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**SMALL RUMINANT  
COLLABORATIVE RESEARCH SUPPORT PROGRAM**

**ANNUAL REPORT 1981~1982**



**SMALL RUMINANT  
COLLABORATIVE RESEARCH  
SUPPORT PROGRAM  
(SR — CRSP)**

THE SMALL RUMINANT CRSP (SR-CRSP)

ANNUAL REPORT

PROGRAM YEAR THREE

1981/82

Prepared by the Management Entity

ANNUAL REPORT  
THIRD PROGRAM YEAR  
1981/82

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PART I  
SUMMARY OF ACCOMPLISHMENTS

## SUMMARY OF ACCOMPLISHMENTS

The Small Ruminant CRSP has been actively in operation for approximately three and one half years, since the middle of 1979, when the first subcontracts were awarded to participating institutions.

The nature of this CRSP, its participating institutions, principal investigators, subject matter areas, countries of operation, goals and objectives, are described in an informational brochure recently distributed and available from the Management Entity Office.

The accomplishments of the SR-CRSP in its first three years fall into three categories, namely, research, training, and public service--the things Universities do best.

CRSP scientists, both US and foreign, have generated over 300 research reports, papers, abstracts and verbal presentations related to SR-CRSP activities. Only those appearing in 1981/82 are included in Part III of this Annual Report. Those directly related to specific projects are so identified. It is particularly gratifying to see that although the United States is not a leading center for goat research, nor has the CRSP been functioning for very long, CRSP scientists contributed approximately 20 percent of the research papers to the Third International Conference on Goat Production and Disease held in Tucson, Arizona, January 1982.

## 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. It has become apparent, however, especially in the last forty years as the world's populations burgeons, that supplying the hungry world with food through distribution of surpluses, in no permanent way alters the cycle of poverty and deprivation in the less developed countries (LDCs). Improving the capability of these areas to supply their own food needs is the only real long-term solution to the problem. 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 capacities 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.

#### WHY A SMALL RUMINANT CRSP?

Forty percent of the world's sheep and 77 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:

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

#### THE ORGANIZATION OF THE SR-CRSP

- THE MANAGEMENT ENTITY (ME)

Seventeen research proposals were selected to embark upon the first CRSP, and UCD, one of the participating institutions, was designated the Management Entity (ME). 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 each Principal Investigator.

- THE BOARD OF INSTITUTIONAL 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.

- THE OVERSEAS COUNTERPARTS

Overseas counterparts at the level of higher administration and at the scientific levels have made regular attendance and inputs to the Technical Committee and joint Technical Committee and Board meetings. In country, there are, in some cases, Program Administrative Committees (PAC) in which Ministry, University and International Agency inputs are made to the SR-CRSP.

SR-CRSP BUDGET

Funds for the SR-CRSP have been committed by AID under the terms of Grant No. AID/DSAN/XII-G-0049 which requires a minimum cost sharing contribution of 25 percent from the participating US institutions. The terms of the grant are favorable for a research program, always a long term venture, providing a two year funding horizon and five year planning horizon for participants. The SR-CRSP budget for the initial five year funding period is 15 million US dollars. The overseas collaborators are likely to contribute substantial resources toward the SR-CRSP.

SR-CRSP OVERSEAS WORKSITES

The group of people towards whom the activities of SR-CRSP are directed are the limited resource producers in the 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 CRSP was considered the cornerstone of the project, great care was taken to select appropriate overseas worksites which meet the following criteria:

- The sites are representative of the various ecozones and production systems encountered in the tropics. The applicability of 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, staffed by scientists, trained personnel, and students with whom the CRSP investigators have an opportunity to collaborate. These institutions also provide the extension links which are pivotal to the implementation of CRSP findings. The current overseas and collaborating institutions are:

- Brazil: EMBRAPA
- Peru: INIPA
- Indonesia: AARD
- Kenya: MINISTRY OF LIVESTOCK DEVELOPMENT
- Morocco: HASSAN II UNIVERSITY

## SR-CRSP RESEARCH PROJECTS AND GOALS

The individual projects were designed to help alleviate some of the major problems which severely hinder small ruminant productivity in the LDCs.

<u>PROBLEM AREA</u>	<u>RESEARCH AREA</u>
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 long range goal of the SR-CRSP is to increase the efficiency of production of meat, milk, and fiber by sheep and goats in order to increase the food supply and raise the income of the smallholder. The program will expand the body of knowledge and increase the level of competence of US and LDC scientists to conduct research on small ruminants in smallholder production systems. This will facilitate the development and testing of appropriate technology and practices to improve small ruminant performance in developing countries.

## SUMMARY OF PUBLIC SERVICE

With respect to public service, this CRSP has undertaken public service which is always harder to define and categorize. I would draw your attention to just four or five examples.

- Involvement in the CAE disease problem in Kenya.

Some time ago, perhaps as far back as 1976, CAE disease was introduced into Kenya via shipments from Europe and the USA by other bilateral programs and the disease went unnoticed. CRSP scientists, on arrival in Kenya, were quick to spot the disease, diagnose it as CAE, initiate widespread testing and propose complete control and eradication measures that have now been taken. It is no exaggeration to say that this alone, although it will never appear as a research paper, book or other visible contribution, may have justified the expenditure of the entire \$15,000,000 invested in the CRSP.

- Institution Building Programs.

It has been the philosophy of this CRSP to undertake administrative institution building efforts to allow our overseas colleagues to truly manage their own CRSP component of the program. Thus, while we initially began with approximately 0.70% FTE of expatriate administrative input per site, we are now down to less than 0.20% FTE per site. In the interim, we have provided support by facilities development and training local staff with a high degree of competence to interact not only with the CRSP, but other international agencies.

- The SR-CRSP has undertaken a large number of workshops and an even larger effort in on-the-job training which does not show in public view. For example, simple advances have been made in such areas as construction of facilities, improved management techniques, identification of disease and support for highly practical applications of US technology. Also, the SR-CRSP has been a major sponsor in financial terms and in contributions to International Symposia and has maximized the participation of overseas participants in these colloquia.
- The CRSP has taken some major initiatives as new opportunities for advancement have presented themselves. One example is a major workshop on "Prolific Sheep" which has drawn together the world's leading scientists and led to new collaborative research in Egypt and Morocco by scientists within the CRSP as well as scientists who have nothing to do with the CRSP. Next year, the SR-CRSP hopes to sponsor a major workshop on Prolific Sheep and we already have a publisher willing to market the proceedings in hardback form, free of charge.
- The Small Ruminant CRSP has also attracted very substantial resources, not only from matching money provided by participating institutions, but by other Bureaus in USAID and particularly overseas governments which easily match the CRSP dollar for dollar on funds placed overseas. Thus, the main grant upon which the SR-CRSP is now based provides less than 50% of the total resources expended.

