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# **SMALL RUMINANT**

**COLLABORATIVE RESEARCH**

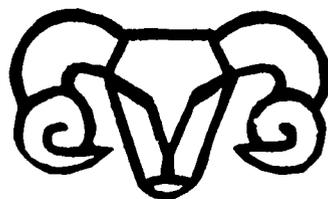
**SUPPORT PROGRAM**

# **INTEGRATED PROGRAM PLAN**

## **PART III**

## **PERU**

**Prepared by the Management Entity**



**PART III**

**REGIONAL SUB PROGRAM**

**PERU**

**TITLE XII**

**SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM**

## BACKGROUND

The semi-arid Sierra highlands of the Peruvian Andes contain 2,200 comunidades campesinas (indigenous Indian communities), with a population of 345,000 families. Most of these comunidades are autonomous villages but some of them are associated with large cooperative agricultural units, Sociedad Agricola Interes Social (SAIS) which were created by the Agrarian Reform Movement of a decade ago. The SAIS generally comprise one or more former haciendas and a number of the surrounding indigenous communities organized into coordinated production units. These comunidades campesinas own 75 % of all the agricultural land in the Sierra with holdings commonly found above 12,000 feet and at elevations as high as the 17,500 foot permanent glacier line. Only about 2 % of this land is arable, with frost, hail and snow imperiling crops grown at all but the lower elevations. Where planting is possible, the Indians primarily cultivate corn, quinoa and potatoes. With 98 % of their land suitable only for pasture, if it is indeed usable at all, the Highland Indians are very dependent on their livestock, particularly small ruminants, for food and cash.

The Puna, the natural grazing land of the high Sierra upon which these animals depend, has an estimated area of about 24 million hectares. The largest extensions of this pastoral land are found in Junin, Huancavelica, and Puno, with important areas also in Cajamarca, La Libertad, Ancash, Apurimac and Cuzco. In Puno, the highlands level out to true Altiplano around Lake Titicaca. In this region, the Altiplano is an extension of the Bolivian Altiplano, and supports a mixed crop-livestock system of agriculture. From Cuzco northward, however, the Puna is suitable only for grazing, with crops limited to the lower elevations. Although soil quality is generally good and the average total annual precipitation is normally adequate (800mm), the extended dry season (May-October) coincides with the coldest months and causes serious reduction of pasture growth. Winter temperatures range from -5° to 14° C and summer temperatures from 5° to 17° C.

Despite these constraints there is potential for forage improvement in the nearly level valleys at the lower elevations around 13,000 feet. Irrigation is possible in these areas, white clover and other legumes can be introduced with little liming, and perennial and annual ryegrasses grow well with adequate water and fertilizer. Evidence that this type of pasture improvement is feasible can be witnessed on the SAIS Tupac Amaru. This unit, comprised of 16 surrounding comunidades campesinas and an internal cooperative, demonstrates the successful use of irrigated pasture in a high intensity, low frequency, rotational grazing system.

The total small ruminant population in Peru is 13 million sheep, 2 million alpacas, 2 million goats and  $\frac{1}{2}$  million llamas. These animals are at least dual purpose and more usually multi-purpose. Goats, found primarily along the coast, provide meat and cheese; fiber and meat are provided by llamas, alpacas and sheep. In addition, alpacas provide hides and llamas are used as pack animals at high altitudes. The expanding market demand for lamb in Peru has caused sheep to become increasingly more important as meat suppliers in addition to their traditional role as export wool suppliers.

Sheep and alpacas are the predominant species in the Highlands and alpacas are especially prevalent and important at the higher elevations. The Criollo sheep is the most numerous type found in the Sierra. Corriedales, the preferred breed, are also present in large numbers. The Junin breed was developed on the SAIS Tupac Amaru and has superior wool quality and production compared to the native types. Average Junin fleece weights of 8 pounds with heaviest yields of 11-12 pounds compare favorably to estimated Criollo fleece yields of 3 pounds. However, although the Junin is productive and well adapted to the Sierra, their reproductive rate is still only about 90%. The alpaca, despite its contribution to the economy of the Sierra and Peru, has not been nearly as well researched as the sheep. As the world demand for alpaca wool grows, it will become increasingly more important to acquire the knowledge necessary to increase the productivity of this small ruminant which is so uniquely adapted to the high Andes.

## INTRODUCTION

Research results generated in the Andean Highlands of Peru could be applied to semi-arid, high altitude regions of Bolivia, China, Nepal, Pakistan, Afghanistan, Iran and the Middle East. These areas exhibit similar environmental conditions and share such common restraints on small ruminant productivity as unrestricted breeding in native flocks, diseases typically encountered at high elevations, inefficiently utilized rangelands, and sparse, highly seasonal feed supplies. Social factors and production and economic systems also exert a powerful influence on small ruminant productivity. Economic studies of such stratified production systems as are found in Peru, have general relevance for other small ruminant producing areas where there are substantial differences in resource availability for animal feeding or where seasonal food production differs within a country.

Studies conducted in Peru indicating which product from each species is the most appropriate to emphasize under different conditions (fiber vs. meat), comparing the productive efficiencies of several species in a given environment (alpacas vs. sheep), and predicting the optimum number and mix of species for the most advantageous utilization of various types of rangeland (stocking rates), address universal problems in an integrated manner. They must take into account the physical, biological, ecological, economic and social elements in the production systems and could provide other highland areas with criteria upon which to base their small ruminant improvement efforts.

Because the problems of small ruminant productivity in Peru are multifaceted, and interact in a dynamic and complex manner, a multi-disciplinary research effort will be required to meet the goals of the Small Ruminant Collaborative Research Support program (SR-CRSP) in this region. The US scientists working in Peru intend to collaborate among themselves and with their Peruvian counterparts. Research facilities, experimental animals, and data collection and dissemination duties will in many instances be shared. The Breeding, Range Management and Nutrition, Nutrition (Forages) Reproduction, Health and Systems projects will together use three field stations, one at La Raya, one at Huancayo, and one at a Central Cooperative near Cerro de Pasco. Animals evaluated in genetic studies will be made available, when practicable, for grazing and herd health studies. Careful planning will minimize the possibility that results from one study will be confounded by carry over treatment effects from the previous study.

The Economics and Sociology components will cooperate closely with each other as well as with the other projects in Peru. One element of the Economics project's objective to characterize the economics of farm management production systems is to

assess improvements in these systems as the project progresses. To accomplish this, they will need in addition to the economic data they collect, technical data from the Breeding, Range Management and Nutrition, Nutrition (Forages), Reproduction and Health studies. The economists will also directly cooperate with the sociologists in conducting comparative socio-economic studies, especially with reference to different farming systems (traditional vs. communal), which again will require data contributed by the other projects.

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

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

**TABLE 1**

**PERUVIAN INSTITUTIONS**

<b>Instituto Nacional de Investigacion Agraria in Lima</b>	<b>(INIA)</b>	<b>Javier Gazzo Carlos Valverde</b>
<b>Universidad Nacional Agraria at La Molina</b>	<b>(UNA)</b>	<b>Guillermo Parodi</b>
<b>Instituto Veterinario de Investigaciones Tropicales y de Altura at San Marcos University</b>	<b>(IVITA)</b>	<b>Alberto Sato</b>

**Table 2**

<u>PRINCIPAL INVESTIGATORS</u>	<u>US INSITUTION</u>	<u>PERUVIAN INVESTIGATOR</u>	<u>PERUVIAN INSTITUTIONS</u>	<u>AREA OF RESEARCH</u>
Robert L. Blackwell	Montana State University (MSU)	Manuel Carpio Jorge Velasco	UNA IVITA	Breeding and Genetics
Donald F. Burzlaff	Texas Technical University (TTU)	Arturo Florez M. Ricardo Valdivia	UNA IVITA	Range Management and Nutrition
Robert W. Van Keuran	Ohio State University (OSU)	Information not yet available	Information not yet available	Nutrition (Forages)
Warren C. Foote	Utah State University (USU)	Cesar Novoa Julio Sumar	IVITA IVITA	Reproduction
Edward A. Nelson	California State Polytechnic University (CSPU)	H. W. Vivanco	UNA	
Cleon V. Kimberling	Colorado State University (CSU)	Dcra Herrera Hugo Samaine	IVITA IVITA	Animal Health
John DeBoer	Winrock International Livestock Research and Training Center (WIRLT)	Julio Echeveria Domingo Martinez	UNA UNA	Economics

**Table 2 cont.**

<u>PRINCIPAL INVESTIGATORS</u>	<u>US INSTITUTION</u>	<u>PERUVIAN INVESTIGATOR</u>	<u>PERUVIAN INSTITUTIONS</u>	<u>AREA OF RESEARCH</u>
Michael F. Nolan	University of Missouri (UM)	Ernesto Yepes Carrol Dale Domingo Martinez	UNA UNA UNA	Sociology
Thomas C. Cartwright	Texas A&M University (TAMU)	Luis F. Coronado Jorge Velasco Alberto Pulmayalla	IVITA IVITA UNA	Systems Analysis

## PROBLEM

The primary animal husbandry system encountered in the high, semi-arid areas of Peru, is extensive range production of sheep and alpacas. The increasing human population adds pressure to an already overburdened production system and exacerbates existing problems which may result in permanent damage to the delicate ecosystem of the region. The small ruminant production system in the high Andes has not been extensively researched and knowledge about those components of the system which critically affect animal productivity and product distribution is lacking. In the past, implementing solutions to agricultural problems without prior consideration of their effects has frequently resulted in a negative rather than positive impact on the small farmer. A specific objective of the Small Ruminant CRSP is to focus research on techniques which will improve the standard of living of the small holder. Research on the impact of modifications of existing production methods is also necessary to ascertain whether or not this objective is achieved.

Some of the more specific problem areas the SR-CRSP intends to investigate include:

### ANIMAL BREEDING AND GENETICS

Because there is inadequate animal identification, poor record keeping, and unrestricted breeding in native flocks, it has been difficult to measure individual animal performance and the genetic potential of the native stock has never been adequately assessed. This is particularly true of the alpaca in the high ranges.

### RANGE MANAGEMENT AND NUTRITION

The lack of knowledge of the genetic potential of the local animals is complicated by the poor environmental conditions under which they must function. Inadequate year round rainfall and feed supplies do not afford the animals an adequate nutritional status to express their maximum phenotypic potential, especially in areas where rangelands are overgrazed, and overstocked, and animal health is poor.

### NUTRITION (FORAGES)

Animal productivity suffers during annual periods of drought that lower range productivity. In addition to the attention the Andean rangelands require, there is a great need to improve cultivated forage production in the Highlands. Cool season grasses and

legumes which can be grazed directly or harvested and stored, could complement dry range forage, supplement protein and energy intake, and increase small ruminant productivity by decreasing nutritional stress, particularly during growth and lactation.

### REPRODUCTION

Animal production in the Andean Highlands suffers not only from poor nutrition and a harsh environment, but also from poor reproductive rates. The lack of knowledge of basic reproductive processes in Highland sheep and alpacas makes it difficult to solve such problems as reduced fertility, poor post natal survival, delayed first parturition, and short reproductive life, which limit small ruminant reproductive capacity.

### ANIMAL HEALTH

The effects of inadequate nutrition and poor reproductive performance are compounded by disease and parasitism which deplete the animals' resistance and even further hamper their performance. Major health concerns which impose severe economic hardship on the owners are enteric diseases, pneumonias, reproductive problems, neonatal mortality, and parasitism.

### ECONOMICS

In addition to the physical and biological constraints on animal productivity in the arid Highlands, the lack of knowledge about various production and marketing mechanisms and demand characteristics for small ruminant products further limits potential improvement to the system within the sociological framework in which the small producer operates.

### SOCIOLOGY

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

## SYSTEMS ANALYSIS

Integration of improvements made in individual components of an animal production system by systems analysis techniques is a relatively new field of science which takes into account the interaction of many factors contributing to the function of the production system. Factors having major effects on small ruminant producing systems in Peru 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 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.

A series of general objectives which are dependent upon a mutual commitment to collaborate between the US and Peru must be initiated before the Small Ruminant CRSP can proceed as an integrated research endeavor. Achieving these general goals, the establishment of functioning field stations and the development of a baseline survey, depends upon the US PI's forging solid working links with the Peruvians. To effectively utilize the IVITA field station at Huancayo, the Central de Cooperatives at Cerro de Pasco, SAIS Tupac Amaru and the alpaca research station at La Raya requires the cooperation of US and Peruvian scientists and government officials and farmers. Support from the government, universities, and local producers is also essential for the development of a baseline description of the current small ruminant production systems. This survey will serve as the foundation upon which research efforts and improvement plans will be based.

Once the mechanisms to meet these general goals have been set in motion, meeting the other objectives, both general and specific, will be more feasible. All the investigators will conduct research which further clarifies the present conditions in the production systems, explores innovations which could improve them, and produces results applicable to Peru as well as other areas with similar conditions. The researchers will also train graduate students, and increase the knowledge and competence of US project participants. The problems of the limited resource farmers 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 will be made available in English and Spanish in the US and Peru. In this way, a large number of people can derive benefit from the Small Ruminant CRSP effort.

The individual projects of the SR-CRSP will fulfill their long range goals by focusing on specific objectives when they conduct their research.

## ANIMAL BREEDING AND GENETICS

In their effort to evaluate and upgrade the genetic potential of Peru's native sheep and alpaca populations, the Breeding project will use existing data to determine production levels and estimate relevant production parameters for these animals. They will also evaluate the current breeding practices and selection procedures. Based on these findings, they will recommend improvements and initiate additional research which will strengthen existing programs and give direction to new endeavors.

