheep model. Simulations would continue during successive years.
3. Once the sheep and goat models are validated and refined at CNPC, EPACE, and CPATSA, they will be available for examining production systems in other ecozones of Northeast Brazil. In each case, information about feed resources, genetic potential of available breedtypes and productivity of existing (traditional) systems will be required. This information may

come from CRSP projects or other projects in Northeast Brazil.

### Objective B3

1. The process of gathering, organizing and collating existing information and modeling production systems will identify knowledge voids or deficiencies. The model can also be used to examine the importance of various 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 Site Coordinator and other collaborating projects in coordinating their research activities (Byerly, 1977). This coordinating process and the function of bringing information from other CRSP projects together to fit into the total production system 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 sheep and goat production systems for both moderate and low rainfall areas utilizing the baseline (validation) simulations to compare against simulations with some changes imposed. The changes imposed will consist of practices recommended from collaborating projects, practices suggested by detailed examination of the simulation outputs to determine at what point production efficiency suffers the greatest, practices suggested by Brazilian research workers and extension personnel, 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 crossbreeding.
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 Brazil 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 locations in Northeast Brazil. Simulations will be designed to examine the effect of various interventions such as altered management practices, drought, quarantines or new government policies on specific production systems and will begin after the models are completed and validated. The close consultation of research workers, extension personnel and other appropriate Brazilian 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 serve as baselines. 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 at CNPC, EPACE, CPATSA, and possibly other Brazilian settings; those data may be collected by other CRSP projects and/or other projects in Brazil.
3. Synthesis of sheep and goat production systems which meet objectives functions specified by Brazilian research workers, extension personnel, etc. in consultation with other CRSP projects.

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 on 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 (Byerly, 1977).

#### F. Assumptions That Achieving Objectives Will Solve Problem

The modeling objective can be attained and will be available for use in

Brazil and the U.S. regardless of the participation or capabilities of Brazil. However, application to specific locations by synthesizing systems and conducting economic analysis depends on the cooperation of key Brazilian personnel. Requirements of expertise level and personnel commitment from Brazil 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 at CNPC, EPACE, and CPATSA 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 Brazil 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.A.

### III. Technical Feasibility

The technical feasibility of this project is divided into two phases:

1) model development and validation and 2) simulation of Brazilian 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 the 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. These models will include functions for accommodating 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 Ruminant CRSP. Other information will have to come from estimation by experienced ruminant nutritionist, 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 these models remains the only point of doubtful outcome. That is, restructuring and refining the models may have to continue for two or three years in order to obtain satisfactory correspondence between simulations of producing 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 part in greatest doubt is validation of goat production systems involving production based largely on browse.

The second phase is that of simulating and synthesizing production systems in Northeast Brazil: that is, examining present systems and new recommended practices or methods. Since this phase depends on data collection and/or data already collected in Brazil and cooperation of Brazilian research workers and extension personnel, the probability of accomplishing these objectives is good because of the expressed interest and support of these parties. 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 personnel of CNPC, EPACE, and CPATSA and on inputs generated by the other projects of the CRSP. Because of the interest and the expected good data base from the CNPC, EPACE, and CPATSA, the outputs of this project should help form the basis for development of policies and programs of EMBRAPA.

#### IV. Inputs (See Budget Section)

#### V. 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. EMBRAPA (Empresa Brasileira de Pesquisa Agropecuaria) (Inclusion of the following personnel as collaborators is subject to their own approval and the approval of their Brazilian supervisors.)
  - a. CNPC (Centro Nacional de Pesquisa de Caprinos)  
Elsio Antonio P. de Figueiredo  
Claudio Bellaver
  - b. CPATSA (Centro de Pesquisa Agropecuaria de Tropico Semi-Arido)  
Martiniano Cavalcante de Oliveira

## VI. Implementation

The implementation of this project occurs in three phases:

1. Model development, validation, and refinement.
2. Simulation of sheep and goat production systems for both low rainfall and moderate rainfall areas of Northeast Brazil.
3. Applications of systems analysis to small-ruminant production systems for other Brazilian 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 project in Brazil and in other LDCs.

The second phase is the application phase and depends heavily on data collected as CNPC, EPACE, and CPATSA and the cooperation of the collaborating projects and the Brazilian counterparts. The simulations will be the basis for examining alternative production practices and synthesizing production systems to most effectively integrate sheep and goat production into small holder agronomic enterprises.

The final phase will involve utilization of data from other projects in Northeast Brazil as well as at CNPC, EPACE, and CPATSA. These efforts can be initiated as soon as the sheep and/or goat models are developed and appropriate input data identified.

## VII. 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 of 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 Brazilian 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 Brazil will be coordinated with the Program Director of the CRSP, the Technical Committee of PIs and personnel of CNPC.

## VIII. Literature Cited

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BRAZIL - SIGNED

MEMORANDUM OF UNDERSTANDING  
ON  
THE ADMINISTRATIVE ARRANGEMENTS  
BETWEEN  
THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
AND  
EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA  
EMBRAPA  
WITH REGARD TO THE ESTABLISHMENT OF A  
COLLABORATIVE RESEARCH SUPPORT PROGRAM  
ON SMALL RUMINANTS

MEMORANDUM OF UNDERSTANDING  
ON THE ADMINISTRATIVE ARRANGEMENTS  
BETWEEN THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
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EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA  
EMBRAPA  
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 Empresa Brasileira de Pesquisa Agropecuária, (EMBRAPA) public institution of the Federal Government of República Federativa do Brasil, created by Law 5.851, on December 7, 1972 and with statutes approved by Decree 75.374, February 1975, and with central office in Brasília, Brazil, have entered into the following understanding:

I. DEFINITIONS - For purposes of this understanding, the following definition 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.