Finally, although the SR-CRSP has accomplished much, it is not perfect. Few programs are. There have been complex and difficult problems to surmount and many still exist. The CRSP has struggled to restructure itself, to account for the sensitivity of overseas missions, not to mention governments, and it has tried to be accountable in equating the output from institutions with the input of funds. It has tried to be responsive to the pressures from the highest levels of administration and implement many of the changes required by a new administration. Many of the specific problems faced have been addressed, but here I wish to draw attention to some outstanding ways in which the Small Ruminant CRSP has been served lately. These are:

- By senior administrators in our collaborating countries who have exerted pressure to change the SR-CRSP into a form best suited to meet their needs.
- By our Project Officer and senior administrators in USAID, who, following the funding hiatus in USAID over the past three years, have really come to grips with the fiscal problems of this CRSP and problems associated with Mission relations overseas. Dr. Haines, Dr. Butchart, and Dr. Robins deserve our special thanks. Also, the staff at BIFAD, and Dr. Elmer Kiehl in particular, who have worked hard to keep the dialogue between USAID and universities going.
- By an outstanding External Evaluation Panel that has done an exhaustive, thorough, and professional job in evaluating the CRSP program and recommending changes which the Management Entity has vigorously enforced. The Small Ruminant CRSP has been fortunate indeed in acquiring the services of an EEP consisting of world class experts in their field, who, apart from their role as evaluators, have no other association with the CRSP.

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| 2.  | 1980/81 Annual Report                           | September 1981 |
| 3.  | SR-CRSP Newsletter - Issue No. 6                | October 1981   |
| 4.  | Third Report of the EEP                         | October 1981   |
| 5.  | Three Year Summary of Accomplishments           | December 1981  |
| 6.  | Minutes of the 1982 Technical Committee Meeting | January 1982   |
| 7.  | Proceedings of the SR-CRSP Kenya Workshop       | March 1982     |
| 8.  | Minutes of the March 1982 Board Meeting         | March 1982     |
| 9.  | SR-CRSP Newsletter - Issue No. 7                | April 1982     |
| 10. | Minutes of the June 1982 Board Meeting          | June 1982      |
| 11. | Fourth Report of the EEP                        | July 1982      |

\* Please refer to earlier Annual Reports for publications preceding the 1981/82 reporting period.

## BRAZIL

The SR-CRSP program in Brazil was based at the National Center for Research with Goats at Sobral with increasing activity at the State stations at Quixada, Ceara, and Pendencia in Bahia. The Economics Project baseline study and long-term monitoring survey provided information on the role of goats and sheep in the economy of farmers in Ceara. Other projects, including Reproduction, Health, and Sociology, enriched on this survey by expanding the subject matter and enlarging the sample surveyed. For example, the Sociology Project found that the poorest rural residents were landless with virtually no animals and that smallholders preferred sheep to goats because they were more manageable. The Health and Reproduction Projects collected data on reproductive rates and disease problems affecting the herds. Meanwhile, the Animal Breeding Project assisted in improving facilities at Quixada so that controlled breeding experiments are now possible. Quantitative data are now being collected on various breeds of goats and hair sheep at Sobral, Quixada and Pendencia. These data will serve as a base for deciding breed improvement experimentation. While emphasis at Sobral and Quixada is on goats for meat and hides, more emphasis is placed on goats for milk production at the Pendencia Station. The Management Project, concerned primarily with the dairy goat, placed a full-time professional at Pendencia and the Forage By-Product Project established feeding trials at that station. At Sobral, by-product feeds are being tested in feeding trials with both sheep and goats with some interesting differences in intake between the species. The Forage Project made excellent progress in establishing a chemical laboratory for forage evaluation. The Range Project is also utilizing the laboratory for analysis of forage selected by sheep and goats in the caatinga. The ecological study of the native vegetation is recording the seasonal variation in biomass production and developing techniques for measurement of plant productivity. One such technique under study is the potential use of satellite imagery data to map soil and vegetation types. Other tools include the development of the herbarium at the Center and the publication of a handbook on the native vegetation.

Dr. Tom Robb replaced Tom Miller as Site Coordinator, and new Brazilian staff were appointed to manage the SR-CRSP office in Sobral, namely Joao Conrado and Celia Pinto de Amorim. We were pleased to have several Brazilian scientists presenting their data at the III International Conference on Goat Production and Disease in Tucson, Arizona, which was also attended by Brazilian students studying in the US.

Since the beginning of the SR-CRSP, six Brazilians have been brought to the US for advanced degrees. In addition, five Brazilians have completed or are completing degree work in their home country. Full or partial financial support for this degree work has come from CRSP funds. A listing of degree candidates may be found in Part II of this report.

## INDONESIA

This year saw the consolidation of the SR-CRSP program in Indonesia with a reduction in the number of disciplines represented but a strong commitment in the placement of US scientists there on long term contracts, which was the modus operandi requested by our Indonesian colleagues. Mr. Monte Bell from the University of California at Davis took up a position with the Animal Breeding group, Dr. Van Eys took up a position with the Nutrition group, and Dr. Knipscheer took up a position with the Economics group and replaced Dr. Neil Thomas as Site Coordinator.

We wish Dr. Neil Thomas well on his return to Canada, and are pleased that he will be retaining connection with the SR-CRSP in a collaborative effort to write up the work of the Indonesia projects. He was instrumental in setting up the village survey work in Indonesia and will be greatly missed. Just prior to his leaving, a volcano erupted in Indonesia and continues to spray ash over vast areas of West Java. It has led to the curtailment of village activities in the West Java survey area and at the well known Margawati Sheep Research Station for the fighting Garut sheep. The continuous volcanic activity has posed an enormous sociological problem for authorities in Indonesia.

We are pleased to see work supported by the SR-CRSP reported in international symposia. Papers were given at the III International Conference on Goat Production and Disease in Tucson, Arizona, and at the International Genetics Conference in Madrid by Indonesian CRSP participants.

Several students continue their training from Indonesia in CRSP institutions as will be seen in later chapters of this report. In addition to the long term resident expatriate scientists in Indonesia, short term expert visits are also planned, not least of which will be that of Dr. Sean Quirke, a world expert on Prolific Sheep and the use of endoscopy, who will be studying the Priangan sheep, which are possibly one of the most prolific sheep in the world.

The project sites were also visited by the External Evaluation Panel in 1981/82, and Indonesia is a major subsection of their annual report. Generally, the impression of the EEP to CRSP work there was highly favourable and the reports have been passed on to appropriate authorities in Washington.

Work on the Sociology Program has continued to focus on collaboration with scientists at Salatiga through conduct of village survey work. The Economics Program has also been involved in the village survey data at other locations where both the Nutrition and Breeding Programs have actively participated in collecting data on the available funds, their quality and the possible use of other by-products, as well as quantitative measurement of the productive parameters of local sheep. The animal breeding work in both the villages and at Margawati suffered severe setbacks due to the volcanic eruption. The nutrition laboratory has also focused upon development and use of analytical facilities at the Lembaga Penelitian Peternaken where experimental work on forages and by-products is proceeding.