## RANGE MANAGEMENT AND NUTRITION

The Range Management project will be concerned with the present precarious state of the Highland's grazing lands upon which the Andes' small ruminants depend almost exclusively for their sustenance. An inventory of rangeland resources, determination of seasonal variation in the nutritive value of range forages, and an evaluation of seasonal effects on nutritional requirements and diet preferences of sheep and alpacas will be conducted. This will facilitate the development of grazing systems that maintain the productivity and health of the Andean rangeland and satisfy the seasonal needs of the livestock population which depends almost exclusively on this resource for their sustenance.

## NUTRITION (FORAGES)

The Nutrition project intends to identify, characterize, and evaluate forages which are currently or potentially available for cultivation under Andean conditions. They will assess the available land and present methods for intensive cultivation as well as the feasibility of this practice in different areas of the highlands. Based on these findings they will develop cultivated forage/animal production systems that complement the extensive range production system and enable them to evaluate and improve animal response.

## REPRODUCTION

The reproductive capabilities of male and female sheep, alpacas and goats will be measured and the processes limiting reproduction and animal productivity will be identified. This information will be used to develop management program components which are compatible with available resources and optimize small ruminant reproduction.

## ANIMAL HEALTH

Because health is so critical to productive output, disease morbidity and mortality

impact of flock disease will be reviewed to determine research priorities. Identification of diseases which hamper small ruminant productivity, improvement in diagnostic techniques for bacterial and viral diseases and internal parasites, exploration of small ruminant immunological responses to selected viral and bacterial agents will be made. This will facilitate the development of herd health programs and disease control policies which will help alleviate the severe disease problems in the Andes.

### ECONOMICS

Economists plan to conduct farm management/production economics and consumer demand marketing studies which examine particularly the problems and marketing constraints which affect small ruminant production and profitability. In addition, project evaluation studies undertaken as the Small Ruminant CRSP in Peru progresses will help to assess the relevance and effectiveness of the CRSP as a whole venture.

### SOCIOLOGY

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

### SYSTEMS ANALYSIS

Computer simulation models of livestock goat production systems have been successfully used to increase the effectiveness of research efforts by identifying knowledge gaps and establishing research priorities and needs. In addition, validated computer simulations can be used for baseline simulations. Model applications of specific interest include the evaluation of production systems that incorporate sheep into agronomic production units in the Central Highlands and study goats, alpacas and mixed species systems, especially combinations of sheep and alpaca under common central management. This evaluation will include the assessment of traditional and alternative management practices, feed resources and supplementation programs, available breed types and application of research results. As appropriate, small ruminant production systems will be evaluated with primary emphasis on integration of 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. Maintaining open lines of communication among all the projects facilitates the sharing of animals, expertise, and facilities and the standardization of experimental and analytical procedures and techniques, activities which are critical to the formulation of coordinated research plans. A maximum exchange of information and ideas is necessary to allow for the level of cooperation that is essential if the Small Ruminant CRSP is going to remain a true collaborative venture. In addition, all the projects will support US and Peruvian students for graduate study, conduct literature searches on topics relevant to their research area and review the available data in their field for inclusion in the baseline survey. This survey, cooperatively assembled, will serve as the blue print for the establishment of future research plans and priorities.

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

### ANIMAL BREEDING AND GENETICS

Available production data and breeding records collected from a large farm cooperative, (Sociedad Agricola Interes Social), the SAIS Tupac Amaru, will be used to calculate estimates of population parameters for important production characteristics including: means, variances, estimates of major environmental effects, components of genetic variance and relationships among relevant traits. This information is needed to monitor and improve existing breeding programs, an activity which demonstrates scientific breeding principles and practices on a large scale, and will provide upgraded, selected native breeding stock to the SAIS's and local farmers. These estimated population parameters will also be used to design and focus further research efforts. Frequent observations on such traits as survival, reproduction, growth, quantity and quality of fiber production (especially in alpacas) and maternal ability will be made in long term experiments conducted at Huancayo and La Raya. Other experiments will study the comparative opportunity for improvement of native stock by selection with the native livestock population, grading up with improved Peruvian breeds and using genetic stock from outside Peru.

### RANGE MANAGEMENT AND NUTRITION

Condition classes, based on a complete range inventory will be assigned to range sites to indicate the degree of deviation from their potential. The range inventory will

include classifying climate, topography, soils and vegetation, stratifying range lands according to altitude and rainfall, determining total biomass production and surveying the hydrological resources. The nutritional value of the range forages will be determined by esophageal cannulation of sheep and alpaca to collect diet samples for botanical classification and in vitro, chemical, nutrient analyses. This will aid in defining input-output relationships, seasonal diets and animal feed preferences which facilitates the development of optimum species mix and stocking rates. These analyses will also aid in developing useful guidelines for effective dry season feed supplementation and food reserve stock piling procedures.

### NUTRITION (FORAGES)

A survey will be conducted to characterize the forages in the Highlands and determine their potential adaptation, utilization and preservation in this environment. The yield, seasonal growth, persistence and nutritive value of various grasses and legumes will be measured. This knowledge, in combination with an evaluation of animal adaptability and nutritional needs, will enable the project to plan a forage production system in relation to the range program which will improve the animal production system.

### REPRODUCTION

Individual reproductive processes including factors relating to performance level and efficiencies and seasonal influences will be measured on male and female sheep, alpacas and goats. Ewes will have their age and weight at puberty and first parturition recorded, and fertility, prolificacy birth weight and postnatal survival measured over the course of a normal breeding/lambing cycle. Rams will have age and weight at puberty, seasonal changes in semen production and libido and endocrine profiles measured. These measurements, made by genotype (within species) for the existing and an improved level of management, will be used to identify the processes limiting reproduction and determine the extent to which they can be modified by changes in genetics and/or management practices.

### ANIMAL HEALTH

In cooperation with the scientists at IVITA, the Health project will conduct research on enteric diseases, particularly enterotoxemia Type A and viral diseases such as chronic progressive pneumonia and parapox diseases. In addition, problems of internal parasites such as liver flukes, reproductive difficulties such as ram epididymitis will be

investigated. Research in these areas in Peru and at Colorado State University, Fort Collins, will include improvement in clinical, pathologic and immunologic means of diagnosis and effective treatments for diseases investigated.

### ECONOMICS

The farm management/production economics study will include baseline surveys, regular farm interviews and management data collection visits as well as analyses of risk, crop-livestock systems and communal resource use problems. Consumer market and demand studies will survey the institutions, policies and constraints of the small ruminant market to establish and define its important characteristics. Data will continually be collected and analyzed to provide an initial assessment of the production system against which to compare the efforts of the SR-CRSP improvement efforts.

### SOCIOLOGY

Several types of intensive field work, including in depth observations and survey techniques, will be employed to define small ruminant production systems. Special emphasis will be placed on examining small holder risk decision making, the role of women and children and how they influence the function of the system, the role of small ruminants in the rural communities' social fabric and the sociology of the range movement. In addition, various types of small ruminant husbandry systems will be compared including traditional comunidades, the large cooperative SAIS's, mixed crop livestock farms and specialized large scale livestock farms.

### 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 the Central and South Central Highlands of Peru 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 primary event which would indicate that the component projects of the Small Ruminant CRSP are making progress towards achieving their goals is the successful establishment of collaborative ties which enable research in Peru to be initiated. 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 on the SAIS's.
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 Peru 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 Peru and the US government's view of Peru 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 Peru 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 Peruvian 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, government, 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 and Genetic Improvement of Small Ruminants in Extensive Management Systems in Peru

Status: New Project

Sub-Grantee: Montana State University  
Bozeman, Montana 59717

Principal Investigator: Robert L. Blackwell

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

## II. Scientific Program in Peru:

The animal breeding project will have as the ultimate objective the development and application of breeding technology for the genetic improvement of small ruminants for meat and fiber production under conditions that exist at high altitudes. The development of effective working relationships with collaborators at the National Agrarian University, La Molina, (UNA) and at the Veterinary Institute for Tropical and High Altitude Research at San Marcos National University (IVITA) will receive first priority. Existing research programs in animal breeding and management will be strengthened and expanded. Cooperation between personnel of the two universities will be encouraged. Evaluation of existing projects and their needs will be undertaken the first year, with proposed modifications initiated as considered appropriate. There is need for the development of a new experiment station for sheep and alpacas in the High Sierra. Planning and initiating research at the new location, yet to be determined, will be included in the first year activity, if possible.

The principal Peruvian collaborators will be:

Manuel Carpio, Sheep and Wool Technology, UNA

Jorge Velasco, Geneticist, IVITA

The genetic principles which form the basis for animal improvement methods through selection and mating systems will be applied experimentally in populations of sheep and alpacas to effect genetic improvement within the environmental constraints imposed by the high altitude of the Peruvian Andes. Included with the breeding research will be appropriate animal management experiments to further clarify the opportunity and cost of environmental enhancement to increase animal productivity.

Currently, breeding research with sheep is conducted by UNA in cooperation with SAIS Tupac Amaru and Ramon Castilla and possibly other large SAIS

(Sociedad Agricola de Interes Social). Production data from this work is available for research. Analyses will be undertaken to provide information on population characteristics that will serve as a guide to future work. Breeding research with the alpaca is being carried out by IVITA on the inheritance of coat color at the La Raya Station. This work continued and the scope of alpaca breeding research at La Raya should be enlarged to include more emphasis on fiber and meat production. More intensive breeding research could be undertaken at new research locations when such facilities become available.

Opportunity for graduate study will be available to a few well qualified students at the Masters level at Montana State University. Graduate students will participate in the research program as a part of their training. Strengthening the graduate program at UNA in animal breeding and management will receive attention.

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

The breeding project will require a large body of production data on traits that pertain to meat and fiber production by sheep and alpacas. These data will be directly useful to the Systems Analysis Project (TAMU). Close coordination with this project will be maintained. The Range Management Research Project (Texas Tech) and the Animal Health Project (CSU) will also be closely allied with the breeding project. This project will give special emphasis to the area of reproduction through efforts of our own personnel and in cooperation with the Reproductive Physiology Projects of Utah and Cal Poly. Personnel from these institutions will serve initially in a consultative capacity. Animals used for breeding research will be made available where possible for grazing-management studies and for animal health studies. Design of experiments will be jointly carried out in those cases where breeding animals will be needed for other projects to insure against confounding of treatment

effects. Production data generated by the breeding project will also be provided to the Economics Project (WI) and the Sociology Project (Missouri). In all cases, information needs of each project will be anticipated in advance so that the animal resources available can be managed to meet these needs.

#### IV. Regional Applicability:

Animal breeding research deals directly with the biological mechanisms of inheritance and the external environmental influences on the animal populations. The development of breeding technology to utilize the natural genetic variation for animal improvement for meat and fiber production is based on sound biological and statistical theory. Application of this technology requires constant assessment of the impact of local environment on animal populations. Animal husbandry practices deal largely with alleviating adverse environmental effects on the individual animal or groups of animals. Interaction between genotype and environment exists in some situations, however, environmental differences apparently must be rather large and unusual before this interaction becomes a serious problem in application of basic research findings from breeding and genetic research. Elevation effects and problems associated with seasonal nutrient availability appear to be the major environmental constraints imposed by the research sites in Peru. Other large regions of the world, such as the entire Andean Highlands, Nepal, Pakistan, parts of China and areas in the Middle East, share these same constraints in varying degrees. Thus, relatively wide application of this research is expected.

#### V. Project Description:

A. The Problem: Small ruminants are economically important to countries with extensive land areas lying at high elevations. These lands usually are agriculturally productive, primarily through the use of grazing animals to convert the forage produced into animal products. Increased human populations

in many areas are taxing the production potential of these lands and in many instances, production levels are being reduced due to excessive numbers of animals and improper grazing practices. The productivity of these lands, in terms of animal products, depends primarily on the combined effects of forage producing capability of the land and on the ability of the grazing animals to effectively harvest and utilize this forage. The land and animal management are highly interrelated. Fewer animals with greater inherent producing capacity undoubtedly would produce more products per unit of land area.

In Peru sheep and alpacas are the major small ruminants of economic importance. Both are valuable meat and fiber producers, however, their productivity is limited by a number of factors. These include a harsh natural environment, a deteriorating feed supply due largely to over-stocking, low animal productivity due to a lack of nutrients for production over maintenance requirements and health problems. In addition to these, a major production deterrent is the fact that most of the animals are unimproved native stock whose intrinsic producing capability has not been systematically improved and whose full potential has not been measured accurately. For alpacas, there is a dearth of scientific information on the production of these species for meat and fiber production. There are 14-16 million sheep and about 3 million alpacas in the highlands of Peru. Approximately 70 percent of the sheep population are unimproved native breeds. In an integrated research program to improve production of these species, it is essential that the genetic resource be included in broadly based breeding and genetic studies that deal primarily with the economically important traits of reproduction, survival, and maternal ability, growth and fiber production. Breeding research is long term with these species. Yet opportunity to increase production potential through breeding is usually substantial in unimproved populations, and the cost is generally low relative to returns.

The questions concerning the most expeditious breeding methods to use in producing the necessary improvement need to be answered for major geographic regions of the world which have special environmental and economic constraints.

B. Objectives:

1. Determine production levels and estimate relevant parameters for sheep and alpaca populations from existing production data.
2. Evaluate current breeding procedures and selection practices for sheep and alpacas; prepare recommendations for improved procedures and practices; plan and initiate additional research projects and strengthen existing breeding programs at cooperating SAIS or cooperatives.
3. Participate in the planning and further development of sheep and alpaca genetic and breeding research programs at the La Raya Station and at an additional research location to be determined.

C. Approach:

Objective 1. A substantial body of production data collected by UNA personnel in their cooperative research with several of the large SAIS in the Central Andes (Tupac Amaru and Ramon Castilla, for example) are available for study. These data constitute a valuable resource from which to obtain estimates of needed population parameters for several production characteristics. Statistics of interest are means, variances, estimates of major environmental effects, components of genetic variance, and relationships among traits. These are basic statistics needed to design future experiments and to develop improved breeding programs. This will require close participation of Peruvian Scientists at all stages of the analysis and interpretation of the results.

