# Small Ruminant

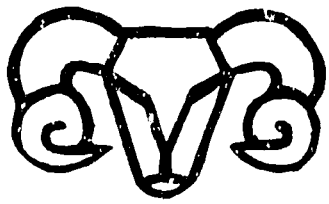
# Collaborative Research Support Program

# Summary

## Report

## Program Year Seven

## 1985-1986



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# THE SMALL RUMINANT

# COLLABORATIVE RESEARCH SUPPORT PROGRAM

# (SR-CRSP)

# SUMMARY REPORT

# PROGRAM YEAR SEVEN

# 1985-1986

Edited and Compiled by the Management Entity

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# THE SMALL RUMINANT

# COLLABORATIVE RESEARCH SUPPORT PROGRAM

## The Concept of the CRSPs

The US, as the world's largest generator of surplus food, has provided aid to millions of hunger victims. Abundant harvests in the US have been widely distributed in acute disaster relief programs and on a regular basis to food deficient nations. However, as the world's populations burgeon, it has become apparent that supplying the hungry world with food through surplus distribution does not permanently alter the cycle of poverty and deprivation in LDCs. Recent famine in Africa has again demonstrated that the only long-term solution is to improve the capability of these areas to supply their own food.

To promote this goal, the US Congress passed the International Development and Food Assistance Act of 1975. Included in the act was Title XII - Famine Prevention and Freedom from Hunger which states: "...in order to prevent famine and establish freedom from hunger, the US should strengthen the capabilities of US land grant...universities in program-related agricultural institution development and research,... improve their participation in the US government's international efforts to apply more effective agricultural sciences to the goal of increasing world food production, and in general should supply increased and longer-term support to the application of science to solving food and nutrition problems of the developing countries."

The act also specified that USAID administer and fund Title XII with money from their existing budget and authorized the President to create the Board of International Food and Agricultural Development (BIFAD) to initiate implementation of the act. BIFAD appointed the Joint Research Committee (JRC) to oversee the research-related aspects of Title XII. It was their recommendation that Title XII-sponsored research be implemented through Collaborative Research Support Programs (CRSPs). Among their suggested topics was small ruminants.

Fifty-six percent of the world's sheep and ninety-six percent of the world's goats are located in LDCs. They are owned primarily by small pastoralists and farmers of very limited means. Despite their low production, these animals contribute significantly to the economy and food supply in these regions and demand for their products exceeds the supply.

Improving the performance of small ruminants would directly improve the diet and standard of living of a great many people because the animals are inherently well-suited to the needs of smallholders and the conditions prevailing in the LDCs. For example, they:

- o Have low initial and maintenance costs
- o Are able to use marginal land and crop residues
- o Produce milk and meat in small, readily usable quantities
- o Produce fiber and skins which sustain cottage industries
- o Are easily cared for by any member of the family

**Statement of Goals**

The primary goal of the Small Ruminant CRSP is to improve meat, milk and fiber production from sheep, alpacas and goats in order to increase the food supply and raise the income of the smallholder. In addition to gaining a better understanding and increasing the efficiency of subsistence level small ruminant production systems, a major objective of the program is to strengthen the research capacity of overseas and US agricultural institutions.

To accomplish these broad objectives, the SR-CRSP is providing leadership for interdisciplinary research programs and furnishing opportunities for advanced training of scientists interested in small ruminants. This results in increased numbers of professionals with the necessary analytical skills and motivation to engage in an organized effort to alleviate the problems confronting small ruminant producers. Publishing and disseminating SR-CRSP project results contributes to an enhanced data base for directing future research, designing sound management recommendations and formulating policy guidelines which mitigate the constraints on small ruminant productivity. Increased attention is being given to preparation of extension type material to inform developing country professionals who, in turn, will be expected to adapt it to their local conditions. The various projects involved in research in the overseas sites play a vital role in the fulfillment of these goals.

The individual projects of the SR-CRSP were designed to help alleviate some of the major problems which severely hinder small ruminant productivity in the less developed countries (LDCs).

| **Problem Area** | **Research Area** |
|---|---|
| Inadequate year-round feed supply | Nutrition and Feeding |
| Improper grazing practices | Range Management |
| Poor reproductive performance | Research on reproduction in the male and female |
| Non-selective breeding | Genetic improvement of local breeds and crossbreds |

| | |
|---|---|
| Disease-Parasitism | Animal Health |
| Sub-optimum utilization of available resources | Management |
| Cultural constraints and lack of capital | Socio-Economic Research |
| Lack of coordination and integration in improvement efforts | Systems Research |

The Small Ruminant CRSP has been in active operation since the middle of 1979 when the first subcontracts were awarded to participating institutions. The accomplishments of the SR-CRSP during the last seven years fall into three categories: research, training, and public service. A major report that describes these accomplishments is titled "Partners in Research" and was published in lieu of the 1982-1983 annual report. Further progress was documented in the 1983-84 and 1985-86 Annual Reports. The 1985-86 Annual Report is assembled by Host Country with separate booklets for each country - Brazil, Indonesia, Kenya, Morocco and Kenya. This summary document only contains a brief report for each project by country. Further information is available from the Management Entity office.

SR-CRSP Scientists, both US and foreign, have generated over 1,500 research reports, papers, abstracts and verbal presentation related to SR-CRSP activity. These are listed by project in the booklets. Copies of individual papers may be obtained from the Principal Investigators at the U.S. institution.

## The Organization of the SR-CRSP

**The Management Entity (ME).** Seventeen research proposals were selected to embark upon the first CRSP and the University of California, Davis, (UCD) was designated the Management Entity. A program director was appointed and three committees, each of which play a distinct role in the function of the SR-CRSP, were established.

**The Technical Committee (TC)** is an executive committee of the SR-CRSP which develops and implements research projects in the US and overseas. It consists of all Principal Investigators.

**The Board of Institutional and Host Country Representatives (BIR)** is an executive committee primarily concerned with budget and policy. It consists of representatives from the administrations of the participating institutions.

**The External Evaluation Panel (EEP)** is an advisory committee responsible for reviewing and evaluating CRSP research activities and progress. It consists of a multi-disciplinary group of eminent scientists from institutions not participating in the CRSP.

**Overseas Counterparts.** Overseas counterparts at the level of higher administration and at the scientific levels have regularly attended and participated in the Technical Committee and Joint Technical Committee and Board meetings. In some countries, there are Program Administrative Committees (PACs) which solicit input about the SR-CRSP from ministry, university and international agencies. Host Country Representatives became full voting members of the Board in January 1984.

## The SR-CRSP Budget

Initially the grants were favorable for research providing a two year funding horizon and a three year planning horizon for participants. Unfortunately this is no longer the situation. Three budget reductions were received for the 1984-85 and 1985-86 budget years. As of January 1987 the ME has receoved verbal assurance of funding through April 30, 1988 at a reduced level.