## KENYA

Major developments have occurred in the Kenya site, the chief of which has been the complete handing over to Kenyans of both technical management and all administrative services. Following Dr. Chema's very capable chairmanship of the Program Administration Committee (PAC) and his excellent leadership in establishing Kenya's priorities for the SR-CRSP program in Kenya, the expatriate site coordinator was entirely withdrawn, releasing more funds for research per se. Also, following Ms. Rose Naliaka's training at the Management Entity office in Davis, she was made the ME administrator in Kenya and has full responsibility for the office. New equipment in the form of vehicles, a computer terminal, and telex system have been ordered for installation, and some of it is already in place, allowing the Deputy Director for Research in the MLD to communicate well not only with the SR-CRSP but any other bilateral program in Kenya. Kenya has proved to be an outstanding example of a program that is run and managed by the Kenyans themselves with expatriate staff providing collaborative research support to their program.

In that context, six US expatriate scientists are working long-term in Kenya. Dr. Dan Brown and Ms. Kathy Boor have continued the nutrition and survey work at Maseno with the Farm Production Systems subgrant and Dr. Sandra Russc, also at Maseno, has been active in the forage research area. They have recently been joined by Dr. Eric Reynolds on the Sociology Program who will work in the Maseno area. Dr. Reynolds has several years of previous experience in Kenya and will also be working closely with Ms. Fanny Nyaribo, who has just joined the Maseno program on behalf of the Economics Program. At Kabete, Dr. Bell continues to provide support for the Health Component, and Dr. Ruvuna provides support to the Systems Analysis Program. The Animal Breeding Component was this year passed over to Texas A&M to provide support and it is hoped that Dr. David Kimenye will continue to collaborate with the program from the vantage of the University as indeed Dr. Alan Carles is doing on the Systems Analysis Program.

In addition to the administrative and technical accomplishments, the SR-CRSP continues its commitment to place Kenyan students in advanced degree programs, both in the US and abroad. For example, partial or full financial support is being provided to approximately 15 Kenya students in US institutions. A complete list of these students may be found in Part II of this Annual Report.

The PAC has also reviewed reports prepared by the US scientists who have returned from Kenya following long term assignment there, notably that of Dr. Mike Sands, Ms. Danna Mortimer, and Ms. Amanda Noble.

Results from research in Kenya are beginning to reach publication format as this Annual Report will show. Several papers were presented to the III International Conference on Goat Production and Disease in Tucson, Arizona, to which the CRSP sponsored the travel in whole or in part of several Kenyan scientists. Many of these results were also made available in the published proceedings of a symposium held at ILRAD and sponsored by the SR-CRSP in March 1982, which also included valuable papers from other colleagues working with sheep and goats in Kenya.

The integration of research in Kenya became a focal point for discussion and led to the development of a highly integrated and combined strategy for research among the Forages, Production Systems, Economics and Sociology Programs. In addition to large trials on introduced and locally available forages and crops, mechanisms of on-farm storage of fodder for periods of deficiency were studied. A dairy goat herd was established at Maseno for testing nutritional regimens and estimating gratuitously the production potential of milk goats under equatorial conditions. The effects of health constraints were estimated in a widespread survey in the west of Kenya. This led to a focus being placed upon work with parasites, trypano tolerance, which will be tested at renovated facilities near Ukunda on the coast, and upon CAE disease, which appears to have been introduced to Kenya some years ago. Health and Animal Breeding Components will work closely together to test the tolerance of animals to disease or measure disease resistance.

## MOROCCO

The program in Morocco took on major developments in 1981/82 with the establishment of four primary disciplines: Range Science, Animal Breeding, Sociology, and Nutrition. Substantial resources were added from the SR-CRSP to initiate these research programs in addition to a supplemental contribution of some \$50,000 from the Near East Bureau. Animal Breeding will concentrate on a comparison of local breeds, notably the D'Man, a prolific sheep, the Timahdite, Sahidi, and Ben Hassan. Mr. Berger moved to Morocco from Kenya to join the group associated with the breeding work which include Dr. Lahlou Kassi, Dr. Bourfia, and Dr. Bougenan. Work will be closely integrated with that of the Nutrition group, who will study the value of crop residues, and particularly, new ways of utilising wheat stubble following harvest of the major cereal crop, in addition to studies upon Berseem clover and alfalfa. The Range Program continues to be focused on sociological aspects of land use through the work of Neil Artz, who will soon complete his term in Morocco. However, the return of Dr. Narjisse and Dr. Berkhat from the USA will greatly add to the team working in Range Science, while El Aich and Neil Artz complete thesis work in the USA. The Sociology group will include cooperation with Dr. Hammoudi and Dr. Gilles of Missouri.

Special aspects of the Morocco program during 1981/82 were the conduct of a CRSP workshop on prolific sheep comprising many world experts, held at Hassan II University. Following the recommendations of this workshop, a major proposal has been developed on Prolific Sheep and submitted to several funding agencies for consideration. The CRSP will also help sponsor and publish the proceedings of a major workshop to be held in conjunction with the International Reproduction and Fertility meetings next year in the United Kingdom to which we anticipate several CRSP scientists will contribute.

Another feature of the Morocco program has been the assignment of substantial funds to assist Hassan II in developing the Tadla Farm as an experimental facility. Sheep have already been moved there in substantial numbers, and the availability of irrigated forages makes this an exceptional site for nutrition and breeding work.

With the augmentation of funds and the building of the Morocco site into the core budget of several Principal Investigators in the US, Morocco is likely to develop into a major site in the SR-CRSP, which is justified on the basis that Morocco has the highest per capita population of sheep and goats in the world.

Congratulations are in order to Dr. Lahlou Kassi, who received the first doctorate to be awarded from Hassan II University. The SR-CRSP takes pride in our association with Dr. Lahlou Kassi in that Dr. Bradford was one of the external examiners, and was impressed with the quality of the work at Hassan II. Congratulations also to Moroccans Bourfia, Berkhat, Narjisse and Rihani just returned from the US and with whom continued cooperation is anticipated.

A complete list of Moroccans in US or overseas degree programs who are partially or fully supported on SR-CRSP funds may be found in Part II of this report.

## PERU

In accordance with the charge to the SR-CRSP to work with limited resource producers, the Sociology Program has had several investigators living in various villages in the Central and Southern Sierra to provide an understanding of the role of camelids, sheep, and goats. Keith Jamtgaard lived in the village of Tocra, studying grazing systems; Constance McCorkle investigated the native management of animal health and diseases; Terry West recorded his observations of alpaca production in Puno; and George Primov examined the sources of meat in the markets of the Southern Sierra. The Economics Program gathered data on three systems of animal and grazing land ownership resulting from recent reforms in the agrarian sector of Peru. Domingo Martinez produced a monograph on sheep enterprises based on his research before his graduate work at Missouri. Ed Lotterman supervised several students at the National Agrarian University (UNA) who gathered and analyzed data on mixed farms and the pricing of such products as alpaca fiber. The need for a classification system for marketing of alpaca fiber was recognized by the Texas A&M group who proposed a joint project with Professor Pumayalla of UNA. The Animal Breeding project also focused on the productivity of the alpaca in the High Sierra and assisted in the analyses of the data collected at La Raya and investigated the effectiveness of selection in improving productivity. Likewise, the Animal Breeding Program compared the wool and meat production of the native sheep (Criollo), the Junin (Peruvian improved), and Corriedale (previously imported) with newly imported Targhee and Targhee x Finn. Working in conjunction with the Reproduction Project, a primary question concerns the ability of sheep to produce twins at high elevations. The Finnsheep are noted for their prolificacy. Their offspring will be compared to a line of the Junin that has been specifically selected for twinning. The twinning trait is desirable as improved forage is developed in the High Sierra.