Objective 2. Certain of the larger SAIS, as presently organized, can contribute greatly to the genetic improvement of the Peruvian sheep population by providing improved breeding stock to the small farmers. Populations of sheep are sufficiently large that important research in applied breeding can

be effectively carried out. Both information and improved genetic stocks should result. In conjunction with Objective 1, the strengths and weaknesses of existing breeding programs will be studied and evaluated. Information derived from Objective 1, along with published information, objective determinations of breeding program goals and the application of genetic and animal breeding principles will be the basis for designing more effective breeding programs. The breeding plans will be designed to provide information from which objective evaluation of selection effort and the effect of certain mating systems can be made. Implementation of these breeding plans to produce a greater number of animals with high genetic merit to use in upgrading the native stock will follow.

The cooperative programs with the large SAIS will emphasize collection of breeding and production records from their herds by which genetic progress can be monitored. It will be desirable if groups of animals can be made available to apply the breeding plans and to produce breeding stock for use elsewhere on the SAIS and in flocks of the local farmers. Demonstration of scientific breeding principles and practices on a large scale is considered important in this phase of the project, since this should have the most direct impact on program acceptance by livestock producers.

Objective 3. It is probable that an additional research site for sheep and alpacas will be identified soon by INIA. Animal breeding and management research with both sheep and alpacas at this new location is considered an important additional effort to that at the La Raya Station in the overall research program. Such facilities will provide additional needed resources for well-designed, long-term experiments under typical high elevation range conditions. Planning the development of this experiment station and research program to include a strong animal breeding component with other areas of

animal and range research will be an important undertaking early in the life of this project. This will have long range impact on future research and development. The more fundamental and detailed research will be done at these locations, and will be an essential support to the more applied breeding and management research possible at the SAIS.

Groups of experimental animals will be provided from which detailed research data can be obtained for this project, the Systems Analysis Project, and for use in grazing studies and animal health research. For these purposes, animals must be managed so that frequent observations on traits such as survival, reproduction, growth, fiber production (quantity and quality) and maternal ability can be made. Experiments should be initiated to study the comparative opportunity for improvement of native stocks through (a) grading up with existing improved breeds in Peru, (b) selection within the native populations, and (c) possibly the use of genetic stock not now available in Peru. Provision will be made for appropriate experimental controls for the 'breeding treatment' variables studied.

The La Raya Station presents an impressive opportunity for breeding research. Research here and at the new station will be designed to be complementary. Desired treatment replication will be possible; undesirable duplication can be avoided. In addition to special groups of animals for breeding research at La Raya, such as for the study of coat color in alpacas, it should be possible to include most of the animals at this location in a program that would provide useful production records for breeding research and for improved herd management. Alpacas from the La Raya Station could form the nucleus of the experimental groups at the new station. Present research on inheritance of fiber color should be continued and expanded, if necessary, to obtain adequate answers to questions of color inheritance as quickly as possible. Data on population dynamics and vital statistics such as birth and death rates, length of productive life, proportions of breeding males and females, replacement rates,

market ages would be obtained.

D. Indicators That Objectives Have Been Achieved:

1. Analyses of existing production data with interpretation of the results in terms of new or improved breeding plans that are applicable to the improvement of sheep in the Andes fo Peru.
2. Acceptance and implementation of these breeding plans by producers of breeding stock (large SAIS) for small farmers.
3. Successful development of a new experiment staion and the initiation of a major breeding research program with both sheep and alpacas.
4. Greater use of the animal resources for a broader based, more detailed breeding research program at the La Raya Station.
5. Well coordinated and cooperative effort undertaken by personnel at UNA and IVITA.

E. Assumptions That Objectives Can Be Met:

1. That the positive attitudes that now exist toward the Small Ruminants CRSP on the part of collaborating scientists and administrator of INIA, UNA, and IVITA and the AID Mission in Peru will continue to be merited.
2. That active research projects can be strengthened and expanded to address important questions in animal breeding relative to sheep and alpaca populations in high altitude environments.
3. That the necessary resources will be made available on a continuing basis, including the development of an additional research location and increased support for breeding research at the La Raya Station.
4. That cooperative working relationships with several of the large SAIS will be continued and expanded in the area of applied animal breeding.

F. Assumptions that Meeting the Objectives Will Solve the Problem:

The small ruminant resource in Peru and many other similar countries and regions are genetically substandard. Opportunity for improvement is great. The existence of improved breeds in Peru are visible evidence that genetic

change can be made through the application of sound breeding methods. A two to four fold increase in wool production in sheep appears possible. Increased meat production of similar magnitude also appears possible through improving the genetic potential for growth, higher reproductive rate, and reduced mortality. The assumptions that the meeting the research objectives will solve the problem of increased animal productivity are:

1. That valid information and applicable breeding plans will result from this research.
2. That methods for transferring the information and technology will become available at an early date.
3. That this breeding methodology will be accepted and applied by producers, and will result in more improved breeding animals available to the small farmer.

G. Outputs:

First year outputs will include: (1) the establishment of effective working relationships with and among principal collaborators on the project, (2) summarization and reporting of the results of data analysis, (3) development of improved breeding plans for the SAIS, (4) design and initiation of long-term breeding research project for the cooperating SAIS, the La Raya Station and the new research station, and (5) publication of reports and research articles.

VI. Technical Feasibility:

The physical resources are available or can be developed to conduct the research. Trained personnel with keen interest in the research program are already working in the area. Administrative support is good. The CRSP will be able to strengthen the existing effort. Technical methodology applicable to high elevation animal production requires a broad approach, involving many disciplines. There is no evidence of serious technological obstacles that

will prevent the animal breeding research from going to its logical conclusion and provide information and appropriate guides for genetic improvement of animals in the High Sierra of Peru and other similar geographic areas.

VII. Inputs (See Budget Section)

VIII. Personnel

Montana State University

R.L. Blackwell - Animal Breeding

P.J. Burfening - Physiology/Animal Breeding

D.D. Kress - Animal Breeding

UNA

Manuel Carpio - Sheep & Wool Technology

IVITA

Jorge Velasco - Geneticist

IX. Implementation:

A visit was made to Peru in July 1979 to become acquainted with the personnel, the problems of small ruminant production at high altitudes, and the resources available for breeding research with small ruminants. General agreement was reached on the broad problems to be solved and on the approaches to be taken. Existing programs of UNA and IVITA will form the basis for this collaborative project by coordinating, strengthening, modifying, and enlarging them through technical and financial support from the Title XII Small Ruminants CRSP. This will be achieved over time as facilities are further developed and as results are obtained. Additional visits will be made to Peru by Montana personnel to develop the long range research plan and annual work plans, to coordinate the data analysis, work with the SAIS in the development and implementation of improved breeding practices. Expansion of the breeding research and development of a unified research program will be a gradual process.

X. Annual Review and Planning

Progress reports will be prepared near the end of the fiscal year. This

document will summarize the activity of the past year and include abstracts of, or references to, specific reports, breeding plans, or published results. The work will be subject to review by administrators from Montana Agricultural Experiment Station, INIA, UNA, IVITA, other U.S. Principal Investigators, the Board of Institutional Representatives, and the External Evaluation Committee for the CRSP.

Planning will be a continuous process, and will involve collaborating scientists from Montana and Peru. Appropriate administrators will be involved to insure the plans are realistic and feasible within the framework of the resources available (personnel, land, animals, equipment and funding), and that the plans address the long term objectives of increased animal productivity. By nature, animal breeding research must be considered long-term. Therefore, general long range plans will be made during the first year. Refinement and detail will be supplied in annual work plans.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Improving Small Ruminant Nutrition, Management and Production  
in Peru

Status: New Project

Sub-Grantee: Texas Tech University  
Lubbock, Texas 79409

Principal Investigator: Donald F. Burzlaff

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

## Abstract of Project Proposal

Title: Improving Small Ruminant Nutrition, Management and Production

Rapidly growing populations in Peru have resulted in increased dependence on the small ruminant as a source of food and fiber. The result has been widespread deterioration of highland vegetation resources and declining productivity from the small ruminants.

This proposal is developed to research alternatives in management of both grazing lands and grazing animals to an end of optimizing resource use and improve the living conditions for a major segment of the developing world. The proposed research calls for an inventory of rangeland and small ruminant resources in the target areas. Grazing lands are to be classified according to soils, climate, topographic features and their capability to produce forage. Grazing systems with stocking rate based on productive potential will allow improvement in range resources.

The nutritive value of individual plant species and the contribution of each species to the diet of small ruminants will be studied. Methods of supplementing diets when feed or nutrients are deficient will be developed. Consideration will be given to reseeding rangelands and production of fodder crops.

Management of grazing animals will be considered in cooperation with segments of the program dealing with animal health and genetic improvement.

Graduate training opportunities will be developed for limited numbers of qualified Peruvian students in disciplines of Animal Science and Range Management. Graduate students and research personnel will provide faculty for short courses and workshops for existing agency personnel in the host country.

D. F. Burzlaff

Texas Tech University

## 2. Detailed Description of Project

### A. Description of problem

Rapidly increasing populations in Peru have resulted in increased dependence on the small ruminant as a source of food and fiber. This increased dependence has resulted in build up of their numbers. The ultimate result has been widespread deterioration of vegetation resources and a reduced productivity from a major source of subsistence, the small ruminant.

Management alternatives exist which, when developed through research, will permit the high elevation rangelands to become more productive and sheep and other small ruminants to attain a higher level of output as they graze an improved resource. Constraints posed by social, economic and traditional activities will have to be adjusted to correct the present resource management problem. Grazing and management systems which allow individual or community use of specific lands under proper stocking rates must be developed.

Any improvement to be expected in production from small ruminants will be accomplished only through improved range management and a simultaneous improvement in animal nutrition and management. Grazing systems and intensities based on the potential of a site to produce forage, together with systems of stockpiling or otherwise developing feed reserves for the dry season will result in improvement of resources. Achievement of these goals will translate directly into improving the welfare of those whose survival depends on small ruminant production.

Acceptance of these practices require development of host-country personnel with the philosophy and capability to initiate effective research and extension programs in target areas.

### B. Project Objectives

The goal of the Small Ruminant CRSP in Peru is to improve production of small ruminant animals. The Texas Tech objectives for the initial year of the program are to initiate work that will accomplish the over all goal. These objectives

include:

1. To collaborate with U.S. institutions conducting research in Peru and other locations under the Small Ruminant CRSP.
2. To identify and establish contact with counterparts at collaborating institutions in Peru.
3. Identify U.S. personnel for the Small Ruminants program in Peru.
4. To initiate development of Small Ruminant Research Centers in Peru.
5. To inventory the rangeland resources available as small ruminant research sites.
6. To determine seasonal variation in the nutritive value of forage from rangelands.
7. To determine seasonal diets and diet preferences of sheep and alpaca that are grazing rangelands.
8. To initiate a long term graduate training component in range management or animal science. The program will be for limited numbers of students from Peru or other countries with similar rangeland and livestock resources.

C. The Project Approach to Research Objectives

Research will obviously be accomplished in phases. For clarity in presentation the approach for each objective will be discussed separately. Some of the objectives will not be completed in one year. The work will be initiated with completion achieved in stages over a period of years.

Objective I.

Personal contact will be maintained among all principal investigators, particularly those working in Peru. This will assure appropriate standardization of analytic and technical procedures. This will be accomplished by periodic meetings of the Principal Investigators in the U.S. and in Peru where the counterpart scientists can be involved for discussions of progress, priorities, needs and future activities. The rangeland resources, experimental animals and research facilities will be shared by principal investigators involved in range

management, range animal nutrition, herd health, animal breeding and herd management. A once a year meeting in Lima is suggested for all principal investigators.

Objective 2:

Principal collaborative institutions in Peru include the following INIA, La Molina, The National Agricultural University and IVITA. The veterinary and animal research arm of San Marcos University. Principal research counterparts for the Texas Tech University program will include: Dr. Arturo Florez M. of La Molina and Dr. Ricardo Valdivia of IVITA. Obviously there will be other close working relationships develop with personnel of INIA, the Ministry of Agriculture and with other faculty and staff of the two universities.

Initial visits to Peru by project workers of Texas Tech will result in formal arrangements for office, laboratory and field facilities with collaborating institutions. At these initial meetings principal investigators and the Peruvian counterparts will prioritize specific research activities and identify equipment and facility needs necessary to accomplish project goals.

Objective 3:

A research associate and two or three graduate students will be identified as early as possible in the budget year. These personnel will be located in Peru in early 1980 to carry out the research program under direction of the Principal Investigators and the Peruvian counterparts.

Objective 4:

Two field research sites will be located in Peru on which range management, animal nutrition and animal management studies will be conducted relative to Texas Tech's program in the small ruminant CRSP.

One of these is at Lachoc Granj near Huancavelica. This land is currently under the control of the Ministry of Agriculture. It is being requested that this land be brought under the control of INIA so that the research activities of Texas Tech University and the collaborating institutions in the U.S. and Peru

can be achieved.

The second site is proposed for La Raya. Four thousand hectares of Ministry of Agriculture land have been made available to IVITA for research associated with alpaca production. Laboratory, living facilities and a productive research history make this a priority location.

Objective 5:

Research activity will begin as soon as sites are established, personnel recruited and equipment is purchased or leased. Survey of rangeland resources will be initiated immediately. This will include literature searches, soil inventory and classification, vegetation inventory and determination of biomass production and water resource inventory.