## SR-CRSP Overseas Worksites

The group of people toward whom the activities of SR-CRSP are directed are the limited resource producers in LDCs, such as smallholders and nomadic husbandmen. The problems unique to their situation make research overseas not only appropriate but essential if meaningful progress is to be made in improving small ruminant productivity under these conditions. Because the overseas research component of the SR-CRSP was considered the cornerstone of the project, great care was taken to select appropriate overseas worksites which met the following criteria.

- The sites are representative of the various ecozones and production systems encountered in the tropics. The applicability of SR-CRSP findings should extend beyond the borders of any nation in which the research was conducted and be useful in other areas of similar climate and topography.

- The countries in which the sites are located have established agricultural institutions which are staffed by scientists, trained personnel and students with whom the SR-CRSP investigators have an opportunity to collaborate. These institutions also provide the extension links which are pivotal to the implementation of SR-CRSP findings. The current overseas and collaborating institutions are:

| | |
|---|---|
| Brazil: | Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) |
| Peru: | Instituto Nacional de Investigacion y Promocion Agropecuaria (INIPA) |
| Indonesia: | Agency for Agricultural Research and Development (AARD) |
| Morocco: | Institut Agronomique et Veterinaire-Hassan II University (IAV) |
| Kenya: | Ministry of Agriculture and Livestock Development (MALD) |

## Bibliography of Major Meetings and Reports

Since the Annual Report in 1984-85, the following reports and minutes have been prepared. Other reports and minutes of meetings in addition to publications listed by project may be obtained from the ME.

1. Workplans and budgets for 1986-87 for each project by site
2. Annual Reports for 1985-86
3. Meetings, Executive Committee of the Technical Committee, December 19 and 20, 1985, March 11, 1986
4. Meeting, Technical Committee. March 12 and 13, 1986
5. Board of Institutional Representatives, June 2-4, 1986
6. Meetings of Program Advisory Committees for Brazil, Indonesia, Kenya and Morocco
7. Eighth Report of the External Evaluation Panel, October 1986
8. Research Highlights - 1980-85 compiled by Kenyan scientists for EEP visit, July 1986

# SUMMARY

# ANNUAL REPORT FOR BRAZIL

# 1985/86

(Detailed Report Available as a Separate)

## INTRODUCTION

The SR-CRSP component in Brazil has been concentrated in the Northeast of that country. The work has been conducted in collaboration with Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) and more specifically with the Centro Nacional Pesquisa en Caprinos (CNPC) and a number of state research agencies including Ceara (EPACE), Paraiba (EMEPA) and Bahia (EPABA). This area contains the largest collection of goats and hair sheep found in the Americas. The area, sometimes referred to as the drouth polygon, encompasses all or part of nine states in the Northeast (Bahia, Sergipe, Alagoas, Pernambaco, Paraiba, Rio Grande do Norte, Ceara, Piaui, Maranhao). The numbers of small ruminants have been variously estimated to contain as many as 5 million head of sheep and 6 million head of goats. The sheep in this region are essentially all hair sheep. The climate is characterized by distinct wet and dry periods, each lasting up to six months, with relatively little seasonal variation in temperature. The seasonal and annual variation in rainfall coupled with a high evaporation loss results in drouth stress for some part of the year. The typical vegetation of the sertao (the more arid interior) consists of small trees or brush known as caatinga. The area has many features common to other arid regions, but in some aspects, it is unique.

The sheep and goats, along with smaller numbers of cattle, and some cropping provide the populace (approximately 12 million) with food (animal protein) and cash income. However, the productivity (offtake) of the flocks in the region is low, and in need of improvement. Sheep and goats serve similar roles, with the exception that a small part of the goat population is milked mostly for home consumption. Some studies have suggested that in this region, the sheep and goats are largely competitive for the same forage resources, but this needs verification.

This annual report covering the 1985-86 budget may have been one of the more productive for some of the projects even though funding levels have been decreased over previous levels. The explanation for this is likely that programs set in motion in previous years have begun to yield results. These results will be summarized by discipline. It should be realized that all the work mentioned was conducted in collaboration with Brazilian collaborators.

## BREEDING

The availability or development of adapted and productive genotypes may well be the most important factor contributing to the success of a livestock industry, especially in adverse environments. Research in these areas cannot be completed in one year or even the period of years in which the SR-CRSP has been in existence. Thus, developing and designing breeding plans and setting these in motion are primary goals.

Four students have completed thesis projects relating to breeding during the year. Two of these involved data collected on hair sheep in Brazil, one involved meat goats in the U.S. and the fourth related to selection for reproductive efficiency in sheep. The genetic parameter estimates obtained indicate that good response should be obtained from selection of hair sheep in Brazil for growth and reproduction, and this is generally the indicated approach. Preliminary data from goats suggests only a limited response to selection for meat production in indigenous(sp?) breeds, indicating a need to consider crossbreeding or crossing to increase genetic variability and response to selection. Selection for reproductive rate is expected to be slow, but economically important. The necessary computer programs and selection indices have been developed.

## REPRODUCTION

Realized reproductive rate is an important component of efficient meat production, and this is the primary purpose for which sheep and goats are maintained in the NE of Brazil. There is little evidence that biological infertility constitutes a serious problem in this region. However, net reproduction, as defined by the number or percent of kids being marketed or entering the breeding flocks, leaves much to be desired. It may be pointed out that it is only net reproduction which impacts the efficiency of an industry. Low net reproductive efficiency (offtake) can be shown to be due to a low percent of adult breeding females in the flock, less than optimum ovulation rates, extended parturition intervals, abortion and death losses of the offspring.

Information collected on 17 goat flocks indicate that 51.4% of the animals were adult females or 58.5% of all animals over one year of age. Only 12.2% of the animal population were kids which is indicative of low offtake rates. Prolificacy (kids per doe kidding) was 1.29 with a kidding interval of 291.8 days. Abortion rates were reported as low and an overall mortality rate was reported as 21.6%, but other experimental studies have shown these values to be much higher. Most of the kids were born in the dry season from matings made during the wet season suggesting nutrition of the breeding female is a limiting factor. Of five practices tested at the producer levels, two (the use of a controlled breeding season and disinfection of the navel) gave encouraging results.

Work with sheep showed that Morada Nova had higher ovulation and lambing rates than other breeds with which they were compared. Also, ewes maintained in confinement had lower ovulation rates than those grazing on the range even though the former had higher body weights. However, confinement is not a current or indicated practice.

There was no significant relationship between time to first suckling and mortality of lambs.

Both males and females may be sexually active throughout the year, i.e. no seasonal restriction. Semen quality of males appear to be better during the dry season, and females are more likely to breed during the wet season. Semen quality of the males has not been shown to be a limiting factor.