The Forage Program established variety trials of new forage plants, tested inoculants, and seeded an irrigated pasture to be used as a supplement to the native range.

The Reproduction Program is determining if flushing with improved pasture will increase twinning. The Range Program, meanwhile, is emphasizing the management of the native ranges to increase their productivity through control of animal numbers, season of grazing and relieving the grazing pressure on the range by use of the irrigated pastures developed under the Forage Program. The Animal Health Program is emphasizing the safeguarding of the young alpaca through control of neonatal enteritis which is the major cause of animal loss. The pathologists from IVITA and US veterinarians are also studying chronic respiratory disease which is the major cause of loss among the sheep in the Central Sierra.

With money provided from the contingency fund, an integrated program involving all of the projects, the Universities at Piura and Lambeyeque, and INIPA are investigating the goat production systems of Northwestern Peru. The Economists have led in collecting baseline data through a survey in which all the SR-CRSP participated. Avi Perevolotsky from the Sociology Project has lived in the area and studied the people who have goats. The Forage and Range

programs have tried to improve the utilization of native feedstuffs and introduced some new sources such as Leucaena.

Two of the residents, Ed Lotterman and Gary Sides, served as visiting professors at the National Agrarian University. Mr. Lotterman also served as a consultant on the use of the newly installed computer at La Molina. A large number of advanced undergraduates and graduate students participated in the SR-CRSP supported projects and contributed productively to the collaborative effort.

A list of Peruvians being trained in the US and overseas in degree programs may be found in Part II. Also included is a list of short term training programs that have been held on SR-CRSP funds.

PART II  
SUMMARY OF THE SMALL RUMINANT CRSP TRAINING PROGRAM

## SUMMARY OF THE SMALL RUMINANT CRSP TRAINING PROGRAM

The Small Ruminant CRSP has just completed its fourth year of operation. One of the SR-CRSP's main goals has been to train research scientists capable of implementing the long range research programs being set up around the world in consultation with some of the best senior scientists in the US (the Principal Investigators). The training has taken several forms:

- Degree training of foreign students in US institutions
- Degree training of foreign students in their own universities
- Degree training of US students in overseas countries
- Non-degree specialized training of foreign students in the US

A summary of the degree training and shortcourses supported by the SR-CRSP is presented in the following pages.

A strenuous effort has been made to dovetail the SR-CRSP into other training programs in the overseas programs to save precious resources of the CRSP. Some of the trainees working on SR-CRSP campuses, participating in sheep and goat research and destined to return to SR-CRSP activities, have been financed by such agencies as FAO (Kenya), USAID scholarships (Kenya and Indonesia), World Bank (Indonesia and Kenya), Minnesota (Morocco), EMBRAPA (Brazil) and INIPA (Peru). Most, however, have been supported directly by the SR-CRSP. Given the slow start up of the SR-CRSP, in which twelve to eighteen months were lost before overseas country operations began, the Management Entity and the External Evaluation Panel feel that Principal Investigators in US participating institutions have done an outstanding job in developing the training of researchers for the future. The record will bear comparison with any other USAID sponsored program.

TRAINING - SR-CRSP SPONSORED STUDENTS IN DEGREE PROGRAMS IN US

NAME	PROGRAM	SUPPORT	DATES	COUNTRY
Aboud, Abdillahi <sup>1</sup>	MS Rural Sociology	Missouri	Fall/79 - 3/82	Kenya
El Aich, Ahmed <sup>2</sup>	PhD Range Management	Utah/Range	6/81 - 9/86	Morocco
Artz, Neil	MS Range Management	Utah/Range	6/81 - 3/83	US
Baker, Jerry <sup>3</sup>	PhD Animal Breeding	Texas A&M/Systems	9/79 - 12/81	US
Bari, Johnson	MS Veterinary Microbiology	Washington	2/81 - 1/83	Kenya
Berkat, Omar <sup>4</sup>	PhD Range Science	Utah/Range	10/81 - 7/84	Morocco
Blackburn, Harvey	PhD Animal Breeding	Texas A&M/Systems	9/79 - 1/83	US
Bravo, Walter	MS Reproduction	Utah/Reproduction	1/81 - 6/85	Peru
Brenni, Geanluca <sup>3</sup>	PhD Animal Breeding	Texas A&M/Systems	1/79 - 6/83	Switzerland
15 Brown, Lynn E.	MS/PhD Animal Nutrition	North Carolina	9/78 - 12/83	US
Burstein, Helaine	PhD Animal Nutrition	North Carolina	Fall/81 - 12/85	US
Castilla, Domingo Martinez <sup>5</sup>	MS Production Economics	Winrock/Economics	1/81 - 12/82	Peru
Coronado, Luis	MS Animal Breeding	Texas A&M/Systems	1/81 - 8/83	Peru
Drobnis, Erma <sup>3</sup>	MS Animal Science	Cal Poly	4/79 - 8/81	US
East, Nancy	MPVM	UC Davis/Health	8/79 - 1/80	US
Eliis, John, DVM	PhD Pathology	Colorado	8/80 - 7/83	US
Farfan, Ramiro <sup>6</sup>	MS Range Management	Texas Tech	9/80 - 12/82	Peru

<sup>1</sup> Attended Ohio State University; thesis research supported by Missouri