Range sites will be identified and stratified according to altitude and rainfall patterns. These then may be projected to the entire area applicable to small ruminant production. Range sites will be evaluated according to frequency and composition of existing vegetation. Condition classes will be assigned to a range site indicating its deviation from its potential. Relict areas and grazing exclosures will be a guide to assess this potential. An estimate of standing biomass will be made for range sites at seasonal intervals. These clippings will function to provide an estimate of stocking rates. A hydrologic survey will be made to determine water distribution and relate these to use patterns. Future water developments at strategic locations may temporarily relieve grazing pressure until management systems can be developed and controlled.

An inventory of the existing grazing pressure is imperative to define potential disaster areas based on current use rates and forage production potentials.

Objective 6:

Invitro digestibility determinations will be made on forage samples from harvested at regular seasonal intervals. Chemical analysis including proximate analysis, acid detergent fiber, calcium phosphorus, sodium, chlorine, carotene and trace elements will be performed. Digestion-balance, metabolism trials and

growth and lactation feeding experiments will be conducted to refine estimates or develop new information on the nutritional values.

Similar information for available feed stuffs and by-products will provide insight on programs of supplementing diets in periods of nutritional deficiency.

Objective 7:

Sheep and alpaca fitted with esophageal cannulae will be used to collect representative diets of grazing animals. These diet samples will provide information on preference as affected by season and physiological condition of the animal. This technique will also be used, eventually, to estimate intake and output under grazing condition. The diet samples will be subjected to in-vitro and chemical analysis. The nature of the diet as affected by the mix of species and various classes of animals will be determined. This will be the basis for developing recommendations for grazing schemes and the optimum mix of small ruminants in production programs.

Objective 8:

Applicants for opportunities in graduate study at the M.S. and/or Ph.D. level will be solicited, interviewed and selected. Such graduate study opportunity will not be available until the second year of the program. Two potential candidates will be sought through local and regional institutions.

D. Conditions That Will Indicate Objectives Have Been Achieved

1. The natural resource inventory will be providing baseline data for the future management.
2. U.S. personnel will be resident in Peru and undertaking project objectives.
3. The two range management research sites will be selected with activities underway to develop and use them to meet CRSP objectives.
4. Research animals will be in place and fistulated animals will be collecting diet samples for nutrition studies.
5. Two graduate students will have been solicited and selected for study in the U.S.A.

6. Plans will be underway for development of short courses and workshops to extend information.

E. Assumptions on Achievement of Objectives (externalities outside direct control of PI)

1. This research project can affiliate with Peru and collaborative institutions are identified.
2. Qualified students are available for selection to graduate programs.
3. The host country will provide land, housing, facilities, and counterpart project leaders to work closely with the on-site project leader from the United States.
4. The research timetable will allow fulfillment of certain objectives related to significant vegetation changes. High elevation range ecosystems are delicately balanced and plant succession is extremely slow. Once an ecosystem has been disturbed it may not heal itself within one man's lifetime. However, trends should be evident to properly evaluate grazing management objectives.
5. That systems of technology transfer can be developed and implemented.
6. The host country must be in full support of the project or implementation of the results will be futile. Development of range improvements or supplemental feed without grazing control is a short-sighted exercise. Since political power is concentrated in the cities where there is little concern or priority for improvement of arid grazing lands, public attitudes will play an important role in final implementation of results.
7. Appropriate government policies must be established. These policies must provide support prices for agricultural products, export markets must be developed, agricultural enterprises must have reliable credit sources made available to them.
8. That qualified graduate students can be identified and selected for the program.

F. Assumptions That Achieving Objectives Will Solve the Problem

1. Range management systems, production data and range site delineation will allow improvement of Peruvian grazing lands.
2. Information on seasonal diets and their nutritive value can lead to appropriate use of supplements to correct deficiencies of diet for small ruminants.
3. Solution of problems will lead to programs of information transfer and adaptation.
4. There will be general implementation of recommended practices will be adopted.
5. That agricultural credit will be available to allow implementation of new technology.

G. Outputs of Project

1. Delineation of range sites and their productive potential plus a data bank of soil, water, animal, and feed resources.
2. An effective system of managing small ruminants which will result in sustained range improvement and will incorporate results developed from those working in the areas of breeding, flock health, socio-economic, and marketing.
3. Identification of seasonal nutrient deficiencies along with solutions and the contribution of palatable plants to the diets of small ruminants.
4. A husbandry plan of optimizing sheep and goat production per unit area of land base in terms of both meat and wool.
5. A workable system of providing supplemental feed for small ruminants during critical periods of the year.
6. At least 12 M.S. graduates (6 LDC and 6 American) trained in Range Management and/or Animal Science, emphasizing small ruminant husbandry.
7. Annual workshops, short courses, and demonstrations.
8. Publications on the many facets of research generated through the

overall program.

9. Data output for incorporation into systems analysis programs.

3. Technical Feasibility

- A. Technical capabilities of range management and animal husbandry will not be a limiting factor in the program. Adequate long-term financing and logistical support from U.S. AID and the host country will be the most critical factors. The goals cannot be met in less than 5 years. Extension from requested funding of 5-year to an 8-year program is fully anticipated by the Principal Investigator.
- B. Implementation of activities and achievements of goals of the proposed project will be dependent upon entering into contract with Peru. The language constraint imposed by working in a Spanish-speaking nation will cause delays, inefficiencies and technical difficulties. Project personnel will be encouraged and selected in part by their willingness to learn the Spanish language.
- C. Implementation will be dependent upon identification of a collaborative institution or agency within the host country. Willingness of the institution to assume a collaborative role and provision of laboratory space facilities and faculty time will be important.
- D. Availability of qualified host country personnel will be of significant importance. Prior training in range management would be advantageous.

4. Inputs (See Budget Section)

## 5. Implementation Plan

<u>Fiscal Year</u>	<u>Objective</u>	<u>Responsibility</u>
1979 - 80	Collaboration with extensive team for Morocco	Texas Tech Research Team (TTRT)
	Host country selection	AID and TTRT
	Retain on-site project leader (OPL)	Extensive team for Peru
	Collaboration with and travel to host country	TTRT
	Begin natural resource inventory	TTRT
	Employ personnel - U.S. graduate students located on site in Peru	TTRT and Host Country (HC)
	Interview and select first group of graduate students in Peru	TTRT, HC
	Establish experimental research centers	HC
1980 - 81	Begin long-term research objectives (1st group of Peruvian graduate students arrive in United States)	TTRT, HC
	Complete natural resource inventory	TTRT, HC
	Short course for agency personnel	TTRT, OPL, HC
	Annual report from on-site project leader	OPL, TTRT, HC
	Report natural resource inventory	TTRT, HC
	Continue long-term research objectives	TTRT, HC
	Interview and select 2nd group of Peruvian graduate students	TTRT, HC
	Short course for agency personnel	TTRT, OPL, HC

## 6. Annual Review and Planning Processes

The ultimate success or failure of the project will be determined by the adequacy of planning during the first year. Initially, the extensive range management team for Peru will communicate with the counterpart extensive team for Morocco. This communication is designed to standardize procedures and parallel research efforts so that objectives, techniques and results will be comparable. This unification approach will insure the funding agency of having a consolidated program with wide ranging applicability at termination of the projects. Secondly, the extensive range management team for Peru will meet with its collaborative extensive project leaders to determine facilities, equipment, labor, and space they will require in the host country to fulfill all research objectives. The extensive range management team along with the OPL will then visit the host country to discuss overall project goals, technical requirements, and availability of facilities. Economic constraints will pose as the major limiting factor to successful operations. Upon returning from the host country, a conference will be held among the extensive team for Peru to report project feasibility based on resources available and to adjust the research goals and objectives accordingly.

In succeeding years, annual reviews of the project should include avenues for maximum flexibility and coordination. Incorporated in these reviews will be an on-sight, host country evaluation involving at least two members of the research team. Review processes will be hierarchial beginning with evaluation of reports from the OPL and his host country counterpart. These reports should be directed (1) to each principal investigator operating in the host country who will review accomplishments of individual projects goals and (2) to an external review committee. This will allow evaluation of technical and economic feasibility with the possible alterations in project design. Progress and changes resulting from these individual reviews should be channeled back to the extensive project leader and the external review committee for overall assessment and future planning. The mid-project report

(see Implementation Plan) should include an overall review of the present status of the project and possible changes requiring implementation for future years.

PROJECT DESIGN SUMMARY  
LOGICAL FRAMEWORK

Life of Project  
From FY 1979 to FY 1983  
Total U.S. Funding \$1,453,250.00  
Date Prepared: 5-17-78

Project Title & Number: Improving Small Ruminant Nutrition, Management and Production

NARRATIVE SUMMARY	OBJECTIVE VERIFIABLE INDICATORS	IMPORTANT ASSUMPTIONS
<p>Program or Sector Goal: The broader objective to which this project contributes: To help Peru improve the welfare of those dependent upon small ruminants and decrease the burden of their day to day living through proper management of native vegetation and small ruminants.</p>	<p>Measures of Goal Achievement: 1. Increased herbage yield and advancement in plant succession on native rangeland. Improvement in overall vegetative response and capability to sustain the improvement. 2. Improved nutrition of small ruminants. 3. Increased number of animals as marketable products. 4. Increased quality of animals reaching markets. 5. Increased meat and wool production per unit area.</p>	<p>Assumptions for achieving goal targets: 1. Cooperation of government in host country. 2. Collaborative institution in host country. 3. Avenues for effective extension programs will be made available to local and remote graziers.</p>
<p>Project Purpose: To inventory all natural resources applicable to small ruminant production. 2. To provide an understanding of proper management both of rangeland vegetation for sustained yield and of the vast sheep herds for increased production. 3. To provide workshops to train individuals in range management and small ruminant husbandry so they can effectively utilize the technology made available. 4. To educate individuals from the arid countries at the graduate level.</p>	<p>Conditions that will indicate purpose has been achieved: End of project status. 1. Natural resources are identified and quantified. 2. Documented evidence that vegetation improvements are feasible. 3. Small ruminant husbandry practices can be enhanced. 4. Host country will have quantitative information to establish future tenure and management policies with regard to small ruminant production, grazing management, and supplemental feed programs. 5. Trained personnel in countries with high elevation semi-arid rangelands.</p>	<p>Assumptions for achieving purpose: 1. Vegetation in arid and semi-arid lands will respond to grazing treatments. 2. Water developments are feasible. 3. Potential feed reserves are available to be included in the overall scheme. 4. Host government will develop legislation for implementation of the overall management plan. 5. Local graziers will accept government intervention and recommendations.</p>
<p>Outputs: 1. Data bank of soil, water, vegetation, animal, and feed resources available to the host country. 2. Publications on proper grazing management for improving and maintaining native vegetation, nutritive deficiencies and probable solutions, effective solutions to herd management problems, quantity and value of potential feed supplements. 3. Workshops to train arid country personnel. 4. M.S. graduates trained in Range Management and Small Ruminant Husbandry.</p>	<p>Magnitude of Outputs: 1. Records of existing and potential carrying capacity of small ruminants based on soil, water. 2. Major publication bulletin at midterm and termination of project ("Small Ruminants and Their Management in Peru") 3. Annual seminars and workshops. 4. At least 5, arid country M.S. graduates 5. At least 12 M.S. thesis and 20 corresponding publications.</p>	<p>Assumptions for achieving outputs: 1. Host country has the organizational structure and leadership to insure outputs are realized. 2. Texas Tech will collaborate and support the project in total.</p>

PROJECT DESIGN SUMMARY (Cont.)

LOGICAL FRAMEWORK

Project Title & Number: Improved Small Ruminant Nutrition, Management and Production

Life of Project:  
From FY 1979 to FY 1983  
Total U.S. Funding \$1,453,250.00  
Date Prepared: 5-17-78

NARRATIVE SUMMARY

OBJECTIVE VERIFIABLE INDICATORS

IMPORTANT ASSUMPTIONS

Inputs: 1. Host country; analytical laboratories field stations and personnel from collaborative institutions. 2. Texas Tech; laboratories, expertise, guidance, and administration. 3. AID contract with Texas Tech University.

Implementation Target (Type and Quantity) 1. Host and/or arid country: analytical laboratory; Co-project leader; develop research center (i.e. labor, land, facilities); qualified B.S. candidates seeking M.S. degree. 2. Texas Tech University: Analytical laboratory, field laboratory, project personnel, on-sight project leader (Collaborative dollars from other American institutions available). 3. AID: Budget - at least \$200,000/year; selection of host country.

Assumptions for providing inputs:  
1. Host country will agree to inputs as designated.  
2. Texas Tech University will retain qualified staff and facilities.  
3. AID will approve project and provide funding.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Cultivated Forage Production Systems for Small Ruminants  
in Peru

Status: New Project

Sub-Grantee: Ohio Agricultural Research & Development Center  
Wooster, Ohio 44691

Principal Investigator: Robert W. Van Keuren

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

## II. Project Proposal

### A. Description Of Problem

Improved cultivated forage production systems for small ruminant production to complement or supplement range in the Andean highlands are needed to increase animal production. Cool season grasses and legumes are needed that can be grazed or stored as harvested feed during critical periods of low range production to meet high animal nutritional needs during lactation and growth or to provide protein and energy supplementation to dry range forage. Methods of intensive forage production in the Andean highlands need to be evaluated. Problems of yield and persistence, particularly of legumes, are prevalent and need study.

### B. Objectives:

1. To identify and characterize the cultivated forages available or that have potential in the Andean highlands.
2. Study the present methods and land availability for intensive forage production, and determine the feasibility of this practice in the different areas fo the Andean highlands.
3. To evaluate cultivated grasses and legumes under Andean highland environments and determine yield, seasonality of growth, persistence and nutritive value.
4. To develop cultivated forage/animal production systems that complement or supplement the extensive range forages and evaluate plant/animal response.

### C. Project Approach: First Year

#### 1. General

- a. Establish working relations with personnel in Peru.
- b. Become familiar with local forages and feedstuff, animal and feed production systems and genetic types of animals available.
- c. Locate laboratory and field facilities.