## HEALTH

Caseous Lymphadenitis, caused by Corynebacterium Pseudotuberculosis is a major cause for concern in Brazil and much of the SR-CRSP health component has been devoted to this disease. It is widespread in Brazil, and visible lesions are evident on many of the sheep and goats. Significant progress has been made during the year in work on this disease. A test has been developed which appears to identify those animals harboring the disease. This test appears to have the potential for use in screening or testing flocks. Also, a second experimental test has been developed. In addition, an experimental vaccine consisting of a concentration of formalized exotoxin with Freund's incomplete adjuvant has been developed. Preliminary testing looks encouraging, and work plans for the coming year call for field testing of the vaccine. This vaccine may also hold interest for potential use in the U.S.

As expected, pneumonia, mastitis and internal parasites are seen as problems in Brazil. Pasteurella and Corynebacterium were the bacteria most commonly associated with pneumonia at the CNPC. Work with mastitis is incomplete at present. A large volume of data are available relating to the problem of internal parasites, but there remains a need to compile and analyze these data and derive recommendations.

## RANGE

The concept of range in the NE of Brazil consists largely of caatinga management except for the possibility of establishing introduced pastures after caatinga removal. However, caatinga management is greatly influenced by the practice of slash and burn agriculture as practiced throughout much of the area. Clearing is more commonly practiced for cropping than as a means of pasture management.

Earlier studies have attempted to characterize the caatinga in terms of species present and nutrient composition. These studies suggest that for goats, diet quality and quantity are adequate during the wet (growing) and early part of the dry season, but that animals will respond to both protein and energy during the latter part of the dry season.

Tree stand reduction (0,25,55,or 95 percent canopy cover) markedly increased herbaceous production and the nutritional state of the grazing animal. Leaf litter biomass was greater on the control plots (zero removal). Selective thinning of the caatinga has the potential for improved and multiple land use management including animal and wood production.

**NUTRITION**

Over the period of years the SR-CRSP has been present in Brazil, much information has been generated relating to nutrition. Observations plus results from most of the individual projects indicate nutrition as an immediate constraint to production. This is evident in slow growth rates and delayed marketing of surplus animals, low reproductive rates and high mortality of kids. Thus, strategies for meeting these become high priorities. Few technological problems are encountered in meeting the animals' needs through the use of energy and protein concentrates. However, socio-economic constraints place severe limitations on the ability of the producers to use this approach.

Work completed during the year include a study of energy supplementation for goats consuming leaf litter. Digestibility studies suggest that the leaf litter is low in protein and high in fiber. Supplementation with energy (corn) tended to reduce leaf litter intake, but not overall intake indicating some degree of substitution. Another study suggested a beneficial effect on weight gains from corn supplementation during the dry season, but not during the wet season.

In another study energy, in the form of cassava meal, improved performance of hair sheep (Somali lambs) consuming Napier grass in the presence of an adequate protein and mineral supplement.

Several studies were reported during the year evaluating various native and cultivated forage species fed either as silages or hays. Some forages contain anti-quality or anti-palatability factors which require further investigation. Limited research suggests that method of preservation may be important in this respect. In the absence of the anti-quality factors protein and fiber levels appear to be major factors affecting intake and value of forages.

Several studies have been conducted which suggest that forages can be grown during the rainy season and utilized to advantage during the dry season. Those which have received the most study are cunha (Clitorea ternatea) and sorghums. Other studies suggest a similar role for by-products such as corn stover and cassava meal.

## ECONOMICS

A review of economic studies over a period of years indicate that sheep and goats are important components of the farming systems in NE Brazil. Throughout much of the region, they are utilized in combination with cattle and mixed farming systems. In more arid regions or in periods of drouth, small ruminants, and especially goats, become relatively more important. Minimal levels of capital inputs and minimal risk are important concepts in evaluating alternatives in management systems. Offtake rates for small ruminants are low and tend to favor sheep except in bad years. This may be somewhat surprising since the forage resource appears much better suited to goats. Resource and management constraints make it difficult to implement improved systems. Climatic variability among areas, and years and seasons impose important constraints which must be kept in mind in considering potential interventions based on technology generated within the CNPC/SR-CRSP programs.

Production systems used by dairy goat producers in a number of states, were surveyed and described. Only a minority of goat producers attempt to commercialize milk production. Those which do exploit goats for milk production have a significant number of animals with average flock size ranging from 83 to 196 for the various states of the region. Cheese production is the most common form of merchandising goat milk products.

## MANAGEMENT

In the broadest concept, management may encompass any discipline, and is the medium by which any intervention may be implemented. Thus work which may be entitled management may derive from more than one discipline. As pointed out earlier, the more immediate concerns may relate to nutrition and disease control. Longer term efforts may encompass enterprise or species choice, breeding season modification or alternative selection or culling practices and grazing management.

In respect to species choices (i.e. sheep vs goats) cumulative research data suggests that sheep are performing better as a meat producer. Still goats tend to be preferred by producers in the more arid regions or more arid seasons. This seems to derive from improved survivability in terms of stress thus providing the producer with greater security. These situations suggest that rather than attempting to replace goats by sheep, efforts should be made to improve the performance of goats. Some problem areas are indicated such as delayed conception, abortion, death loss of kids and poor growth rates. The above statements apply to meat production, whereas on a world wide basis, milk is the most important product obtained from goats. Only a small portion of the goats in Brazil are exploited for milk production. Most of the milk which is produced is utilized by the family. Feasibility studies do not provide much encouragement for marketing fluid milk from the goat. Cheese production seems to hold more promise and more interest. Several studies indicate that some type of supplemental feeding is required to expect appreciable levels of milk

production. The use of purchased "off farm" feed inputs for this purpose is questionable from an economic standpoint. The use of home grown feed supplements are encouraged at this point.

On a short term basis, feeding at critical periods holds the greatest promise to increase meat production from sheep and goats. Several studies have shown that a response can be obtained from feeding during the latter part of the dry season. Socio-economic constraints appear to limit the likelihood that harvested feeds will be used for this purpose. However, a number of feeds or forages can be grown on the property at essentially no cash costs. Among these are algaroba, cunha, sorghums, etc., and the economics of this approach appear quite feasible.

If feeding can be used to encourage breeding of the females during the dry season, a shift of lambing or kidding season may be accomplished with the result that lactation will occur during the wet season and production of either meat or milk can be improved. However, several studies have shown that death losses of kids born early in the wet season represents a problem.

Several studies have shown a potential for feeding lambs or kid goats to increase market weight or reduce slaughter age by use of feedstuffs available in the region. However, at present, there does not appear to be an established market structure to provide a sufficient reward for the superior quality of animal obtained from this practice.