B. "Participating Institution" means a university or other research institution which has been awarded an active subgrant by The Regents of the University of California under the authority and provisions of the grant No. AID/DSAN/XII-G-0049 to conduct a component project of the CRSP.

C. "Management Entity," or "ME," 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.

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

II. THE SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

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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 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 Brazilian 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 in Brazil.

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 its Agency for International Development (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 developing countries.

B. The current Plan of Operation of the research program is described in Annex 1. The plan will be revised from time to time by mutual written agreement of the Parties.

C. The agreement shall commence on the date of the signing of this Memorandum of Understanding and shall continue to remain in force for as long as the aforementioned grant is provided to the ME by AID.

### III. THE MANAGEMENT ENTITY CONTRIBUTION

The ME shall extend to EMBRAPA manpower and resources in accordance with the mutually agreed program plan as described in Annex I and as revised and extended from time to time. 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 ME contribution shall include funds with which to pay the following direct costs incurred under this understanding:

1. Salaries, Wages, benefits of US scientific and administrative personnel in Brazil; supplies and

expenses; and equipment necessary to conduct the work of the CRSP.

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

3. ME-approved international travel by US persons for the work of the CRSP, and of Brazilian trainees and scientific and administrative staff working in the US for the CRSP.

4. Costs of training and traineeships.

5. Other ME-approved direct costs, including a possible Site Coordinator in Brazil.

All requisitions for purchase of supplies, equipment, 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 Brazil.

B. Manpower: The ME shall make available through the Participating Institutions the following manpower resources to EMBRAPA.

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

2. Advanced personnel at the post-doctoral or immediate pre-doctoral level for work in Brazil on the problems of small ruminants.

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

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

1. Traineeships to study in the US to the MS or Ph.D level, to the extent determined by EMBRAPA.

2. Short-term training as deemed necessary by principal investigators for other EMBRAPA personnel.

D. Administration: The chief executive officer of the CRSP shall be the Program Director appointed by the ME. The Program Director shall provide direction to the program in the US and Brazil.

#### IV. EMBRAPA CONTRIBUTION

A. EMBRAPA being the competent authority in Brazil shall provide:

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

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

3. All the costs for travel in Brazil by Brazilian scientists, but no travel of US scientists, as they work on the CRSP.

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

B. EMBRAPA shall also:

1. Adopt all measures within its legal capabilities to obtain from the competent authorities in Brazil exemption from duties, taxes and similar charges incident upon the importation to Brazil of materials solely for use of the CRSP, when purchased from other countries and brought to Brazil as donations to EMBRAPA. If such exemptions shall not be granted by Brazilian authorities, EMBRAPA will support the cost of said duties, taxes and similar charges.

2. Provide the orientation and information necessary to make adequate arrangements within its legal capabilities in order to help the US Embassy in Brazil make contact with the appropriate authorities for the provision of exemption from taxation for all US staff working in Brazil under the CRSP. Such an exemption shall not have different conditions and privileges than those applicable in the bilateral agreement between the Government of the United States and the Government of Brazil, and providing that the US Embassy in Brazil considers such US staff engaged in CRSP work as included in the Terms of the said bilateral agreement.

#### V. PROGRAM FUNDS

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

B. If mutually deemed to be desirable by the ME and EMBRAPA, CRSP funds may be provided to EMBRAPA 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 EMBRAPA as part of the CRSP. Any such funding shall be through a separate agreement between the ME and EMBRAPA, executed as a subcontract under the AID grant for the CRSP. Such a subcontract shall specify the work to be conducted and the terms and conditions for the use of the funds.

#### VI. INTERPRETATION AND MODIFICATION

This Memorandum of Understanding is written in

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four (4) English version originals and four (4) Portuguese version originals of the same form and contents, being signed by the Parties and two (2) Witnesses, as required by the Brazilian Law, and constitutes the full agreement of the Parties hereto with respect to the CRSP and supercedes any and all prior agreements or understandings of the Parties regarding the CRSP and no modification of this memorandum unless in writing and signed by authorized representatives of each of the Parties shall be valid. In the event of any discrepancy or conflict of interpretation of the English and Portuguese versions, the English version shall govern.

Approved for the Regents of the  
University of California

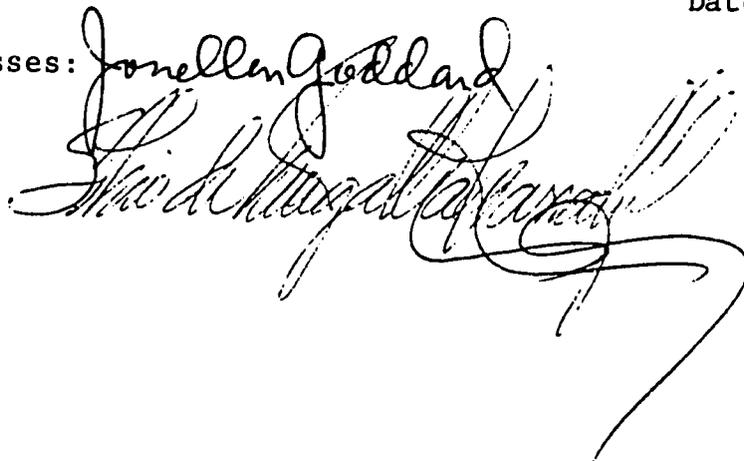
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Date:

Witnesses:



Approved for Empresa  
Brasileira de Pesquisa  
Agropecuaria--EMBRAPA

By:



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Date: 28th March, 1980.