- d. Obtain and train support personnel for on-site and Ohio locations.
2. Objective I (identify and characterize forages)
  - a. Review literature on Andean cultivated forages.
  - b. Study potential of the area for intensive forage production.
  - c. Preliminary survey and evaluation of forages in terms of potential adaptation, yield, utilization, and preservation.
3. Objective 2 (evaluation of cultivated forages)
  - a. Locate potential sites for laboratory and field studies and develop plans for forage evaluation.
4. Objective 3 (forage/animal production systems)
  - a. Preliminary evaluation of forage and animal production systems in terms of availability, adaptation, and animal nutritional needs as currently known and in relation to range programs.
  - b. Plan production systems based on information obtained under "a".

D. Indicators and Outputs

1. Indicators
  - a. Identification of potential forage/animal systems.
  - b. Establishment of laboratory and field site working conditions.
2. Outputs
  - a. Literature reviews on forages and small ruminant production in Andean highlands.
  - b. Development of cooperative plans with collaborators at site locations.
  - c. Collection of on-site forage and rumen samples.
  - d. Survey data on forages.

E. Assumptions:

Host countries will collaborate in developing and implementing projects and that the necessary laboratory, animal, and field facilities and experimental animals are available.

F. Inputs (See Budget Section)

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 Peru

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

Low reproduction performance significantly influences production levels of small ruminants (including new world camelidae) in the highlands of Peru. This is true because level of reproduction determines levels of production, especially where numbers of animals are involved. Low reproduction performance, particularly in traits such as age at first parturition, fertility and prolificacy, also limit the rate at which genetic improvement can be made because of its influence on such factors as generation interval and selection pressure.

The problem of low reproduction performance is associated with the following reproduction problems in sheep and goats: low fertility, including seasonal changes in the female, measured as percent females producing young, delayed age at first parturition due to slow development, early termination of reproductive life, reduced postnatal survival and growth, and apparent generally reduced fertility in the male. It appears that much of the reduced fertility and/or reduced postnatal performance is directly influenced by environmental factors. Females bred at the time of year most suitable for improved fertility complete gestation and lactate when environmental conditions (i.e. feed) limits survival and growth of young. Breeding at a time more suitable for the young results in additional limitations in fertility. A major limiting factor in developing genetic-management and related programs to improve reproduction is the severe lack of information on the reproductive capability of sheep and goats, including basic information on key reproductive processes and how they are influenced by the genotypes and environments involved.

Reproductive performance is also very low in the cameloids. However, considerable information is available on reproductive processes. Some of the principal investigators in this CRSP component have investigated the unique features of many of the reproductive processes in the camelidae. These unique features include induced ovulation, differential uterine horn function, sexual behavior and long gestation period. The limiting factors appear to be variation in time to ovulation

(delay) following copulation which can result in reduction of sperm fertility, high embryo mortality, differential uterine horn function related to placentation, survival and growth of young and male infertility problems. The identification of the mechanism controlling these limiting factors is necessary to the development of procedures to increase reproduction performance in the camelidae under the existing environments. Particularly sheep and camelidae (alpaca and llama) are produced throughout the Andean regions of Bolivia, Chile and Argentina under conditions similar to those existing in Peru. Any information obtained on reproduction of these species in the SR-CRSP would therefore have application and important economic impact throughout these regions of South America.

B. Objectives

1. To measure reproduction capabilities of the major genotypes of sheep in Peru.
2. To determine mechanisms controlling reproduction processes in New World Cameloids that limit reproductive performance.
3. To develop and test management programs consistent with available resources that are designed to increase reproduction performance in sheep and in cameloids.
4. As resources become available, to measure reproduction capabilities of goats in Peru and develop the required management programs for their increased reproductive performance.
5. To cooperate with other SR-CRSP components in reproduction related research.
6. To assist Peruvian scientists to increase their research capabilities through advanced degree programs and to cooperate with Peruvian scientists to provide appropriate training to Peruvian technicians, extension personnel, ministry personnel, and others working in reproduction and reproduction related research.

7. 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

The achievement of the objective will be approached through a fully coordinated and cooperative effort of the scientists of the National Agrarian University and IVITA, coordinated through INIA, California State Polytechnic University and Utah State University. All research is to be production oriented.

The major research facility for sheep and alpaca will be located at La Raya, Puno. The facilities assigned to the reproduction component of the SR-CRSP will be used as required by all scientists involved. Other field research programs will be established as necessary in the Central Andes in cooperation with large sheep and/or alpaca cooperatives.

In addition, laboratories will be established in facilities available at the National Agrarian University and IVITA. These will include laboratories for general physiological and chemistry work; semen processing, freezing and evaluation; and hormone analysis such as radioimmunoassay. A general physiology and chemistry laboratory and surgery facilities will be established also at La Raya. It is anticipated that a site in either Peru or Brazil, where RIA capabilities and experience already exist will be used initially for RIA. This will be used for analysis of tissue from both countries until facilities and capabilities can be developed in each.

Training programs will also be an integral part of the overall cooperative effort. Such programs will include graduate programs for advanced degrees for Peruvian scientists, training for technicians, extension personnel, ministry personnel and others working with reproduction or related programs.

Procedures For Each Objective Are Outlined As Follows:

#### Objective 1

Reproduction performance will be measured for the Criollo and the Corriedale-

type breed managed under existing and an additional management program consistent with available resources and designed to improve reproduction performance. Research will begin the first year of the study.

#### Research With The Female

The data obtained from these ewes during the regular breeding-lambing cycle will include age and weight at puberty and at first parturition, fertility (based on ewes exposed and ewes breeding), prolificacy, birth weight, and post-natal survival and growth, and the occurrence of postpartum estrus and relative endocrine profiles.

Other groups of ewes will be maintained unbred and checked throughout the year with tease: rams, under existing and improved management conditions, to determine the seasonal incidence of estrus and ovulation, and the rate of ovulation. Those ewes will also be used to measure endocrine profiles during the estrus cycle and seasons of anestrus.

The data collected in this objective will provide the basic information necessary for development of management programs to improve or optimize reproduction in Objective 3. Research in this objective might also be used to support thesis research for the M.S. or Ph.D. degree for a Peruvian scientist. Research on this objective will be initiated during the first year.

#### Research With The Male

Reproductive performance of the male will be determined for the two major genotypes of sheep under the management programs described above for females. Measurements taken will include age and weight at puberty, seasonal changes in semen production and libido, the freezability of semen, and endocrine profiles.

The reproductive performance of rams used for breeding will be estimated in terms of the required ratio of rams to ewes and general fertility. The number of genotypes measured at one time and the numbers of animals involved in research on both the male and female will be determined by the resources available.

## Objective 2

The primary effort of this objective will be to conduct appropriate research to illucidate the mechanisms regulating the processes which limit reproduction performance. The processes include those related to time of ovulation following the copulatory stimulus, differential uterine horn function, high in-utero loss of embryo or fetus, low male fertility, and low survival and slow growth rate of young. The first step in achieving the objective will be a careful review and analysis of results of relevant research already conducted. Following this, research will be undertaken.

It is expected that these research efforts will be directed initially toward three areas as follows. (1) Delayed time to ovulation following copulation, (2) differential uterine horn function and relationship to early embryonic loss and (3) low male fertility related to semen and sexual behavior.

Techniques and procedures used will include laparotomy, laparoscopy, hormone analysis (RIA), exogenous hormone treatment, semen collection and analysis, embryo recovery and analysis, and surgical modification.

## Objective 3

Research to achieve this objective will be undertaken when sufficient data are available from Objectives 1 and 2. It will involve the use of management components required to control and augment processes necessary to improve reproductive performance. The management components recommended will be consistent with resources available to the producer and that are compatible with an overall management system.

The management programs will be tested by imposing them on appropriate groups of animals and comparing their response to similar animals being maintained under the standard (control) management program. Modifications or adjustments will be made in an effort to obtain the most useful program.

#### Objective 4

Research on this proposal will be delayed until the necessary resources are available to conduct it without limiting research dealing with the other objectives. However, the achievement of this objective is considered to be of real significance because although only a small proportion of the people in Peru produce goats they constitute an essential contribution to those involved. The goats are generally of two production types in two locations. One type is used primarily for meat and is located in the valley areas of the Andes. The other is located in the coastal areas in northwest Peru and is used primarily for dairy.

In both areas the first step in achieving the objective will be to identify and analyze pertinent information on goat reproduction and persons and organizations involved in reproduction or production in goats.

Three organizations have been suggested in this regard (1) Piura University, Piura; (2) Pedro Ruiz Gallo University, Chiclayo; and (3) CIAGII, Chiclayo, INIA. The latter two may have some cooperative work already underway.

The generation of information on reproduction capacity will be undertaken in a manner similar to that outlined for both the male and female in Objective 1. It is expected that the efforts will be more limited. The information on reproductive capability, both in terms of strengths and weaknesses, will be used to develop management components designed to increase reproductive performance commensurate with available resources and production levels. The usefulness of these management components will be compared to existing programs and their compatibility to other systems required for production.

#### Objective 5

This objective will be achieved by promoting and engaging in cooperative efforts with other SR-CRSP's in measuring and evaluating reproductive performance of their research animals, in developing overall management programs to optimize reproduction and production and in any other way to promote the overall objectives of the SR-CRSP or any of the cooperating Peruvian organizations.

## Objective 6

Work on this objective will be undertaken the first year. It can be divided generally into three parts. The first deals with programs for advanced degrees. In these programs persons will be identified by Peruvian and U.S. cooperating personnel on the basis of the value of the graduate program to personal and professional growth and development of the individual and to the increased capability of the Peruvian research programs. Research for the advanced degrees (M.S. or Ph.D.) will be conducted in Peru. The person will take his course work and receive training in special techniques at California State Polytechnic University or Utah State University. Where appropriate, graduate students from the U.S. will also conduct research in Peru which is a part of the cooperative effort for their degrees.

The second part of the training program deals with providing training programs such as short courses and workshops on specific aspects of livestock management, research procedures and techniques or other information that would improve the capability of the individual and also increase the efficiency and performance of the research effort. Such training programs would be provided to Peruvian technicians, extension personnel, ministry personnel and others working in reproduction and reproduction related programs. These training programs will be planned and conducted cooperatively by Peruvian and U.S. scientists.

The third part of the training program involves development of resource material for use by all personnel as they have interest or need. This includes strengthening libraries by adding selected books and research and popular periodicals, proceedings, and publishing materials developed and presented in short courses, etc. appropriate audio-visual aid materials would also be made available.

Reviews of the total cooperative efforts could be conducted in which all personnel, scientists and technicians would be involved and the role and inputs of each phase would be evaluated and ways to strengthen the overall program

would be developed. At least indirectly this could constitute an evaluation of both the program and the personnel.

#### Objective 7

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 Peru 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 use.
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 cooperating Peruvian scientist will be assisted in obtaining an advanced degree. Short courses (one per year) will be held for training cooperating Peruvian scientist 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 objectives 1, 2, 3 and 4 will provide information on reproduction performance from selected genotypes under selected management conditions. This will contribute to improved level and efficiency of production by providing alternative programs for increasing reproduction performance.
2. Achievement of Objective 5 will improve quantity and quality of cooperative efforts of SR-CRSP in Peru.
3. Completion of training programs (Objective 6) will improve the research and management capabilities of foreign work site personnel.

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. 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 NAU and IVITA are adequate for the research planned.
3. The cooperative effort in Peru has the full support of administrators at U.S. universities and INIA, NAU, and IVITA.

4. Requested resources are adequate to accomplish the programs planned.

I. Inputs (See Budget Section)

J. Time Phase and Scope of Work

Work for each objective will be initiated according to the following schedule. Objectives 1, 2, 3, 5, 6 and 7 FY 1980 and continue throughout project. Objective 4 FY 1982 and continues 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: An Investigation of Small Ruminant Health Problems in Peru

Status: New Project

Sub-Grantee: Colorado State University  
Fort Collins, Colorado 80523

Principal Investigator: Cleon V. Kimberling

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

## Project Description:

### A. The Problem

A number of conditions and diseases in the small ruminants and cameloids of Peru restrict their productive efficiency. A review of literature, I.V.I.T.A. reports, necropsy and diagnostic laboratory reports plus interviews with I.V.I.T.A. scientists reveal major problems involving all phases of production from embryonic mortality to neonatal mortality to lack of productive efficiency from a myriad of infectious and noninfectious conditions. To further complicate the problem, many of the small holders are faced with social and economic constraints which prevent ideal management practices. Many sound management and herd health programs can be implemented on an Extension basis to assist the small holder but a basic knowledge of the causes, pathogenesis and immunologic protective mechanisms must precede implementation of prophylactic and management techniques to control disease.

### B. Objectives

1. Establish a small ruminant collaborative research program between Colorado State University Scientists and Peruvian Scientists.
2. Review disease morbidity and mortality in the small ruminant population of Peru with consideration of the socioeconomic impact of these conditions on Peruvians who depend on small ruminants for food, fiber and cash income.
3. Improve the diagnostic capabilities for small ruminant diseases.
4. Following a review of the causes of morbidity and mortality in small ruminants, conduct further epizootiological studies to determine priorities for research consideration.
5. Develop new knowledge about immunologic reactions in small ruminants to selected viral and bacterial agents.
6. Provide Peruvian scientists and other interested personnel with research findings through timely technical reports thus facilitating the dissemina-

tion of new knowledge in an understandable and meaningful fashion to the small ruminant producer.