The work of several disciplines involved point out the biological potential and seem to provide some technological support for marked improvement in efficiency and offtake from the sheep and goat industries of the NE of Brazil. Socio-economic constraints and the slow pace of technology transfer (Extension) appear to be the primary constraints. The latter is not a responsibility of the SR-CRSP. The socio-economic constraints may represent an inability of the individual producer to access the resources necessary to improve production or a concern about the risk factors involved. On a higher level, it may represent the absence of a market structure to reward the producer for these efforts. These factors are difficult for the SR-CRSP to impact, and the most likely approach for SR-CRSP research is to work with the producer to improve his capability for improved production and to respond to market opportunities. In this connection, a number of approaches appear to be indicated. It has been shown that the low percentage of adult females in the breeding flock is a contributing factor to a low rate of offtake. Improved growth rate and earlier marketing of surplus animals offers the means of altering this picture. Numerous studies have shown that supplemental feeding during dry periods offers the potential for early improvements in reproduction, survival and growth. It may, in some cases, be feasible or economical to meet these needs through purchased supplements. More likely, this should be accomplished by farm grown feedstuffs. Research work has shown that a number of plant species offer potential in this respect. In most years, moisture is adequate for some type of production, and the necessary technology is available, though not necessarily at the producer level. Manipulation or management of the caatinga (selective or partial canopy removal)

appears to offer the potential for marked improvement in offtake per unit area. There is a need for further research to show the long term effect of these practices on productivity of the caatinga. Research completed to date appears to provide guidelines for development or implementation of the necessary genetic improvement programs. There remains a need to implement the indicated programs. Opportunities for immediate genetic improvements appear to be limited largely to those producers interested in improving milk production through some type of crossbreeding and improved management system.

Under the auspices provided by the SR-CRSP, a number of Brazilian scientists have received advanced training and are now back working at the CNPC and associated with state agencies. With appropriate encouragement and support these scientists should be able to conduct the type of work necessary to meet the needs of producers in the area.

Many of the items discussed above are not unique to Brazil, but apply to other developing regions as well. Thus, some of the concepts can be applied directly to other regions. On the other hand, forage production and caatinga management strategies may be largely unique to this region, but some of the concepts involved have wider application.

## SUMMARY

## ANNUAL REPORT FOR INDONESIA

## 1985/86

(Detailed Report Available as a Separate)

### INTRODUCTION

In Indonesia more rural households are involved with sheep and goats than with any other species (except village [scavenger] chickens). One out of every five rural households in Indonesia keeps sheep and goats. On Java, this proportion is 25% or higher.

Annual consumption of meat per capita (1982) in Indonesia was about 4 kg, well below the national nutritional standard. Large ruminants (cattle and buffalo) constitute 48% of the Indonesian meat supply, while poultry contributes 32%. The remaining 20% of the meat supply is about equally divided between small ruminants (sheep and goats) and pigs. Although the relatively minor role of sheep and goats for national protein supply cannot be disputed, it plays a major role in providing employment, food, income, and manure for the direct benefit of many of Indonesia's small farmers and landless laborers.

In order to bridge the gap between animal protein availability and minimum dietary requirements, livestock development efforts in Indonesia have focused on dairy production and commercial poultry. For these sectors, modern technologies have been imported and generally proven satisfactory. However, only about 180,000 rural households are involved in these enterprises -- less than 1% of the 18.5 million rural households in Indonesia. Thus the major development efforts directed to these sectors benefit only a very select group of farmers.

While large ruminants -- because of their high capital value -- are generally kept by medium- or high-income farmers, small ruminants are typically identified with the small farmer. Sheep and goats are easy to raise, prolific, and have a ready market. Their initial and maintenance costs are low and they use marginal land and crop residues. In many instances, they fulfill a number of other functions in the farming system which are often overlooked -- such as a means to accumulate and store capital, and provision of manure. These functions are enhanced by the role of sheep and goats at social and(or) religious ceremonies such as Idul Adha and Idul Fitri.

Other special advantages of small ruminants over large ruminants include higher production efficiency (offtake: live weight produced divided by kg live weight kept as stock), broader adaptability to different environments, easier marketability, and lower risk. In areas where water is in short supply during part of the year, small ruminants are often the only livestock that can be kept.

The two main management systems for sheep and goats in Indonesia are cut-and-carry and grazing. Both systems are labor intensive. For farmers with minimal land holdings, sheep, and goats offer an important employment opportunity, since labor with low opportunity cost value (young and elderly persons) can be provided productive employment.

The most recent livestock population figures indicate that in 1982, about 12.1 million small ruminants were kept versus 9.2 million large ruminants, 3.6 swine, and 0.7 million horses.

Recent research showed that a large gap exists between village productivity of small ruminants and their potential. For example, the Doe Productivity Index (the ratio of total weight offspring at weaning age per kg doe per year) for Kacang goats under on-station management was 1.16, while semicommercial on goat production specialized farms reached an index of 0.76. Under village management, only an index of 0.51 was achieved. Technologies are available to bridge this gap, but the effective communication between scientist, extension agents, and farmers is lacking.

The SR-CRSP in Indonesia, in close collaboration with the Central Research Institute for Animal Sciences (CRIAS) is developing strategies to improve the transfer of results between researchers and producers. During the project year 1985/86, four major accomplishments in technology transfer can be listed. First, the SR-CRSP sponsored the development of an outstanding videotape on small ruminant research in Indonesia. The 20-minute tape is geared for extension agents, as well as farmers. It gives (a) an overview of the role of small ruminants in Indonesian farming systems, (b) the status of small ruminant research in Indonesia, and (c) approaches used to improve research-extension-producers linkages to increase research efficiency.

Secondly, the Outreach Pilot Project (OPP) was started in the Bogor District. In collaboration with the local livestock service a number of "field laboratories" was established. These consisted of a subsidized loan and the distribution of five females and one male animal per group of farmers. Per female animal, a farmer's group will return the second offspring to the livestock service and the fourth offspring to the research institute. The rest of the offspring is to be distributed among members of the group. Infertile females will be replaced. The distribution of animals took several months. The project has several objectives. Primarily the OPP is aimed at establishing a dialogue with a number of farmers' groups in order to develop appropriate small ruminant management improvements. The "field laboratory" can serve as 1) a testing ground, 2) a demonstration farm, and 3) a multiplication center. By aiming at establishing a dialogue with farmers, the project deviates from the conventional small ruminant development projects where animals are distributed without a preconceived technology package or -- more often -- without any management recommendation at all. Thus, the focus of the OPP is on increasing farmers' management awareness as opposed to increasing animal numbers. Previous research by the nutrition scientist at the Research Institute for Animal Production and by scientists at the Research Institute for Animal Disease had indicated

that a limited input of mineral supplement and antiparasite treatment had a significant positive effect on animal growth rate and possibly, also on the reduction of lamb/kid mortality rates. Recent SR-CRSP research confirmed that the first 3-month growth period is the most critical in determining future performance and health of the animal. The OPP is presently one year underway, having expanded from the original 10 to now 17 locations.

The third extension activity was the translation of the Goat Health Handbook into the Indonesian language and its publication. This publication was funded by another AID grant (No. PDC-0182-G-SS-1086-00) whereby the Indonesian SR-CRSP program acted as facilitator for the translation.

Fourthly, under SR-CRSP sponsorship a workshop on Farming Systems Research and Development (FSR/D) was held at Ciawi (Bogor) where specific examples of the application of the broad guidelines of FSR/D to livestock-based system were highlighted. The workshop meant a starting point for the application of new sheep and goat technologies to upland watershed development activities in West and Central Java.