<sup>2</sup> Attending Colorado State; partial support

<sup>3</sup> Partial support

<sup>4</sup> At Texas A&M, but overseas research supported by Utah

<sup>5</sup> Attending University of Missouri

<sup>6</sup> Partially supported by LASPAU

<u>NAME</u>	<u>PROGRAM</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Fierro, Carlos	PhD Range Science	Texas Tech	1/82 - 12/84	Mexico
Flores, Enrique <sup>6</sup>	MS Range Management	Utah/Range	Fall/80 - Win/83	Peru
Garcia, Laura <sup>3</sup>	MS Animal Science	Cal Poly	Spr/81 - Spr/83	US
Garcia, Omar <sup>3</sup>	PhD Genetics	UC Davis/Breeding	9/78 - 8/81	Venezuela
Gathuka, Zachariah <sup>7</sup>	MS Animal Breeding	Texas A&M/Systems	9/80 - 5/82	Kenya
Gonzales, Gonzalo <sup>3</sup>	PhD Genetics	UC Davis/Breeding	7/80 - 9/82	Uruguay
Gutierrez, Nestor <sup>8</sup>	PhD Agricultural Economics	Winrock/Economics	10/79 - 1/83	Colombia
Hardesty, Linda Howell	PhD Range Science	Utah/Range	Win/81 - Spr/84	US
Haryanto, Budi	MS Animal Nutrition	North Carolina	1/81 - 1/83	Indonesia
Hawariatt, Girma <sup>3</sup>	PhD Animal Breeding	Texas A&M/Systems	9/78 - 12/82	Ethiopia
Howard, Pamela Jo <sup>9</sup>	MS Marketing	Winrock/Economics	1/81 - 12/81	US
Hussein, Mohamed	MS Range Management	Utah/Range	Win/80 - Win/83	Morocco
Jamtgaard, Keith	MS Rural Sociology	Missouri	1/79 - 12/82	US
Jimenez, Lidia	MS Rural Sociology	Missouri	Fall/81 - Spr/84	Peru
Job, Morgan <sup>10</sup>	PhD Agricultural Economics	Winrock/Economics	6/80 - 12/82	Trinidad/Tobago
Kibuchi, James N. <sup>11</sup>	MS Animal Management	Winrock/Management	9/80 - 7/82	Kenya
Kimotho, Judith W. <sup>12</sup>	MS Animal Science	Cal Poly	8/81 - 6/84	Kenya
Kiriro, Philip	BS Animal Breeding	TAMU/Systems	1/81 - 6/83	Kenya
Kirmse, Robert	PhD Range Management	Utah/Range	Spr/82 - Sum/84	US
Kooyman, David <sup>3</sup>	MS Animal Science	Cal Poly	8/82 - 6/84	US

7 Partially supported by FAO

8 Attended Purdue University

9 Attended University of Florida

10 Attended Purdue University

11 Attended Tuskegee Institute

12 Partially supported by USDA

<u>NAME</u>	<u>PROGRAM</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Lasslo, Laurel <sup>3</sup>	PhD Genetics	UC Davis/Breeding	7/80 - 6/82	US
Luginbuhl, Jean-Marie	MS/PhD Animal Nutrition	North Carolina	6/79 - 1/83	Switzerland
Mandari, Godfrey <sup>12</sup>	MS Animal Science	Cal Poly	8/80 - 8/82	Tanzania
Mathenge, James	MS Animal Breeding	Texas A&M/Systems	6/80 - 12/81	Kenya
Mwiria, Stanley	MS Veterinary Physiology	Washington	Spr/81 - 1/83	Kenya
McCorkle, Constance <sup>13</sup>	PhD Anthropology	Missouri	2/80 - 12/82	US
Mesquita, Roberto	MS Range Management	Utah/Range	Fall/82 - Sum/84	Brazil
Mortimer, Danna Lee <sup>14</sup>	MS Animal Health	Winrock/Economics	9/80 - 5/82	US
Muhuyi, William <sup>12</sup>	MS Animal Science	Cal Poly	6/80 - 6/82	Kenya
Mukisira, Ephraim <sup>15</sup>	MS Ruminant Nutrition	Winrock/Management	8/82 - 8/84	Kenya
Muljadi, Agus <sup>16</sup>	MS Production Economics	Winrock/Economics	5/81 - 7/83	Indonesia
Mwandotto, Bonfance	PhD Animal Breeding	Texas A&M/Systems	9/81 - 6/84	Kenya
Narjisse, Hamid	PhD Range Management	Utah/Range	8/79 - 5/81	Morocco
Neira, Roberto	PhD Animal Genetics	UC Davis/Breeding	4/81 - 8/82	Chile
Neumaier, Marisa	MS Rural Sociology	Missouri	6/81 - 8/83	Brazil
Njanja, J.	MS Veterinary Parasitology	Washington	Spr/82 - present	Kenya
Noble, Amanda	MS Rural Sociology	Missouri	9/79 - 8/82	US
Nolte, M. Enrique <sup>17</sup>	PhD Animal Science	Ohio/Texas Tech	8/81 - 8/84	Peru
Novoa, Cesar	PhD Repro. Physiology	Utah/Reproduction	1/81 - 1/85	Peru
Odenya, William <sup>7</sup>	MS Animal Science	UC Davis/Genetics	3/80 - 6/82	Kenya

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- <sup>13</sup> Attended Stanford University; thesis research supported by University of Missouri  
<sup>14</sup> Attended Washington State University  
<sup>15</sup> Attending Louisiana State University  
<sup>16</sup> Attending Texas A&M University  
<sup>17</sup> Now being supported by Texas Tech

<u>NAME</u>	<u>PROGRAM</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Okeyo-Mwai, Alfeyo	MS Animal Science	UC Davis/Genetics	9/81 - 6/83	Kenya
Padilla C., Terezinha	PhD Comp. Pathology	UC Davis/Health	1/82 - 1/85	Brazil
Perevoïotsky, Avi <sup>18</sup>	PhD Anthropology	Missouri	8/81 - 9/83	Israel
Pfister, James A.	PhD Animal Nutrition	Utah/Range	Fall/79 - Sum/83	US
Queiroz, Joao S. de	PhD Range Management	Utah/Range	Spr/80 - Win/84	Brazil
Ramirez, Antonio	MS Microbiology	Colorado	7/82 - 7/84	Peru
Reiner, Richard	PhD Range Science	Texas Tech	6/82 - 5/85	US
Rotich, Daniel <sup>3</sup>	MS Animal Science	Cal Poly	6/82 - 6/85	Kenya
Sands, Michael <sup>19</sup>	PhD Animal Science	Winrock/Management	1/80 - 8/82	US
Silitonga, Sorta <sup>20</sup>	MS Animal Nutrition	North Carolina	4/81 - 12/82	Indonesia
Simplicio, Aurino	PhD Repro. Physiology	Utah/Reproduction	8/82 - 8/85	Brazil
Subandriyo <sup>21</sup>	MS Animal Breeding	UC Davis/Genetics	3/82 - 3/84	Indonesia
Suradisastra, Kedi	MS Rural Sociology	Missouri	1/81 - 1/83	Indonesia
Ubirici, Jose	MS Reproduction	Utah/Reproduction	5/81 - 6/84	Brazil
Valdivia, Corinne <sup>5</sup>	MS Agricultural Policy	Winrock/Economics	1/81 - 12/83	Peru
Vivanco, H. William	MS Reproduction	Cal Poly	9/81 - 6/83	Peru
Wilcox, Brad	MS Range Management	Texas Tech	1/80 - 12/82	US

18 Attending University of California, Davis; thesis research supported by University of Missouri  
19 Attended Cornell University  
20 Attending University of Minnesota  
21 Attending Montana State

TRAINING OF OVERSEAS DEGREE CANDIDATES OVERSEAS WITH CRSP SUPPORT

<u>STUDENT</u>	<u>PROGRAM/INSTITUTION</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Aguirre, Lucrecia <sup>1</sup>	Licenciatura University of Cuzco	Missouri	9/81 - 9/82	Peru
Ait Mhannd, Thami	3eme Cycle Range Management Hassan II	Utah/Range	9/82 - 7/83	Morocco
de Assis-Arruda, Francisco	MS Animal Husbandry Federal University of Ceara	North Carolina	1/80 - 12/82	Brazil
Bueno S., Juan	MS Animal Breeding National Agrarian University, Lima	Montana	7/81 - 12/83	Peru
20 Bueno, Luiz Juan	Ing. Agr. National Agrarian University, Lima	Texas Tech	1/80 - 12/82	Peru
Cabrera, Prospero	MS National Agrarian University, Lima	Montana State	3/80 - 3/83	Peru
Caldas, Willi <sup>1</sup>	BA National Agrarian University, Lima	Missouri	9/81 - 9/82	Peru
Chavez, Diana	Ing. Agr. National Agrarian University, Lima	Montana State	7/81 - 12/83	Peru
Chergaoui, Abdelaziz	3eme Cycle Range Management Hassan II	Utah/Range	9/80 - 3/82	Morocco
de Costa, Odorico	MS Marketing Federal University of Ceara	Winrock/Economics	11/80 - 2/82	Brazil