7. With currently available knowledge, assist the small holder and the principal investigators of CRSP in designing herd health programs to maximize production of small ruminants and cameloids.
8. Assist Peruvian scientistst in the development of new diagnostic tests for internal parasites. (Liver flukes and others.)
9. Assist Peruvian scientists with evaluating new antihelminitics in the control of liver flukes and other internal parasites.
10. Cooperate with the appropriate Peruvian regulatory agencies in identifying disease control policies which will aid in preventing diseases among the small ruminants.
11. Establish a program whereby Peruvian scientists will visit Colorado State University, and other laboratories such as the National Animal Disease Laboratory as deemed necessary, for education and training. These visits will be sufficient time and breadth to train the Peruvian scientist in research and diagnostic techniques.
12. As the Title XII program continues we will strive to work on disease problems in the small ruminants that have a major socioeconomic impact on the Peruvian small holder.

#### C. Rationale

1. In the intended sense of collaborative research support, we will mesh ongoing small ruminant research strengths at Colorado State University with appropriate counterpart programs and scientistst in Peru.
2. During the formative periods of Title XII CRSP Small Ruminants, emphasis was placed on collaboration of US Scientists and those of the underdeveloped country. Support was given to ongoing research with definite instructions that Title XII was not intended to initiate or generate new research projects.

3. A site visit to Peru was conducted in August 1979 by Dean Robert Phemister, Dr. A. F. Alexander and Dr. C. V. Kimberling. Research, educational and administrative facilities and personnel were visited. INIA was identified as the administrative unit to coordinate the activities of CSU and Peruvian scientists. IVITA was identified as the organization with which to develop a collaborative research program.
4. With a limited budget for research and training of Peruvian counterparts it was decided to identify areas of research currently underway at CSU and Peru which would be mutually beneficial to both countries.
5. A review of facilities and equipment in Peru indicated that San Marcos would be the best choice for locating the core research program as facilities, equipment and personnel are available. A visit to IVITA stations at Huancayo and La Raya revealed a nucleus of good facilities, personnel and animals for conducting trials and gathering data.
6. During visits to IVITA stations at Huancayo and La Raya plus a visit to the Cerro de Pasco sheep station morbidity and mortality reports were reviewed and discussed. Among the major economic and health concerns were parasitism, enteric diseases, reproductive problems, pneumonias, and neonatal mortality. Research workers at IVITA and CSU are working on many of these conditions.
7. Priorities for research under the USDA special research grants program for sheep and goats are 1. Respiratory diseases, 2. Enteric diseases, and 3. Abscesses. Priorities for research as listed by the Animal Health Science Research Advisory Board are 1. Respiratory diseases (especially progressive pneumonia), 2. Enteric diseases including parasites, 3. Multistrain blue-tongue vaccine, 4. Poisonous plants including photosensitization, 5. Regional sore mouth vaccines (need to develop proper strains), 6. Foot rot, 7. Drug clearance for minor species (a. Wormers,

Liver fluke treatment, b. Monensin, rumensin.)

8. At the present time Dr. Lauerman and Dr. Meyers at CSU are engaged in research on enteric diseases, specifically enterotoxemia type A, with an emphasis on protection. (Appendix I.) The same group has the capability of incorporating work on Liver fluke diagnosis using the ELISA (Enzyme Linked Immunospecific Assay Test). Dr. DeMartini and Dr. Pearson are researching the immunological principals of soremouth and parapox viruses in an effort to better understand the immunological basis for these and other infectious diseases with an ultimate goal of superior vaccines. (Appendix II.) Other areas of study at CSU which may be incorporated into the collaborative research program are areas of reproduction, including field diagnostic tests for ram epididymitis and parasitology, including diagnostic procedures and treatments for Liver flukes. Dr. Stuart Young of CSU has many years of research on chronic progressive pneumonia.
9. During the site visit, budget limitations of the Title IXX CRSP were discussed. It was mutually agreed by IVITA administrators and researchers that an attempt to solve all disease problems of small ruminant in Peru would dilute the resources making the effort worthless. It was agreed between the IVITA personnel and the site visit team that research and training would commence on sore mouth and parapox and enterotoxemia type A. Other research in the areas of internal parasites, reproductive problems, and pneumonias will be investigated as time and money permit.

#### D. The Approach

1. During the administrative visit to Peru in August 1979, contacts were made with INIA and USAID to establish the necessary liaison between CSU and Peruvian researchers.
2. IVITA and San Marcos University were identified as the research organization with which to develop a collaborative research program.
3. Personnel with IVITA were identified to collaborate with CSU scientists.

Appendix I and II.

4. Pending approval of the memorandum of understanding between the management entity and Peru, scientists from IVITA will be invited to Colorado State University to study techniques relevant to their particular research project. Other US laboratories and universities will be incorporated into the training program depending on the needs of the Peruvian scientists.
5. Two graduate veterinary research associates will be assigned to the project. These research associates will conduct research activities at CSU. As the project progresses these researchers will work directly with their Peruvian counterparts on research problems, data collection and search for areas of future research needs.
6. Monies have been budgeted for supplies and expenses to be used by the foreign scientists. Monies for training Peruvian scientists have also been provided in the budget under international travel.

E. The Indicators and Outputs

1. Initiation of a collaborative research program with Peruvian scientists.
2. Presentation of research results at scientific and producer meetings.
3. The design of herd health programs applicable to small ruminant flocks of the small holder.
4. Progress reports.
5. Publication of research results in scientific journals, producer journals, and extension material designed for the small holders.
6. Technical reports prepared specifically for Peruvian counterparts.

F. The Assumptions

1. That host country scientists are available and interested in the areas of research mentioned in the project approach and that a mutually beneficial research program can be initiated.
2. That the host country scientists have facilities available for research

activities.

3. That the host country scientists have adequate equipment and supplies to support the planned research; project funds for such expenditures are minimal.
4. That exchange of research techniques will be dependent upon the availability of the host country scientists to visit Colorado State University and the scientists from CSU to spend time in the host country.

#### G. Technical Feasibility

Research by Colorado State University scientists Dr. J. DeMartini (co-principal investigator) and Dr. L. Lauerman (co-principal investigator) includes immunogenic and diagnostic studies vital to understanding host-agent responses and developing products to protect the small ruminant. Research stations and Peruvian scientists were visited to determine the suitability and availability of facilities and personnel who have research capabilities. Dr. Dora Herrera and Dr. Hugo Samame of IVITA and San Marcos University are actively researching common problems and indicated a sincere interest in a collaborative research effort. As there are qualified scientists in both countries studying similar problems with facilities and experimental animals available, the project is technically feasible.

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

#### I. Implementation

1. Literature reviews.
2. Preparation of research proposals for review by the research committee on:
  - a. Small ruminant immune system responses.
  - b. Clostridial diseases affecting small ruminants.
3. Appointment of a laboratory technician to assist with ongoing research of the above named conditions.
4. Search for two graduate veterinary research associates.

5. Continue in the development of research techniques for the above conditions.
6. Invitation of Peruvian scientists to Colorado State University for training.

J. Annual Review and Planning

A progress report will be submitted annually for review by the Board of External Examiners. Before developing the next year's work plan, an extensive review will be conducted keeping in mind the ultimate benefits to the small holder of small ruminants and cameloids. This review and future planning will be done in conjunction with Peruvian counterparts and other principal investigators working in Peru.

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 Peru

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.

## II. Scientific Program in Peru

The economic program in Peru has the general objectives of 1) describing sheep and alpaca production systems in the High Sierra of Peru, 2) conducting farm management-production economics studies, 3) carrying out consumer demand-marketing studies to identify marketing constraints and problems affecting small ruminant production and profitability in Peru, and 4) performing project evaluation studies.

The first year program in Peru is oriented towards initiating some aspect of each of the above four areas of general studies; establishing an operational framework for initiating these studies including assignment of research responsibilities between the Principal Investigator, Peruvian collaborators, and expatriate staff assigned to the project in Peru; planning specific research projects to be carried out over the next 3-5 years; and conducting a workshop of all Title XII Small Ruminants CRSP researchers with inputs into the economics program as soon as the collaborators and projects are identified and organized.

The chief collaborators at this stage will be:

Dr. Julio Echevaria and Sr. Domingo Martínez, Departamento de Economía y Planificación, Universidad Nacional Agraria - La Molina, Peru.

While the working out of specific research responsibilities between the collaborators, the Principal Investigator, and a Ph.D. candidate in Agricultural Economics (who is anticipated being at work at UNA in March) has not yet been finalized, the research interests of the collaborators would indicate that Dr. Echevaria would conduct research on marketing and pricing of sheep and alpaca products while Sr. Martínez would assume responsibility for description of production systems and the farm management-production economics research. It is anticipated that some UNA graduate students will conduct specific studies within each of the above areas.

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

1. Production systems description research project - survey work should be

carried out by multi-disciplinary teams to allow the systems description to include information on physical resources (Texas Tech, WI), animal resources (Montana State, CSU, Texas A&M, WI), and socio-economic characteristics (University of Missouri/WI).

2. Farm management/production economics -

Some of this work would assess improved production systems. Data on technologies of improved production systems would be provided by Texas Tech, Montana State, Texas A&M, and CSU.

3. Project evaluation studies -

Baseline data must be collected during 1980 to provide the "before" aspects of the project upon which improvements in production parameters and system productivity can be assessed after 4-5 years. The need for interdisciplinary survey teams and the cross collaboration would parallel 1. above.

4. Collaborative studies with the University of Missouri Rural Sociology Project - Comparative socio-economic characteristics of alternative methods for organizing small ruminant production, including the traditional comunidades, the Sociedad Agricola de Interes Social, mixed crop-livestock farms and more specialized large scale livestock farms.

IV. Regional Applicability of the Research Beyond Peru

Research on the comparative economics of sheep vs alpaca production is applicable to Bolivia. Economic studies of sheep production for meat vs wool is applicable throughout the Andean highlands and perhaps to Nepal, Pakistan and high altitude areas of the Middle East.

Economic studies of stratified production systems would have general relevance for other small ruminant producing areas where substantial differences in resource endowments for animal feeding existed or where seasonality of feed production differed within a country.

## V. Project Description

### The Problem

The economics program in Peru will attack three major problems the first year - a lack of knowledge of:

- a) traditional small ruminant production practices,
- b) economic structure of various production and marketing organizations and
- c) demand characteristics of small ruminant products.

Such information is needed to help orient the biological research programs, and help design the long-term strategy for economic research on small ruminants in Peru.

### The Objectives

- a) Describe existing small ruminant production systems in physical, organizational and socio-economic terms.
- b) Initiate farm management - production economics studies, including baseline surveys, regular farm management data collection visits, analysis of risk, crop-livestock systems, and communal resource use problems.
- c) Carry out initial marketing and demand studies to define market institutions, policies, and constraints.
- d) Begin collecting data for long-term project evaluation study.
- e) Establish working collaborative relationship to allow studies to proceed.

### The Approach

Using a combination of existing literature and secondary data, establish the major field areas for conduct of economics project field research. Then begin baseline survey work to define production systems for small ruminants in Peru. This would be followed by a marketing

survey to establish characteristics of the product markets for small ruminants, review existing institutions and government policies as they impact on the agricultural sector in general and on the small ruminants sector in particular. More detailed work on production economics will follow using detailed farmer interviews to ascertain resource use for small ruminant production and comparative costs of production for sheep and alpacas. It is anticipated that this work will be divided among the collaborators, a research fellow located in Peru as the Economics Project Coordinator, and a Ph.D. candidate carrying out his thesis field research. In addition, Peruvian graduate students would undertake specific studies for their theses.

#### Indicators that First Year Project Objectives in Peru Have Been Achieved

- a) Publication and use of description and classification of existing small ruminant production and marketing system.
- b) Completion of broad-based economic surveys which can be updated on a yearly basis for project evaluation and monitoring purposes.
- c) Establishment of an interdisciplinary economic research program at each major research site, including on-site training and collaboration by counterpart agricultural economists, a regular schedule of data collection for farm management and marketing studies and the establishment of an effective economic services function to assist other research projects at the major work sites.
- d) The provision of the necessary field support facilities and staff for the economic research program and the establishment of effective links between headquarters staff at Winrock International and field staff.

#### The Assumptions (that objectives can be met)

- a) Initial data base will be adequate to allow fairly efficient procedures to be followed for conduct of baseline surveys and

selection of sample units for farm management studies.

- b) Host governments and collaborating institutions appreciate the the potential value of a comprehensive economic research program and will thus allow researchers reasonable access to small ruminant producers.
- c) Local small ruminant producers and marketing agents will provide adequate levels of cooperation on survey aspects.
- d) Adequate availability of suitably trained counterpart staff to supervise the routine aspects of the economic research program, to interact with the other research projects at the field sites, and to effectively provide economic services to these projects.
- e) An ability and willingness by other small ruminant CRSP researchers (both U.S. and collaborating personnel) to utilize the information generated by the economic research program and to interact effectively with economics staff in the research formulation, execution and evaluation stages.

The Assumptions (the meeting of objectives will solve the problem)

- a) The Government of Peru has a genuine interest in developing the agricultural sector in general and the small farmer of the High Sierra in particular.
- b) That implementation of changes in production and marketing practices does not prove impossible from a social, legal, administrative or political standpoint.
- c) The research capability developed by counterpart staff will be recognized and utilized for practical problem solving research on small ruminants in Peru.

The Outputs

- a) First year publications including descriptive material on pro-

duction and marketing systems.

- b) Progress Reports by Winrock field staff assigned to Peru project.
- c) An established farm management data collection system to extend over the life of the project.
- d) A baseline survey and individual farm management survey questionnaires.
- e) A computerized system of farm management data processing and analysis.

#### VI. Technical Feasibility

The project makes use of known methodology and survey techniques for use with small farmers in developing countries. Field enumerators will be hired on short-term basis from existing institutions in the highlands. Farm interviews will be timed so as to avoid conflicts with farmers work schedules. The feasibility of quickly establishing interdisciplinary projects with other PI's, is of course, dependent on the early implementation of the other CRSP research projects in Peru.