The SR-CRSP has played a pioneering role in demonstrating the need for integrated research activities such as FSR/D. Despite the small resource base of the program in Indonesia, a comprehensive research program could be maintained by the strong collaboration not only between the SR-CRSP subprograms, but also between the SR-CRSP and other research programs (notably the Farming Systems Program) as well as between the SR-CRSP and other institutes (notably the Research Institute for Animal Diseases and a number of Indonesian universities). The SR-CRSP therefore fulfills an essential function in catalyzing collaborative research.

Research of the past five years has generated a substantial amount of basic information. The surveys and the long-term monitoring of small ruminant production systems in West Java have identified a number of critical nutritional and managerial limitations to increasing productivity. Concurrent station research on specific feedstuffs has provided insight and possibilities for maximum utilization of large roughage base, and suggested optimum combinations of readily available by-products of agriculture and industry. Specific nutritional deficiencies in the small ruminant diet have been identified and solutions are being tested. At the Cicadas station, very good data on inheritance of prolificacy have been (and are still being) collected. Village performance data on sheep and goat has indicated the parturition interval as main constraint. Plans are being finalized to ship hair sheep breeding stock to the research substation at Sei Putih, North Sumatra. By 1987, it will be known if the exceptional variability in prolificacy of Javanese sheep is due to segregation of a gene with large effect on ovulation rate. If the preliminary conclusion that this is the case is confirmed, the program will be well into the process of establishing several lines with high and low prolificacy and have started tests of the two kinds of rams in our village programs. The socioeconomic work, which has been partly conducted in collaboration with the Satya Wacana University in Salatiga, has focused on the types

of management (traditional versus semi-commercial, herding versus complete confinement); resource allocation (labor, cash); types of labor (husbands, women, children); sociological environment; and market structure. Now that the biological programs have entered the technology design/evaluation phase, the participation of the socioeconomic group in on-farm testing has become more critical.

In the near future, nutrition research will continue to explore the most optimal management systems under rubber by screening pastures and evaluating feed management systems (cut-and-carry, herding, fencing, etc.). Breeding research will focus on the development of a hair sheep strain by crossing St. Croix sheep with local ewes. The evaluation of the hair sheep and their $F_1$ progeny from local ewes should be well started by 1987. So far the genetic research on goats has been limited. It is expected to develop a more active research effort on goats as they contribute two-thirds of the Indonesian small ruminant population. It will be oriented towards genetic improvement of milk production potential.

The socioeconomic program will increasingly devote its attention to technology testing and transfer. The new production packages will include information on selection and management practices, to increase frequency of parturitions, and to increase growth rates by better nutrition and health practices.

# SUMMARY

# ANNUAL REPORT FOR KENYA

# 1985/86

(Detailed Report Available as a Separate)

## INTRODUCTION

Much of Western Kenya is blessed with fertile soils and a bimodal rainfall pattern allowing two cropping seasons per year. This area largely escaped the drought which recently brought hunger to many parts of sub-Saharan Africa. However, this good fortune has had unfortunate consequences. Human population numbers have grown rapidly, severely taxing the food and income generating capacity of the land. As family sizes have increased, average farm sizes have declined to less than one ha in many districts. These small farms often provide neither adequate nutrition or income to meet family needs.

The situation in Western Kenya is all too typical of problems elsewhere in tropical Africa. Wherever agricultural potential is high, numbers of people are likely to be increasing rapidly. Traditional agricultural systems become inappropriate -- producing less food than is needed even for subsistence while often severely eroding the natural resource base. Changes in traditional systems are needed, if they are to yield the necessary balance of protein and energy food and generate additional income to improve the family living standard.

The Small Ruminant CRSP is addressing this problem in Kenya. The goal of the SR-CRSP is to develop dual-purpose goat (DPG) productions systems suited to the needs and resources of smallholders. Goats have many potential advantages in such systems. Their diet can consist of feeds which are by-products of food crops and browse from marginal lands. Keeping 3 to 5 does instead of a cow adds a small, but consistent, milk protein supplement to family diet year-round. Litters of two or three kids at 7 to 8 month intervals can also substantially increase offtake of slaughter stock for family consumption or marketing. Because goat meat is a highly desired product, goats are potentially a significant new "cash crop."

To meet the needs of smallholders, DPG production systems must be based on low-cost, low-risk technology and be minimally competitive -- preferably complementary -- with cropping activities. Research to develop appropriate DPG production systems involves the close collaboration among a multidisciplinary team of Kenyan and expatriate scientists. The Ministry of Agriculture and Livestock Development is the principal host country institution. In addition, the SR-CRSP collaborates with scientists from the University of Nairobi, Egerton College, and other Kenyan institutions.

U.S. institutions participating in the SR-CRSP/Kenya include:

Texas A&M University -- breeding, systems analysis
Washington State University -- health
University of Missouri -- sociology
Winrock International -- economics, production systems
(goat nutrition-management, feed resources)

Each of the six senior resident scientists employed by U.S. institutions works with a least two MALD scientists, most of whom have completed graduate level training under SR-CRSP sponsorship.

The implementation strategy followed by the SR-CRSP in Kenya is diagrammed in figure 1. This strategy has involved a three-stage process:

Stage 1 (1980-82). Characterization of social-economic-biological activities of traditional farming systems; on-station component research in breeding, health, goat nutrition, and agronomy.

Stage 2 (1983-85). Monitoring limited numbers of DPG on farms; scientist-managed, on-farm component research (agronomy, goat nutrition, health management); on-station component research in breeding, health, nutrition, and agronomy; preliminary cost/benefit and social feasibility analyses.

Stage 3 (1986-1990). Large scale technical, economic, and social evaluation of DPG production systems under farmer management; component research -- both on station and farm -- will continue.

Emphasis has been placed on a farming systems approach to ensure that research will be relevant to needs and resources of farmers in Western Kenya. In addition, the general principles and many of the specific technologies developed by SR-CRSP should prove adaptable to farming systems in other parts of the tropics.

Even as comprehensive evaluation of DPG production systems continues, SR-CRSP research in Kenya has already yielded significant results. Examples include:

Development of an effective vaccine for contagious, caprine pleuropneumonia (CCP).

Identification of an indigenous tree legume (Sesbania sesban) which provides a protein supplement for livestock, improves soil fertility, serves as both a living fence and a source of firewood.

Development of computer models of goat production systems to support ex ante analysis of DPG systems in Kenya and elsewhere.

Importation of superior dairy bucks to provide the foundation for developing a new breed "synthetic" as well as up-grade the dairy merit of Kenya goats.

Establishment of the technical feasibility of DPG production on small farms in Western Kenya, leading to a substantial demand for DPG from farmers.

Training of 16 Kenyans to M.Sc. level and 4 Kenyans to Ph.D. level under SR-CRSP sponsorships.