<sup>1</sup> Support for thesis research only

<u>STUDENT</u>	<u>PROGRAM/INSTITUTION</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Cruces, Martha	Ing. Agr. Agricultural Economics National Agrarian University, Lima	Winrock/Economics	11/80 - 12/83	Peru
Darfaoui, El Mostafa	3 <sup>eme</sup> Cycle Range Management Hassan II	Utah/Range	9/81 - 7/82	Morocco
Diaz, Roxana	Ing. Agr. Agricultural Economics National Agrarian University, Lima	Winrock/Economics	11/80 - 9/82	Peru
Escalante, Victor <sup>1</sup>	Licenciatura University of Cuzco	Missouri	9/81 - 9/82	Peru
Gamarra, Jorge	Ing. Agr. National Agrarian University, Lima	Texas Tech	9/80 - 12/83	Peru
Garagay, Gladys	Ing. Agr. National Agrarian University, Lima	Montana	3/82 - 4/83	Peru
Gutierrez, Carlos	DVM San Marcos University, Lima	Texas Tech	1/80 - 5/83	Peru
Harkousse, Mohammed <sup>2</sup>	3 <sup>eme</sup> Cycle Range Management Hassan II	Utah/Range	9/81 - 7/82	Morocco
El Honsali, Mohammed	3 <sup>eme</sup> Cycle Range Management Hassan II	Utah/Range	9/82 - 7/83	Morocco
Huapaya, Gladys	MS National Agrarian University, Lima	Montana	3/80 - 3/83	Peru
Igmoullan, Ahmed	3 <sup>eme</sup> Cycle Animal Nutrition Hassan II	North Carolina	10/81 - 7/82	Morocco
Khal, Mohamed	3 <sup>eme</sup> Cycle Animal Nutrition Hassan II	North Carolina	10/81 - 7/82	Morocco

<sup>2</sup> Partial support

<u>STUDENT</u>	<u>PROGRAM/INSTITUTION</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Kitivo, Daniel	MS Grassland Science Reading University	CRSP Exchange Funds	8/82 - 12/83	Kenya
Larez, Ivan	Ing. Agr. National Agrarian University, Lima	Texas Tech	6/80 - 12/82	Peru
Llerena, Gorki	Licenciatura Economics and Marketing National Agrarian University, Lima	Winrock/Economics	11/80 - 1/82	Peru
Lopez, Victor	Ing. Agr. National Agrarian University, Lima	Montana	Completed 1981	Peru
Machuca, Juan	Ing. Agr. Agricultural Economics National Agrarian University, Lima	Winrock/Economics	9/80 - 9/81	Peru
Mathuva, Moses	MS Grassland Science Reading University	Winrock/Management	8/82 - 12/83	Kenya
Mawi, Syahrir	MS Sociology Institut Pertanian, Bogor	Missouri	8/82 - 8/84	Indonesia
Moura Fe, Fatima	MS Animal Science Federal University of Ceara	Winrock/Economics	8/81 - 8/83	Brazil
Rios, Marina	DVM San Marcos University, Lima	Texas Tech/ Colorado	6/80 - 6/81 2/82 - 7/82	Peru
Rodriquez, Humberto	MS National Agrarian University, Lima	Montana	3/80 - 4/81	Peru
Roque, Juan	MS Animal Breeding National Agrarian University, Lima	Montana	7/81 - 12/83	Peru
Ruiton, Jesus	Ing. Agr. Agricultural Economics National Agrarian University, Lima	Winrock/Economics	1/80 - 9/82	Peru
Sabrani, M. <sup>2</sup>	PhD Gadja Mada Univ., Jogkarta	Winrock/Economics	6/82 - 12/84	Indonesia

<u>STUDENT</u>	<u>PROGRAM/INSTITUTION</u>	<u>SUPPORT</u>	<u>DATES</u>	<u>COUNTRY</u>
Sahnoun, Abdelatif	3eme Cycle Animal Nutrition Hassan II	North Carolina	10/81 - 7/82	Morocco
Setiadi, M.	MS Animal Science IPB University, Bogor	UC Davis/Breeding	4/81 - 3/83	Indonesia
Valderi, Vierira da Silva	MS Production Systems Federal University of Ceara	Winrock/Economics	8/81 - 8/83	Brazil
Soto, Alberto	MS Animal Health San Marcos University, Lima	Colorado	4/82 - 8/82	Peru
Souza, Jose de	MS Marketing Federal University of Ceara	Winrock/Economics	9/80 - 2/82	Brazil
Sugiyanto	MS Production Economics Institut Pertanian Bogor	Winrock/Economics	8/80 - 12/82	Indonesia
Velarde, Ruben	Licenciatura Agricultural Economics National Agrarian University, Lima	Winrock/Economics	1/80 - 12/83	Peru
Vasquez, Nelly	Ing. Agr. National Agrarian University, Lima	Texas Tech	6/80 - 8/83	Peru

SR-CRSP SPONSORED SHORTCOURSES

<u>COURSE</u>	<u>SPONSORED BY</u>	<u>WHERE HELD</u>	<u>DATES</u>
Sheep Production 23 participants	All Projects	Indonesia	6-7/80 (2 wks)
Reproduction 18 participants	Utah/Cal Poly Reproduction	Sobral, Brazil	9/80 (2 wks)
Management of Reproduction 26 participants	Utah/Cal Poly Reproduction	Lima, Peru	3/81 (5 days)
Forage-Vegetation Sampling 16 participants	Utah/Range	Sobral, Brazil	5/81 (2 days)
Veterinary Lab Techniques	Washington	Kabete, Kenya	6-7/81 (6 wks)
Animal Breeding 65 participants	Montana	Lima, Peru	11/81 (5 days)
Training on Pathology & Immunology Lab 5 participants	Colorado	Lima, Peru	2/82 (2 wks)
Diet Analysis Techniques 9 participants	Utah/Range	Sobral, Brazil	3/82 (2 days)
Animal Breeding & Systems 21 participants	TAMU/Breeding & Systems	Sobral, Brazil	5/82 (2 days)
Nutrition	North Carolina		
Part I: Nutrition Update for Sheep and Goats 20 participants		Sobral, Brazil	7/82 (5 days)
Part II: Practical Training in Feed Analysis 10 participants		Procedures Sobral, Brazil	8/82 (5 days)
Management & Improvement of Natural Pastures 117 participants	Texas Tech	Lima, Peru	8/82 (4 days)