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

#### VIII. Personnel

- a. A. John De Boer, Principal Investigator
- b. Dr. Julio Echevaria and Sr. Domingo Martinez, Agricultural Economists, Departamento de Economica y Planificacion, Universidad Nacional Agraria - La Molina, Lima, Peru (Collaborating Scientists).
- c. Graduate Research Assistant (Ph.D. candidate from U.S. University, being recruited).
- d. Research Associate - Professional Agricultural Economist (M.S. or Ph.D.) for long-term assignment in Peru (being recruited).

#### IX. Implementation

The Principal Investigator visited Peru July 7-14 and will again visit Peru

October 20-24 to discuss research plans, meet potential Peruvian M.S. students and discuss a draft of the baseline survey questionnaire with Dr. Echevaria and Sr. Martinez. By the first of the year, it is hoped to have the Research Associate established in Lima, followed 2-3 months later by the first Graduate Research Assistant. The Baseline Survey should be implemented during January-March 1980 followed by the farm management and marketing surveys during April-May, 1980.

X. Annual Review and Planning

The first planning session should be held October 22-23 with the P.I. and Peruvian collaborators followed by a planning session in January between all Peruvian staff who will participate in the project, the P.I., and the Research Associate. First Year Progress Reports will be prepared in May, reviewed by the P.I. and a Project Consultant and the results discussed with the Peruvian counterparts. Planning for interdisciplinary work with other projects will proceed during visits of PI's to Peru, a Peru sub-group meeting during meetings of the Technical Committee, and visits by the Economics P.I. to other insitutions, if needed.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

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

Status: New Project

Sub-Grantee: University of Missouri  
Columbia, Missouri 65211

Principal Investigator: Michael F. Nolan

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

## Project Description

### The Problem

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

In Peru most small ruminants production is carried out by small producers on either private land holdings or within a cooperative structure (e.g., SAIS). In order for production interventions to succeed, the differences and inter-relationships between these different production systems will have to be taken into account along with the more general social and cultural conditions common to both systems.

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

### Objectives

- I. Obtain an accurate description of the current system of small ruminant production in both the Central Sierra and altiplano regions of Peru.
- II. Determine the key constraints on increased productivity both from the perspective of the peasants and from a structural socio-economic perspective.
- III. Initiate a number of intensive field projects designed to provide in depth understanding of the precise nature of the key social constraints to production. The determination of topic areas will be made following the completion of Objectives I & II and in collaboration with our

Peruvian counterparts. While we are avoiding predisposing ourselves to any given set of topics we anticipate that the areas of risk/decision making, role of women/children in SR production, role of SR in social fabric of rural communities and the sociology of range movement will be given serious consideration for future studies. These areas will probably be important regardless of site. In addition there are a number of subject areas which are unique to Peru, in particular those involving a comparison of the cooperative (enterprise) production system with individual small holder units and a comparison of sheep and alpaca production.

IV. Develop, or participate in the development of alternative strategies for increasing productivity in accord with the local socio-cultural patterns.

This will probably not occur until after year three, at the earliest.

#### Project Approach

During the life of the project in Peru we propose to utilize a variety of approaches to accomplish our stated objectives. Initially we intend to send an economic anthropologist (or someone with comparable skills) to Peru for 4-6 months to provide us with a description of the current system of production both in the central sierra and altiplano. The individual charged with this task will prepare a report in both English and Spanish for distribution to all involved in the Peru project.

Prior to and during the time this work is being done, we will be conducting an extensive review of the literature relevant to a project on SR production. The results of this literature review, along with the descriptive account of the current production system will form the basis for setting priorities for future research activities. The establishment of research priorities will be a joint undertaking of Peruvian counterparts and ourselves.

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

reports may guide the developemnt of survey instruments and surveys may suggest areas for future field observations.

Throughout our intent will be to work closely with Peruvian social scientists. We have been in contact with Dr. Ernesto Yepes and Dr. Carrol Dale of the Department of Human Sciences at UNA (La Molina). They, along with Mr. Domingo Martinez of the Department of Economics at UNA, are interested in working with us and would serve well as counterparts. As the project advances we anticipate making contacts with additional Peruvian social scientists with whom we may collaborate on specific research projects. Unfortunately our limited time to date has not allowed us to discuss the project with all the well trained and qualified social scientists in Peru.

In addition to working closely with Peruvian social scientist we anticipate continuing to build on the close relationship we enjoy with other projects which anticipate working in Peru. We expect to collaborate closely with the economics project on our interests and theirs overlap in several areas. In the production area we will work closely with the range management project, and maintain close lines of communication with the health and breeding projects. Throughout we will try to accommodate their requests for information.

#### Indicators and Outputs

For the first year of effort in Peru we expect modest outputs. They are as follows:

1. Establish a project reference center composed of published and unpublished reports related to the role of socio-cultural factors in livestock production.
2. Initiate a study of the current system of SR production in Peru. The report of this study should be available in the summer of 1980.
3. Establish a priority list of research topics to be pursued in Peru for the next 3-5 years. This list will always be subject to change, but none-the-less will provide a basis upon which to plan future activities.
4. Establish firm counterpart relations with Peruvian social scientists.

Some work has been done in this already but more is needed before we can truly make this a collaborative endeavor.

#### Assumptions for this Time Table

1. That a signed agreement between the ME and the GOP is in place prior to November 1, 1979.
2. That a site coordinator is hired and working by January 1, 1980.
3. That sufficient logistical support (e.g., Vehicles) is available to allow field work to begin by February 1, 1980.
4. That no difficulties are encountered at any level in establishing scientist to scientist contacts.
5. That current political tensions in Peru don't worsen to the point that work becomes impossible.
6. That sociological research activities are not restricted through official action.
7. That natural disasters, wars or other "acts of God" do not cause the project to be interrupted or curtailed.

#### Assumptions that Achieving the Objectives will solve the Problem

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

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

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

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

#### Technical Feasibility

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

#### Personnel

Michael F. Nolan, Principal Investigator  
Jere L. Gilles, Co-PI  
George P. Primov, Co-PI  
Graduate Research Assistant  
Research Associate

Collaborating Scientists - Dr. Yepes, Dr. Dale, Sr. Martinez and others.

Inputs (See Budget Section)

#### Implementation

The Principal Investigator visited Peru July 7-19. He and/or another member of the project staff will return in late Fall or early Winter to continue discussions of future studies with the collaborating scientists mentioned earlier. By February 1, 1980 we expect to place a social scientist in the field to begin to collect baseline descriptive data which will form the basis for making final decisions on future studies. This will take from 3-6 months to complete.

#### Annual Review and Planning

The first planning session with Peruvian collaborators was held in July 1979 and the second will occur prior to February 1, 1980. It is intended at some point to involve the key U.S. staff in meetings with the Peruvians who will participate in the project so that the next period of work can be planned with as broad a base of input as possible.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

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

Status: New Project

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

Principal Investigator: Thomas C. Cartwright

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

## Proposal Abstract

### Systems Analysis And Synthesis Of Small Ruminant Production

Generalized, comprehensive, biologically based, mathematical models for simulating sheep production provide a systematic method for bringing knowledge relating to isolated production components together for the entire production system. These models, and simulations from them, organize available knowledge, identifying 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 Peru as well as the U.S. The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.
2. To collect production data and characterize production systems in the highland areas of central and south-central Peru; to validate the model and input parameters; and to use these validated simulations as baseline simulations.
3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Peru.
4. To supply input-output data of sheep production systems for use in

economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of sheep production systems to alterations or interventions requested or agreed upon by project personnel.
6. To develop objectives (1) through (5) for goats, alpacas to some degree, and mixed species as time permits and as requested by INIA.

## II. Project Description

### A. Description Of Problem

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

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

Factors having major effects on small ruminant producing systems in Peru 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 dynamic of such complex systems through mathematical models (Van Dyne, 1978). These models may be constructed at various levels of refinement and generally (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, management procedure or feed resource can be conveniently applied to the

general model. Thus, these models are adaptable for simulating production systems in Peru as well as the U.S.

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

#### B. Objectives 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 Peru 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.
2. To collect production data and characterize production systems in both the central and south-central highlands of Peru; 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 Peruvian CRSP.
4. To supply simulated input-output data of sheep production systems for use in economic analysis and sociological assessment.
5. To evaluate, through simulations, the response of sheep production systems to alterations or interventions of interest to project personnel.

6. To develop objectives (1) through (5) for goats, alpacas to some degree, and mixed species as time permits and as requested by INIA

### 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; the sheep model is expected to be ready for preliminary runs during the second year.

#### Objective B1

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

1. The first step in the development of a sheep production systems model is to search out and evaluate available data and research results relevant to model construction, including consultation with experienced specialists. The uniqueness and utility of the cattle model results from its conceptual structure: the driving variables are quantity and quality of nutrient resources; biological responses are conditioned by animal genotype, management practices and other environmental 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. Even though the proposed form of the model has proven useful with beef

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

4. The major modelling effort will be directed towards completing and utilizing the sheep model. As the sheep model is refined and project personnel become more experienced with the techniques and applications of the systems approach in Peru, it is expected that this expertise will be utilized to study goats, alpacas and mixed species systems, initially emphasizing combinations of sheep and alpaca under common central management.

#### Objective B2

1. The available feed resources and breedtypes of sheep will be characterized through the use of data collected at the IVITA experiment station near Huancayo. These data will be used to verify the primary equations of the sheep model as to the sheep and their environment on a specific highland location.
2. After the working model is completed for the highland area, it will be subjected to validation tests which will consist of simulation of the production systems on the Cooperative and SAIS locations where the other CRSP projects are operating. Sequences of simulation, validation, model modification and new simulation are necessary. This recurrent process is tedious and time consuming but absolutely essential. These validation runs also serve as baseline documentation against which recommended

changes are to be compared. The sheep model is expected to be ready for validation during the second year, and validation completed and production simulations initiated during the third year.

3. Once the sheep model has been validated at the IVITA Huancayo experiment station and selected Cooperative and SAIS locales, it will be available for examining production systems in other highland ecozones. 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 and/or other projects in Peru.

#### 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 SR-CRSP 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 mixed species production systems for the highland area 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 Peruvian livestock researchers, and other types of changes. The changes examined would include such practices as supplemental feeding, disease control, marketing at younger ages, breeding seasons of different lengths at different times of the year, introduction of exotic breeds and crossing.

2. These simulations would include effects on the total production system 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 Peru 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 highland locations. 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 Peruvian 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 confi-

dence, and to 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 model which is comprehensive, general, biologically based, dynamic and programmed for computer use.
2. Validation of these models against data collected at Huancayo and specific Cooperative and SAIS settings; those data may be collected by other CRSP projects and/or other projects in Peru.
3. Synthesis of sheep and goat production systems which meet objective functions specified by Peruvian research collaboratives and other personnel of cooperating Peruvian organizations in consultation with other CRSP project leaders.

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

production systems. Another assumption is that the available knowledge can be incorporated into adequate models and that these models will closely predict the outcome of production systems alternatives. A large-ruminant model has been developed (Sanders and Cartwright, 1979a,b) and successfully applied in LDCs (Cartwright et al., 1977; Davis et al., 1976; ILCA, 1978). This success suggests that similar small-ruminant models can be developed; however, research data for small ruminants are not as extensive and sensitivity, especially in earlier versions, may be reduced.

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

The modeling objective can be attained and will be available for use in Peru and the U.S. regardless of the participation or capabilities of Peru. However, application to specific locations by synthesizing systems and conducting economic analysis depends on the cooperation of key Peru personnel. Requirements of expertise level and personnel commitment from Peru 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 INIA, IVITA and UNA 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 Peru 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 Peruvian production systems and synthesis and examination of new systems.

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

methods, and expertise are available.

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

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

The probability of attaining this first phase of the project at least in substantial amounts is almost certain.

The second phase is that of simulating and synthesizing production systems in Peru, that is, examining present systems and new recommended practices or methods. Since this phase depends on data collection and/or data already collected in Peru and cooperation of Peruvian research collaborators and other personnel of cooperating Peruvian organizations, 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 INIA, IVITA and UNA and on inputs generated by the other projects of the CRSP. Because of the interest and the expected good data base

from the IVITA and UNA, the outputs of this project should help form the basis for development of policies and programs of INIA.

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. Instituto Nacional de Investigacion Agraria (INIA)

J. Gazzo

C. Val Verde

J. Lozano

3. Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA) - San Marcos

Luis F. Coronado

Jorge Velasco

Universidad Nacional Agraria (UNA) - La Molina

Alberto Pulmayalla

VI. Implementation

The implementation of this project occurs in three phases:

1. Model development, validation, and refinement.
2. Simulation of sheep production systems for the highland area.
3. Applications of systems analysis to small-ruminant production systems for Peruvian locations.

The first phase will actually continue throughout the project and require input

from the collaborating projects as well as data and information collected on the projects in Peru and in other LDCs.

The second phase is the application phase and depends heavily on data collected at the Huancayo research station and the cooperation of the collaborating projects and the Peruvian counterparts. The simulations will be the basis for examining alternative production practices and synthesizing production systems to most effectively intergrate sheep production into small holder agronomic enterprizes.

The final phase will involve utilization of data from other projects in Peru as well as at IVITA and UNA. These efforts can be initiated as soon as the sheep model is 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 system 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 Peruvian 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 Peru will be coordinated with the Program Director of the CRSP, the Technical Committee of PI's and personnel of INIA.