The success of the SR-CRSP in Kenya demonstrates the advantages of a multidisciplinary farming systems approach. Significant benefits can be expected from the milk and meat produced by dual-purpose goats. However, perhaps even greater benefits will be realized from the SR-CRSP demonstration of effective collaboration between U.S. and Kenyan institutions successfully working together to the benefit of smallholder agriculturists.

# SUMMARY

# ANNUAL REPORT FOR MOROCCO

# 1985/86

(Detailed Report Available as a Separate)

## INTRODUCTION

Both sheep and goats are important in Morocco, but to date the SR-CRSP has chosen to focus on sheep. With 12-15 million sheep, Morocco has one of the highest densities of sheep of any country in Africa.

Sheep are kept in all areas of the country. There are three general types of production: use of range, which involves extensive transhumance; mixed crop - livestock systems, involving particularly sheep and cereal grains; and intensive confinement production in small flocks in oases in valleys on the north edge of the Sahara desert. The first two of these comprise the bulk of the nation's sheep, and there is overlap between the two systems in some areas.

A common feature of both the range and sheep - cereal systems is very heavy stocking rates and severe overgrazing. This is reflected in low offtake and high mortality rates. The latter are found both seasonally and due to longer term climatic variations. An example of seasonal variation is the 25% mortality of ewes in winter in a communal grazing area, described in the CRSP Nutrition project current annual report. The susceptibility of the national flock to variation in rainfall is evidenced by a reduction from an estimated 15 to 16 million head of sheep to less than 12 million during a recent two-year drought. Clearly the numbers kept during good years exceed substantially the long term carrying capacity of the country, given the other livestock kept.

The SR-CRSP in Morocco has four projects: Range and Nutrition, on which work was initiated in late 1981, and Sociology and Breeding, begun in 1982. Thus the Morocco CRSP has been less comprehensive, with a lower total funding level, than those in Peru, Brazil, and Kenya, with 6 or 7 projects each. The Morocco CRSP is also the only one in which the collaborating institution is a University, rather than a Ministry. IAV (The Hassan II Agronomy and Veterinary Institute) has a very active USAID-funded faculty training program at the doctoral level, managed by the University of Minnesota. A substantial number of well-trained young scientists are returning to the Institute to carry out their doctoral research, and to establish research programs following completion of their doctorates. For this and other reasons, the SR-CRSP in Morocco appears to be regarded by host country scientists as more of an institution building program than is the case for the SR-CRSP in other countries.

Based on the interests of IAV scientists, the four CRSP projects developed in several different geographic areas and production systems.

The Range project is being carried out by three Moroccan co-PI's, working in different ecosystems, and has had two different U.S. PI's. The greatest contribution of the range project has been to develop a data base of grazing impacts on rangeland that is rapidly deteriorating, because of excessive grazing. Research is focused on these impacts on Artemesia herba-alba range, the Jaaba forest, and the Middle Atlas mountains. Considerable progress has been made in understanding the systems studied, and in developing knowledge of what stocking rates should be. However, due to the importance of animal numbers to producers, and the existence of long standing traditions of management, interventions such as lower stocking rates, are extremely difficult to implement.

While the Range project work is carried out mostly in different areas of the Middle Atlas, the Sociology project has worked, to date, primarily on a study of a communal grazing system in the High Atlas. Here again, the conclusion is that there are no obviously feasible methods which can dramatically increase small ruminant productivity; there are opportunities for marginal increases, but these animals are part of a delicately balanced system which may not benefit from or even tolerate major interventions.

The Nutrition project has focused on research on feeding value and methods of utilization of by-product feeds, particularly wheat stubble because of its exceptional importance in the diet of Moroccan sheep. Trials are being carried out to evaluate carrying capacity of stubble fields for gestating ewes (the principal class of animals using this resource), and to evaluate different supplementation strategies. Feeding trials have also been carried out during the past year on citrus and beet pulp and on carob meals, other by-products of Moroccan agriculture. Several of the feeding trials have been carried through to include body composition and carcass evaluation of the animals used.

Work on the Nutrition project, particularly the surveys of production systems, has reinforced the conclusion that sheep are an extremely important part of cereal grain farming systems in Morocco, and that there is the potential for substantial increases in productivity of the sheep in these systems.

The Breeding project took as its primary goal the evaluation of the genetics of the prolific D'Man breed from the oases of Southern Morocco, and of its potential, in combination with a larger sized but less prolific Moroccan breed, to contribute to increased productivity of sheep for cereal producing and irrigated areas of the country.

Work on this goal required experimental facilities, and the Breeding project took the lead in developing facilities for sheep research at IAV's Tadla Application Farm in Central Morocco. The Nutrition project also contributed to this development. As a result, there is now a very good 1000-head sheep research facility, with breeding pens, units for feeding research, and some basic laboratory capability. Of at least

equal importance is the presence of trained support staff at Tadla, capable of keeping the necessary records, collecting biological samples, doing laparoscopies, etc. for a comprehensive research program.

The first phase of the D'Man and Sardi comparisons has been completed, with the results showing that the D'Man has very high potential for increasing productivity of Moroccan sheep under a moderate level of nutrition and management. This comes about not only through higher prolificacy, but also through transmission of longer breeding season and earlier puberty, and a higher efficiency of males. The next phase of the research, involving study of several different proportions of D'Man and Sardi inheritance, is providing animals for three doctoral dissertation research projects on reproduction and production. Studies on physiological responses to heat stress are also being carried out by members of the IAV Physiology Department.

The 1985 EEP report recognized that the CRSP lacked the funding and personnel to work in all areas of Morocco, and suggested that future work be focused on the mixed crop-livestock production system, for which work can be carried out at the Tadla Farm or in the Tadla region. Also, a shift in emphasis away from use of irrigated forages, e.g. alfalfa, and toward more work related to the rainfed cereal production system has been suggested by IAV participants. Since the Nutrition and Breeding projects are already actively involved at Tadla and in the use of cereal by-products, it is expected that those two projects will continue in general along current lines, with the planned addition of on-farm trials in the future. The Sociology project report indicates an intent to respond to these recommendations and to shift the site of the major activities to the Tadla area in the coming year; some activity in the High Atlas will be continued.

With the development which has occurred at Tadla and three projects to be involved in the area, there are now the facilities and a substantial proportion of the scientific and support personnel available for a comprehensive approach to research on one of the important sheep production systems in Morocco. An active program is underway, and given continuation of SR-CRSP and IAV funding, and collaboration among IAV Departments, the next few years could be a very productive period.

The Range project will probably continue to function fairly independently of the other CRSP projects. During 1986-87, funding for the project is coming from the USAID/University of Minnesota program. Also, this project is currently without a U.S. PI, and its future as a CRSP project is uncertain. The importance of the range resource to small ruminant production in Morocco is unquestioned, but there is a question, not yet resolved, as to whether the SR-CRSP has the resources to support work in all the major production systems of the country.