LONG TERM OVERSEAS PARTICIPANTS

NAME	DEGREE	PROJECT	DATES
<u>Brazil</u>			
C. Daley	DVM	UCD/Health	8/81 - 10/81
N. East	DVM	UCD/Health	8/79 - 2/80
N. Gutierrez	PhD Cand.	Winrock/Economics	3/80 - 9/81
<b>D. Hansen</b>	<b>DVM</b>	<b>UCD/Health</b>	<b>5/81 - present</b>
<b>L. Hardesty</b>	<b>PhD Cand.</b>	<b>Utah/Range</b>	<b>2/82 - present</b>
<b>R. Kirase</b>	<b>MS</b>	<b>Utah/Range</b>	<b>9/80 - present</b>
M. Knight		All Brazil Projects	7/81 - 12/81
T. Miller	BS	ME	6/80 - 7/82
<b>M. Neumaier</b>	<b>MS Cand.</b>	<b>Missouri</b>	<b>7/82 - present</b>
J. Pfister	PhD Cand.	Utah/Range	10/80 - 7/82
<b>G. Primov</b>	<b>PhD</b>	<b>Missouri</b>	<b>8/81-2/82; 6/82-present</b>
Joao Queiroz	PhD Cand.	Utah/Range	11/80 - 2/82
<b>T. Robb</b>	<b>PhD</b>	<b>North Carolina/ME</b>	<b>7/81 - present</b>
<b>C. Zometa</b>	<b>PhD</b>	<b>Texas A&amp;M/Breeding</b>	<b>8/82 - present</b>
<u>Indonesia</u>			
<b>M. Bell</b>	<b>MS</b>	<b>UC Davis/Breeding</b>	<b>7/82 - present</b>
<b>H. Knipscheer</b>	<b>PhD</b>	<b>Winrock/Econ.-UMo-ME</b>	<b>10/81 - present</b>
J. Levine	PhD	UC Davis/Breeding	1/80 - 1/81
S. Mink	MS	Winrock/Economics	6/80 - 9/80
N. Thomas	PhD	North Carolina/ME	6/80 - 6/82
<b>J. Van Eys</b>	<b>PhD</b>	<b>North Carolina</b>	<b>6/82 - present</b>
<u>Kenya</u>			
<b>J. Bell</b>	<b>MD</b>	<b>Washington</b>	<b>10/81 - present</b>
Y. Berger	MS	UCD/Breeding-ME	8/80 - 8/82
H. Blackburn	PhD Cand.	Texas A&M/Systems	6/81 - 12/81
<b>K. Boor</b>	<b>MS</b>	<b>Winrock/Management</b>	<b>10/81 - present</b>
<b>D. Brown</b>	<b>PhD</b>	<b>Winrock/Management</b>	<b>7/81 - present</b>
M. Job	PhD	Winrock/Economics	7/80 - 10/81
R. Matthewman	MS	Winrock/Economics	9/81 - 6/82

NAME	DEGREE	PROJECT	DATES
<u>Kenya, cont.</u>			
D. Mortimer	MS	Winrock/Economics	9/80 - 1/81
Amanda Noble	MS	Missouri	7/80 - 3/81
T. Quick	MS	Ohio	2/80 - 12/80
E. Reynolds	PhD	Missouri	8/82 - present
S. Russo	PhD	Winrock/Management	10/81 - present
F. Ruvuna	PhD	TAMU/Systems	11/81 - present
M. Sands	PhD	Winrock/Management	2/80 - 8/81
P. Sayer	DVM	Washington	1/80 - 10/81
<u>Morocco</u>			
N. Artz	MS Cand.	Utah/Range	6/81 - present
Y. Berger	MS	UCD/Breeding	9/82 - present
<u>Peru</u>			
T. Capps	MS	Winrock/Economics	1/81 - 5/82
R. Cochran	MS	Texas Tech	6/80 - present
K. Jamtgaard	PhD Cand.	Missouri	6/80-6/81; 1/82-present
E. Lotterman	PhD	Winrock/Economics	11/80 - 7/82
C. McCorkle	PhD	Missouri	2/80 - 6/80
T. Nelson	PhD	Colorado	7/82 - present
A. Perevolotsky	PhD Cand.	Missouri	9/81 - present
G. Primov	PhD	Missouri	3/82 - 6/82
B. Quijandria	PhD	Montana-ME	9/81 - present
A. Schlundt	PhD	Texas Tech	6/80 - present
G. Sides	PhD	Utah/Reproduction	1/81 - present
T. West	PhD	Missouri	2/80 - 6/80
B. Wilcox	MS	Texas Tech	7/80 - 8/81

## PUBLICATIONS

Publications--formal and informal--and verbal presentations by SR-CRSP related or supported personnel during the period covered by the 1981/82 Annual Report.

### Refereed Journal Articles (Accepted)

- Abegunde, T. O., H. E. Adler, T. B. Farver and A. J. Da Massa. 1981. A Serologic Survey of Mycoplasma putrefaciens Infections in Goats. Am. J. Vet. Res. 42: 1798-1801. **UCD-Health**
- Brooks, D. L., A. J. Da Massa, and H. E. Adler. 1981. Caprine mycoplasmosis: Immune Response in Goats to Mycoplasma putrefaciens after Intramammary Inoculation. Am. J. Vet. Res. 42: 1898-1900. **UCD-Health**
- Campbell, R. R., M. F. Nolan and John F. Galliher. 1981. Reflections of Title XII Collaborative Research: The Case of Sociology in the Small Ruminant CRSP. (Presented at 5th World Congress for Rural Sociology. Mexico City) The Rural Sociologist 1(1):2-10. **U.Mo.-Sociology**
- DeBoer, A. J. 1981. Socioeconomic Aspects of Dairying in Developing Countries. J. Dairy Sci. 64(12):2453-2462. **Winrock-Economics**
- Gilles, Jere L. and Keith Jamtgaard. 1981. Overgrazing in Pastoral Areas - The Commons Reconsidered. Sociologia Ruralis XXI(2):129-141. To be reprinted in "Nomadic Peoples". **U.Mo.-Sociology**
- Gutierrez, N. F., A. J. DeBoer and E. Ospina. 1981. An Econometric Model of the Columbian Beef Sector: 1950-1970. Canadian J. Agr. Econ. 30(1):61-70. **Winrock-Economics**
- Kennedy, B. W., C. M. Finley, E. J. Pollak and G. E. Bradford. 1981. Joint Effects of Parity, Age and Season of Kidding on Milk and Fat Yields in Dairy Goats. J. Dairy Sci. 64:1707-1712. **UCD-Breeding**
- MacLachlan, J., D. Gribble and N. East. Polyradiculoneuritis in a Goat. JAVMA 180:2:166. **UCD-Health**
- Sabrani, M. and A. Muljadi. 1981. Prospects for Small Ruminant Development with Reference to Land Holdings in Ciburuy Village, Bogor. Lembaron LPP (1):1-4. **Winrock-Economics**
- Shelton, M. and Elsie A. P. Figueiredo. 1981. Types of Sheep and Goats in Northeast Brazil. Int'l. Goat & Sheep Res. 1:258-268. **TAMU-Breeding & CNPC**