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MEMORANDUM OF UNDERSTANDING  
ON  
THE ADMINISTRATIVE ARRANGEMENTS  
BETWEEN  
THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
AND  
INSTITUTO NACIONAL de INVESTIGACION AGRARIA

WITH REGARD TO THE ESTABLISHMENT OF A  
COLLABORATIVE RESEARCH SUPPORT PROGRAM  
ON SMALL RUMINANTS

MEMORANDUM DE ENTENDIMIENTO  
SOBRE ORDENACION ADMINISTRATIVA  
ENTRE  
LOS REGENTES DE LA UNIVERSIDAD DE CALIFORNIA EN DAVIS  
Y  
EL INSTITUTO NACIONAL de INVESTIGACION AGRARIA  
  
EN RELACION AL ESTABLECIMIENTO DE UN PROGRAMA DE  
APOYO COLABORATIVO PARA LA INVESTIGACION  
DE RUMIANTES MENORES

MEMORANDUM OF UNDERSTANDING  
ON THE ADMINISTRATIVE ARRANGEMENTS  
BETWEEN THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
AND  
INSTITUTO NACIONAL de INVESTIGACION AGRARIA  
WITH REGARD TO THE ESTABLISHMENT OF A  
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

MEMORANDUM DE ENTENDIMIENTO  
SOBRE ORDENACION ADMINISTRATIVA ENTRE LOS REGENTES  
DE LA UNIVERSIDAD DE CALIFORNIA EN DAVIS Y  
EL INSTITUTO NACIONAL de INVESTIGACION AGRARIA  
EN RELACION AL ESTABLECIMIENTO DE UN PROGRAMA DE  
APOYO COLABORATIVO PARA LA INVESTIGACION DE RUMIANTES MENORES

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 the Instituto Nacional de Investigacion Agraria (INIA), under the provisions of its law no. 22431 and with central office in Lima, Peru, 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)

Dentro el marco del Titulo XII Acta de Ayuda de 1975 para el Desarrollo Internacional para la agricultura y la alimentacion la Universidad de California en Davis (UCD), actuando para y a favor de los Regentes de la Universidad de California y siendo la autoridad competente de los Estados Unidos bajo las regulaciones de la Donación No. AID/DSAN/XII-G-0049 y el Instituto Nacional de Investigación Agraria (INIA), bajo las previsiones oforgadas por deoreto ley no. 22431 con oficina central en Lima, Perú, celebran el siguiente entendimiento:

I. DEFINICIONES - Para fines del presente entendimiento, serán de aplicación las siguientes definiciones:

A. "CRSP" significa el Program de Apoyo para la Investigacion Colaborativa de Rumiante Menores, establecido dentro del marco del "Titulo XII" por acción conjunta de la Agencia para el Desarrollo Internacional (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

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:

y la agencia para el Desarrollo Internacional para la Agricultura y la Alimentación (BIFAD) y consolidado por una donación del AID otorgada a los Regentes de la Universidad de California.

B. "Institucion Participante", significa una universidad o cualquier otra institución de investigación a quien los Regentes de la Universidad de California le haya otorgado una sub-donación, bajo la autoridad y regulaciones de la antes referida donación Grant No. AID/DSAN/XII-G-0049 a fin de que conduzca un proyecto componente del CRSP.

C. "Entidad Administradora" o "ME", significa la Universidad de California en Davis designada por AID y BIFAD como la institución legalmente responsable para la conducción de los asuntos fiscales y el program del CRSP.

D. "DIRECTOR del Program", significa la persona designada por la Universidad de California en Davis para actuar como el funcionario jefe ejecutivo del CRSP.

## II. PROGRAMA DE APOYO PARA LA INVESTIGACION COLABORATIVA DE RUMINANTES MENORES

A. El acuerdo principal será la intención de establecer un CRSP cuyas metas constituyan la conducción de un programa de entrenamiento y de desarrollo de la investigación en apoyo de la producción de rumiantes menores por los productores de recursos más limitados y pequeños propietarios, a fin de:

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 Peruvian 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 Peru.

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.

1. extender el grueso de conocimientos y proyectar su aplicación hacia la solución de problemas específicos;

2. extender el nivel de capacidad de los científicos americanos, así como los del Perú, para la conducción de la investigación;

3. desarrollo y comprobación de tecnologías apropiadas para mejorar la producción de alimentos, fibras y pieles;

4. mejorar las capacidades de producción de rumiantes menores para la alimentación humana así como para fibras y pieles, por los pequeños propietarios en USA y en el Perú.

Para apoyar en la planificación del programa, las partes desean dejar establecido un breve acuerdo de su intención de realizar el trabajo colaborativo como parte del CRSP, patrocinado por los Estados Unidos de Norteamérica a través de su Agencia para el Desarrollo Internacional (AID) con arreglo al Título XII del Acta de Ayuda de 1975 para el Desarrollo Internacional de Alimentos. El Título XII tiene como uno de sus principales objetivos, el desarrollo de programas para hacer frente a los problemas de la producción de alimentos y su utilización en los países en vías de desarrollo, uniendo los recursos y experiencias de universidades y otras instituciones de investigación en los Estados Unidos y países en vías de desarrollo.

B. The current Plan of Operation of the research program is described in Annex 1. The plan is subject to revision on an annual basis, to take into account the changing technical requirements of the program.

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, unless revoked by either party after adequate advance notice.

### III. THE UNITED STATES' CONTRIBUTION

The ME shall extend to INIA and through INIA to collaborating Peruvian institutions, manpower and resources in accordance with the mutually agreed program plan as described in Annex I or as revised by mutual agreement after annual review. 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 United States' contribution shall include funds with which to pay the following direct costs incurred under this understanding:

B. El Plan de Operación del programa de investigación se describe en el Anexo 1, El Plan esta sujeto a fin de considerar requerimientos tecnicos que signifique cambios en el program.

C. El acuerdo comenzará en la fecha en que se firme el presente Memorandum de Entendimiento y continuará vigente en tanto la donacion anteriormente mencionada, sea proveída por el AID al ME; sin embargo, con previo aviso de cuclquiera de las Partes el memoradum de enfendimiento podra ser cancelado.

### III. LA CONTRIBUCION DE LOS ESTADOS UNIDOS

El ME concedera al INIA, y a través del INIA a otros instituciones perunanas colaboradoras, el potencial humano y recursos en concordancia con el plan del programa acordado mutuamente, según descrito en el Anexo I, o revisado segun mutuo acuerdo despues de la revision anual. Los costos de los recursos y del potencial humano serán afrontados con fondos del CRSP otorgados a las Instituciones Participantes para ejecutar los proyectos componentes del CRSP gastados por o bajo la autorizacion del Director del Programa.

A. Costos Directos: La contribución de los Estados Unidos incluirá fondos para pagar los siguientes costos directos incurridos bajo el presente Entendimiento:

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

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

3. ME-approved international travel by US persons for the work of the CRSP, and of Peruvian 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 Peru.

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 Peru.

B. Manpower: UCD shall make available through the Participating Institutions the following manpower resources to INIA and collaborating Peruvian institutions.

1. US scientists of the highest competence who shall be the principal investigators from the

1. Salarios, jornales y beneficios de científicos y personal administrativo de USA en el Perú; suministros y gastos; y equipo necesario para conducir el trabajo del CRSP.

2. Costos de viajes a y dentro de US de todas las personas de USA y del Perú, para realizar el trabajo del CRSP.

3. Viajes internacionales aprobados por la ME para personas de USA que trabajen para el CRSP y para personas del Peru en entrenamiento, así como para el cuerpo de científicos y administrativos que estén trabajando en los Estados Unidos para el CRSP.

4. Costos de entrenamiento y becas.

5. Otros costos directos aprobados por la ME incluyendo un Coordinador Local en Peru.

Todas las solicitudes para la compra de suministros, equipo, viajes de cualquier naturaleza y otros gastos, deben ser aprobados y firmados por el Director del Programa en la Universidad de California o por su representante, sin tomar en cuenta si el costo se ha incurrido en USA o en el Perú.

B. Potencial Humano: La UCD proporcionara a través de las Instituciones Participantes, los siguientes recursos de potencial humano al INIA y a otras instituciones peruanas colaboradoras:

1. Científicos de USA altamente calificados, quienes serán los investigadores principales y co-investigadores de las

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 Peru on the problems of small ruminants.

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

4. All persons who travel to Peru, for work of the CRSP, whether for short or long term, shall be subject to clearance by Peruvian regulations and INIA.

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

1. Traineeships to study in the US to the MS or Ph.D. level, to the extent determined by INIA or Peruvian collaborating institutions designated by INIA.

2. Short-term training as deemed necessary by principal investigators for other Peruvian 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 Peru. By mutual agreement of the Program Director and the Executive Director of INIA, certain administrative functions may be delegated to a Site Coordinator, resident in Peru.

instituciones con las cuales la ME tiene acuerdos de subdonaciones bajo el presente CRSP.

2. Personal calificado a nivel de post-doctorado o nivel inmediato de pre-doctorado para trabajar en el Perú, en los problemas de rumiantes menores.

3. Tecnicos con habilidades especiales para resolver problemas especificos, segun la necesidad lo requiera.

4. Todas las personas que viajan en Peru confines de trabajo del CRSP, sea de corto o largo plazo, la autorizacion previa del gobierno peruano a travel del INIA.

C. Entrenamiento: Los siguientes tipos de becas para personal peruana pueden ser otorgadas:

1. Becas para estudiar en USA a nivel de Master o Doctorado, en una extensión determinada por el INIA o por las instituciones colaboradoras designadas por el INIA.

2. Entrenamiento de corto plazo que estimen necesario los investigadores principales para personal peruano.

D. Administración: El funcionario jefe ejecutivo del CRSP, será el Director del Programa designado por la ME. El Director del Programa ejercera la dirección en USA y en el Perú. En acuerdo mutuo con el Director Ejecutivo del INIA y el coordinador local. Ciertas funciones administrativas podran ser delegadas al Coordinador local, residente en el Peru.

#### IV. HOST COUNTRY CONTRIBUTION

INIA being the competent authority in Peru shall provide, directly or through collaborating institutions:

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

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

C. 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.

D. Exemption from Peruvian duties and taxes as provided in the General Agreement of Technical Cooperation between the Government of Peru and the Government of the United States of America, signed on January 25, 1951, and approved by Legislative Resolution No. 11831 of April 3, 1952, and in effect since January 15, 1953, for all materials solely for official use of the CRSP in Peru, whether purchased locally, in the US, or in other countries.

#### IV. CONTRIBUCION DEL PERÚ

El INIA siendo la autoridad competente en Perú proporcionara directamente o a traves de otras instituciones colaboradoras:

A. Facilidades y espacio para oficinas y laboratorios, así como facilidades agricolas y de tierras para que realicen su trabajo, tanto las cientificos locales como los de USA.

B. Todos los costos directos asociados con el trabajo en el Perú, incluyendo: costos por electricidad, agua, personal de secretariado, técnicos locales, limpieza y mantenimiento, obtención de ganado y su manejo.

C. Los costos para el manejo, liberación y transporte desde el puerto de ingreso, para vehiculos, equipo, suministros y ganado que provee la ME y las Instituciones Participantes.

D. Eximir de los derechos e impuestos y otros al amparo del convenio general de cooperacion tecnica entre el gobierno del Perú y el gobierno de los Estados Unidos de America firmado el 25 de Janero de 1951 y aprobado por Resolución Legislativa No. 11831 del 03 de Abril 1952 y vigente desde el 15 enero de 1953 a todo el material utiuzada oficial y exclusivamento por el CRSP en el Perú va sea one este se aduvniera localmente en USA o en otros países.

E. Exemption for all US staff from taxation within Peru and provision to such staff the same conditions, privileges, and other exemptions as are applicable under the bilateral agreement between the United States Government and the government of Peru.

V. PROGRAM FUNDS

A. As stated in Article III hereof, direct expenditures in support of CRSP work in Peru 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 INIA CRSP funds may be provided to collaborating Peruvian institutions 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 CRSP collaborators as part of the CRSP. Any such funding shall be administered by the Site Coordinator on behalf of the ME and INIA.

E. Exoneración para todo el personal de USA de los impuestos de Perú, otorgando a dicho personal las mismas condiciones, privilegios y otras exoneraciones que son de aplicación bajo acuerdo bilateral entre el Gobierno de USA y el del Peru.

V. ADMINISTRACION DE LOS FONDOS DEL PROGRAMA

A. Según indicado en el Art. III, los gastos directos en apoyo del trabajo del CRSP en el Perú, serán efectuados por o bajo la autoridad del Director del Programa con fondos otorgados en sub-donaciones a las Instituciones Participantes.

B. Si es acordado mutamente por la ME y el INIA, por considerarlo pertinente, fondos del CRSP pueden ser otorgados a otras instituciones peruanas colaboradoras en representación de uno o mas Investigadores Principales de USA, o para ser utilizados en apoyo de trabajo conducido por colaboradores peruanos como parte del CRSP. Tal financiación será administrada por el Coordinador Local en nombre de la ME y el INIA.

VI. INTERPRETATION AND  
MODIFICATION

This Memorandum of Understanding in English and Spanish 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.

Approved for  
the Regents of the  
University of  
California  
By:

\_\_\_\_\_  
Allen G. Marr  
Dean, Graduate Studies  
and Research  
University of California  
275 Mrak Hall  
Davis, CA 95616  
Date: \_\_\_\_\_

VI. INTERPRETACION Y  
MODIFICACION

El presente Memorandum de Entendimiento escrito en español en ingles constituye el acuerdo de las partes con respecto al CRSP y reemplaza cualquier y todos los acuerdos previos o entendimientos de las Partes en relacion al CRSP, y ninguna modificación en el presente Memorandum sera valida a menos que sea por escrito y firmada por representantes autorizados de cada una de las Partes.

Aprobado por el Instituto  
Nacional de Investigacion  
Agraria  
Por:

\_\_\_\_\_  
Javier Gazzo Fernandez Davila  
Director-Executivo  
Sinchi Roça 2728, Lince  
Lima, Perú  
Fecha: \_\_\_\_\_