## SUMMARY

## ANNUAL REPORT FOR PERU

## 1985/86

(Detailed Report Available as a Separate)

### INTRODUCTION

Implemented in 1979, the SR-CRSP in Peru has dedicated itself to seeking ways to improve range livestock production. Research has focused on livestock diseases, genetic improvement, reproduction and fertility, range management, improved forages, and social and economic constraints. While technological packages do not apply to every single producer in the Andean zone above 3,800 m, the findings do have far-reaching implications in **Bolivia, Ecuador, Colombia, Chile and Argentina.**

Most of Peru's 15 million sheep and 3 million camelids derive most, if not all of their nutrition from two primary sources--range vegetation and improved forages. Furthermore, degradation of these resources is occurring at an accelerating rate. Research efforts indicate stocking rates of sheep should never exceed three to four sheep/ha on the very best native pasture. Since most of the Andes rangeland is in poor to fair condition, stocking rate norms should probably be 0.5 to one sheep/ha to sustain long-term animal production until the range recovers. Greatest protein stress for sheep occurs from June through November and protein supplementation should be considered during this time. Potential energy deficiencies could occur during gestation (October-November) and the first eight weeks of lactation (December-January). Alpacas are under nutritional stress as they enter the last trimester of gestation (August-October). Mixed-species grazing of native range with sheep and cattle or sheep and camelids is encouraged. Greatest economic use of improved pastures occurs when these pastures are used in a yearly production system which includes fattening, flushing, hay harvest, maturation of young females, and supplementation of native range during stress periods. To be sure, improved irrigated pastures should rarely be used as feed for a few elite animals at specific times of the year.

The fertility level of the sheep industry in Peru, and the Andean region itself, is low. Reproductive physiologists working in Peru have studied such factors as the environmental influence on semen characteristics, the effect of rams upon the incidence of ewe ovulation, hormone therapy, hormonal control, postpartum intervals, and incidence and rate of ovulation. Low fertility rates of alpaca also has received attention, but much work still needs to be done. Some of the findings for sheep demonstrate that (1) Corriedale and Criollo breeds produce usable semen throughout the year (2) implants of progesterone plus exposure to rams affects ovulations in females, (3) low levels of fertility are due primarily to fertilization failure and/or embryo fetal

losses, (4) progesterone and pregnant mare serum gonadotrophin (PMSG) can induce estrous and a moderate level of PMSG can increase ovulation and lambing rates, (5) Criollo sheep have a higher potential than Corriedale or Junin sheep for intensive breeding programs, and (6) introducing prolific genotypes can increase ovulating performance of indigenous ewes.

Genetic improvement of Criollo sheep through introduction of superior breeds or other indigenous breeds appears to have some application in the Andean region. Crossbreeding of Criollos to improve growth rate and wool production (Targhee breed) or reproduction and maternal ability (Finnish breed) has enhanced these desirable traits. However, adaptability of progeny must be insured before embarking on Criollo crossbreeding programs. Currently used indigenous breeds, Criollo, Corriedale, and Junin, also may have potential for improvement of desirable traits through classification and selection of sires. Certainly, a classification system based on growth rate and fleece weight are superior to the selection system currently being used in the Andean Zone. Screening rams for mating ability is an area fertile for application in the high Andes.

Above 3,800 m in the Andes, sheep production in constrained by two viral respiratory diseases, sheep pulmonary adenomatosis and ovine progressive pneumonia. Because there currently are no effective methods for their control, research is focused on the cause, pathogenesis, transmission, and diagnosis of these diseases. Recently acquired ability to experimentally induce both diseases in neonatal lambs will allow progress in achieving these objectives. Emphasis also has been placed on causes of reproductive failure in sheep such as chlamydiosis, leptospirosis, and ram epididymitis. Control strategies for these diseases are in developmental stages. Perinatal mortality in camelids, particularly the economically important alpaca, is a constraint to their production. Researchers have targeted enteritis caused by Clostridium perfringens, and enteropathogenic E. coli for intensive study. Currently, improved methods of detection and a potential vaccine have been developed for C. perfringens.

While biological information is important, its application hinges on an understanding of the social and economic constraints of the potential benefactors. For example, low-cost alternatives for parasite control must become available before privately owned animals will be systematically treated. Through research findings of rural sociologists, the profound role of women in day-to-day management of flocks suggests extension activities should include, if not focus on, participation of women in Andean communities. Further, governmental extension efforts to distribute technology, animals with improved traits, or vaccine/medicines should consider that both reciprocal and al partir sharing occurs. The latter, where one person provides animals and another provide labor, results in division of offspring. Thus, all who share labor, animals, or products must be targets of extension efforts. Extension specialists should also understand that technology which requires more management time, expertise and capital may not be

well received. The ultimate value of animals to peasants is that they require a minimum of attention and little capital. Extensionists should never overlook the relative importance of cropping vs herding.

Not unlike other peoples of the world, decisions are made based on a multitude of factors. One of those factors is economic profitability. Research has encompassed wide-ranging topics like 1) economic analysis of the use of native pastures and improved forages, 2) labor allocation in mixed herding/farming systems and 3) a detailed analysis of cooperative sector units. Research has documented that using improved forages as the only forage base for alpaca or sheep production system yielded internal rates of return (IRR) of 13.3% and 14.9%, respectively. These IRR values are too low to be profitable in most Andean production systems. However, improved pastures were found to be profitable if used as a supplement to the forage base of native rangeland. Although continuous, yearlong grazing (CG) and rotational grazing (RG) had about the same net value ($32.40/ha/yr for CG vs $34/12/ha/yr for RG), RG is recommended for optimum health of the range resource. Rotationally grazing mixed-species (cattle and sheep) resulted in a net value of $59.20/ha/yr. It appears that inability to absorb the labor force within social cooperatives may create unprofitable situations. As the number of beneficiaries increases, resources available for reinvestment decreases. Thus, the level of capitalization needed for the development of the enterprise was lacking. Also, it was determined that the profitability of any new practices must not only be evaluated against profitability of current farm enterprises, but also against the earnings cooperative members derive from off-farm employment.

The Small Ruminant Collaborative Research Support Program has matured to the point where research results are applicable to many similar range livestock production systems throughout the Andean chain, mostly above 3,800 m. The United States Agency for International Development should be applauded for their timely contribution to developing nations in this region the world.

## GENERAL PUBLICATIONS

Blond, R. (Ed.) 1983. Partners in Research. University of California, Davis. NTIS PB8-4-189182. **Management Entity**

Haines, C. E. and W. P. Warren. 1986. USAID-Supported Animal Research. J. Anim. Sci. 63:1600-1606. **US/AID-Washington**

Robinson, D. W. and W. C. Weir. 1982. United States Universities Experiences. Presented at a Symp. on "International Animal Agriculture--Plans to Improve International Animal Agriculture: Lessons Learned from Past Experiences, Future Priorities and Procedures." Joint ASAS-CSAS Mtg., Guelph, Ontario. **Management Entity**

Land, R. B. and D. W. Robinson. 1985. Genetics of Reproduction in Sheep. Butterworths, London. 427 pp. **UCD-Breeding & ME**

### General--Kenya

Ngei, P. J. 1982. Opening Address. 1982. Proc. SR-CRSP Kenya Workshop. p. 5. **MALD**

Robinson, D. W. and S. Chema. 1982. Introduction. Proc. SR-CRSP Kenya Workshop. p. 7. **Management Entity**

NOTE: Other publications and training listed in country reports.

TABLE 1

Small Ruminant CRSP
USAID Grant No. DAN-1328-G-SS-4093-00

Program Budgets
(In dollars)

| Institution/ Category | Discipline | Approved Year Six 1984/85 | Approved Year Seven 1985/86 | Approved Year Eight 1986/87 | TOTAL |
|---|---|---|---|---|---|
| California | Breeding | $242,034 | $226,100 | $165,900 | $634,034 |
| California | Health | 170,000 | 150,750 | 73,100 | 393,850 |
| Colorado | Health | 170,000 | 153,450 | 126,400 | 449,850 |
| Missouri | Sociology | 307,800 | 295,700 | 173,400 | 776,900 |
| Montana | Breeding | 145,000 | 144,000 | 126,400 | 415,400 |
| North Carolina | Nutrition | 235,178 | 240,488 | 165,900 | 641,566 |
| Texas A&M | Breeding/Mgt | 185,000 | 121,500 | 67,200 | 373,700 |
| Texas A&M | Breeding/Systems | 185,000 | 187,026 | 142,200 | 514,226 |
| Texas Tech | Range | 297,000 | 239,850 | 126,400 | 663,250 |
| Utah State | Range | 190,000 | 168,750 | 126,400 | 485,150 |
| Utah State | Reproduction | 195,000 | 161,030 | 21,900 | 377,930 |
| Washington | Health | 170,000 | 165,150 | 126,400 | 461,550 |
| Winrock Intl. | Economics | 235,000 | 258,829 | 165,900 | 659,729 |
| Winrock Intl. | Management | 232,000 | 234,900 | 169,900 | 636,800 |
| Subtotals | | $2,959,012 | $2,747,523 | $1,777,400 | $7,483,935 |
| Management Entity | | $450,000 | $432,000 | $300,200 | $1,182,200 |
| Contingency Funds | | 89,200 | 27,412 | 55,600 | 172,212 |
| Overseas Sites | | 501,788 | 393,065 | 316,000 | 1,210,853 |
| GRAND TOTAL | | $4,000,000 | $3,600,000 | $2,449,200 | $10,049,200 |

TABLE 2

SMALL RUMINANT CRSP
USAID GRANT NO. DAN-1328-G-SS-4093-00

MATCHING CONTRIBUTIONS FROM US INSTITUTIONS

| Institution | Discipline | Year Six 1984/85 | Year Seven* 1985/86 | TOTAL |
|---|---|---|---|---|
| California | Breeding | $106,748.75 | $117,007.00 | $223,755.75 |
| California | Health | 60,184.00 | 40,921.00 | 101,105.00 |
| Colorado | Health | 56,667.00 | 53,833.00 | 110,500.00 |
| Missouri | Sociology | 95,388.54 | 94,190.49 | 189,579.03 |
| Montana | Breeding | 331,265.00 | 262,557.00 | 593,822.00 |
| North Carolina | Nutrition | 87,462.00 | 80,549.04 | 168,011.04 |
| Texas A&M | Breeding/Mgt | 66,474.41 | 67,573.65 | 134,048.06 |
| Texas A&M | Breeding/Systems | 59,755.04 | 64,026.43 | 123,781.47 |
| Texas Tech | Range | 114,381.91 | 110,950.00 | 225,331.91 |
| Utah State | Range | 103,929.97 | 115,510.02 | 219,439.99 |
| Utah State | Reproduction | 90,408.40 | 128,057.46 | 218,465.86 |
| Washington | Health | 89,817.59 | 85,610.80 | 175,428.39 |
| Winrock Intl. | Economics | 78,111.67 | 73,975.07 | 152,086.74 |
| Winrock Intl. | Management | 58,364.49 | 73,428.47 | 131,792.96 |
| TOTALS | | $1,398,958.77 | $1,368,189.43 | $2,767,148.20 |

*Amounts are based upon estimates from subgrantees as of September 30, 1986.

TABLE 3

SMALL RUMINANT CRSP
USAID GRANT NO. DAN-1328-G-SS-4093-00

EXPENDITURES BY PROGRAM

| Institution | Discipline | Year Six 1984/85 | Year Seven* 1985/86 | TOTAL |
|---|---|---|---|---|
| California | Breeding | $192,562.10 | $258,979.56 | $451,541.66 |
| California | Health | 119,308.75 | 142,139.33 | 261,448.08 |
| Colorado | Health | 159,902.05 | 160,000.00 | 319,902.05 |
| Missouri | Sociology | 270,247.05 | 303,631.08 | 573,878.13 |
| Montana | Breeding | 145,000.00 | 143,210.92 | 288,210.92 |
| North Carolina | Nutrition | 235,178.00 | 244,088.00 | 479,266.00 |
| Texas A&M | Breeding/Mgt | 158,827.67 | 144,103.35 | 302,931.02 |
| Texas A&M | Breeding/Systems | 143,489.80 | 150,870.66 | 294,360.46 |
| Texas Tech | Range | 282,151.09 | 246,700.00 | 528,851.09 |
| Utah State | Range | 180,566.51 | 182,274.60 | 362,841.11 |
| Utah State | Physiology | 195,000.00 | 161,103.00 | 356,103.00 |
| Washington | Health | 158,632.69 | 172,017.00 | 330,649.69 |
| Winrock Intl. | Economics | 235,000.00 | 258,829.00 | 493,829.00 |
| Winrock Intl. | Management | 200,019.76 | 229,030.00 | 429,049.76 |
| Subtotals | | $2,675,885.47 | $2,796,976.50 | $5,472,861.97 |
| Host Countries | | | | |
| Brazil | | $111,019.71 | $118,010.51 | $229,030.22 |
| Indonesia | | 86,587.76 | 80,367.03 | 166,954.79 |
| Kenya | | 68,963.59 | 76,433.50 | 145,397.09 |
| Morocco | | 28,734.26 | 59,971.50 | 88,705.76 |
| Peru | | 123,245.70 | 123,191.95 | 246,437.65 |
| Subtotal | | $418,551.02 | $457,974.49 | $876,525.51 |
| Management Entity | | $376,306.95 | $415,263.66 | $791,570.61 |
| Miscellaneous Expenses | | $.00 | $11,541.71 | 11,541.71 |
| TOTALS | | $3,470,743.44 | $3,681,756.36 | $7,152,499.80 |

*These are approximations; final expenditures were not all in at the time this report was prepared.