## Theses

### PhD

Garcia-Betancourt, O.J. 1981. Genetic Analysis of a Crossbreeding Experiment Using Improved Dairy Goat Breeds and Native Goats in a Dry Tropical Environment. University of California, Davis. **UCD-Breeding**

McCorkle, Constance. 1981. Animal Management and the Agro-Pastoral Dialectic with Implications for Development. Stanford University. **U.Mo.-Sociology**

Narjisse, Hamid. 1981. Acceptability of Big Sagebrush to Sheep and Goats: Role of Monoterpenes. Utah State University. **Utah-Range**

Provenza, Frederick D. 1981. Some Morphological and Chemical Responses of Blackbrush (Coleogyne ramosissima) to Goat Browsing: Influences on Dietary Blackbrush Selection by Goats and Cattle. Utah State University. **Utah-Range**

### MS

Brown, Lynn E. 1981. Goats and Sheep: A Comparison of Intake, Digestibility, and Other Metabolic/Digestive Parameters When Fed Wheat Straw Rations. North Carolina State University. **NCSU-Forages**

Chami, Mohamed. 1982. Productions Animales et Systemes Alimentaires des Troupeaux du Haut Atlas Occidental (Vallee de Rheraya). (Feeding Systems and Animal Products in the High Atlas). IAV Hassan II, Rabat, Morocco. **Utah-Range**

Chergaoui, A. 1982. Etude des Preferences Alimentaires des Ovins et de la Vegetation sous Differents Niveaux de Charge a la Station Pastorale de Timahdite. IAV Hassan II, Rabat, Morocco. **Utah-Range**

Chergaoui, A. 1981. Etude Bibliographique de l'Effet de Charge sur Dynamique de la Vegetation: (1) Preferences Alimentaires des Animeaux sur Parcours; (2) Valeur Nutritive de la Ration Alimentaire sur Parcours; (3) Performanced des Animeaux sur Parcours. IAV Hassan II, Rabat, Morocco. **Utah-Range**

Chriyaa, Abdelouahid. 1982. Etude des Effets de la Charge et de la Saison sur les Preferences Alimentaires des Ovins a la Station Pastorale de Timahdite. (Effects of Season and Stocking Rates on the Sheep at the Timahdite Feeding Behavior Experimental Station.) IAV Hassan II, Rabat, Morocco. **Utah-Range**

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PART IV  
PARTICIPATING INSTITUTION ANNUAL REPORTS  
BRAZIL

H6a

## Annual Report for 1981/1982

1. Project Title: Evaluation of Meat Goats and Hair Sheep
2. Institution: Texas A&M University
3. Principal Investigator: Maurice Shelton
4. Funds allocated from:

Grant No. AID/DSAN/XI-G-0049 from 1981/82 Subgrant:	\$150,000
Matching Contribution from 1981/82 Subgrant:	\$50,000

5. Statement of Project Goals  
(Refer to Original Subgrant Agreement)
6. Summary Of Accomplishments In Previous Years

The project has been fully functional from one to two years prior to the period covered by this report. The major activity during this period consisted of making overseas contacts (Brazil), identifying collaborators, outlining collaborative research activities, and establishing experimental flocks and data collection routines. The latter activity has taken place in both the United States and at appropriate overseas sites. Flocks which have been established in the US, utilizing CRSP funds, have been those which are somewhat unique to the United States production history, but which have international interest (i.e., meat goats and hair sheep). Genetic studies at host country sites (Brazil) have intentionally been written as a host country project (EMBRAPA) with CRSP collaboration. This was done because these projects require large resource inputs (people, land area, and animals) which the CRSP is in no position to provide or utilize efficiently. Also, breeding projects must be long duration efforts, and this can best be insured by making it a host country effort. Insofar as possible, similar activities are being conducted in the US so that combined results may be more applicable to broader areas, and more definitive and that a useful data base may be more quickly obtained.

7. Statement of Specific Objectives for 1981/82
  - A. Continue data collection and selection efforts with flocks of meat goats and hair sheep in both US and Brazil.
  - B.
    1. Summarize, publish and articulate conclusions relevant to LDC conditions from completed work characterizing major genetic types of sheep and goats relative to meat qualities, foraging and feeding behavior and various hormone profiles and blood parameters.
    2. Explore possibilities of extending to LDC environments those observations which appear to be warranted from the data reported under B-1 above.

- C. Investigate the potential of using blood hormone profiles, response to GnRH challenge, or testicular measurements to predict inherent fertility of young males as a means of simplifying and speeding up selection for a higher lambing and kidding rate. This will initially be done in the US, but will be extended to LDC environments if the results warrant and as arrangements can be made to perform the necessary analyses.
  - D. Work with Brazilian collaborators and other members of the CRSP to establish prototype production and management systems for improved sheep and goat production in Northeast Brazil.
  - E. Initiate graduate training programs for at least one Brazilian student during this time.
  - F. Explore with Brazilian collaborators the desirability and possibility of adding additional genotypes to sheep and goat breeding programs in Brazil.
  - G. Participate with Brazilian collaborators and other members of the CRSP in any joint training exercises that may be desired or requested.
  - H. Explore the possibility of establishing outreach locations to extend CRSP work to other areas. This may be to obtain additional and more relevant research observations or to extend current results to serve new areas.
8. Description of Work Undertaken

#### Brazil

The goats and hair sheep genotypes of Northeast Brazil have been surveyed and described along with the resources available for their production. The most prevalent type of sheep is the Criollo (which might be translated as native), and is a rather amorphous type which defies characterization. In the more arid regions, particularly in the State of Bahia, a somewhat similar type exists which is called the Rabo Largo and has had some infusion of fat-tail sheep. Three rather recognizable types of hair sheep ("Ovinos Deslanados" or "Pelo de Boi") are found in the region. These are the Morada Nova, Santa Inez, and the Brazilian Somali. Evaluation of these breeds, along with that of goats, has been underway at CNPC predating the formal organization of the SR-CRSP. However, the SR-CRSP breeding component has from the outset primarily contributed to these efforts in an advisory role. In addition, these evaluations are particularly important to the SR-CRSP and CNPC in formulating breeding and research plans and goals. Some preliminary analyses of these data have been made. In the case of sheep, it appears that all three of the definitive breed types mentioned above will find a place or make a contribution to the Northeast. The Santa Inez is the larger of the three and will no doubt receive preference where appearance, growth rate, or size are emphasized. The Morada Nova are present in larger numbers, have a higher lambing rate, and may be more adaptable to local conditions. They come closest to being a native of the area. The Brazilian Somali is the smallest of the types, and the genetic base is very limited. However, this breed is derived from a fat-rump type which should give it adaptive advantages to the region.

Ideally, breeding programs would be conducted with all three breeds, and efforts should be made to introduce new genetic material for the Somali.

In the case of goats, several local or endogenous types such as SRD (Sem Raca Definida-without a well defined type), Moxoto, Repartida, Marota, and Caninde are present, as are two exotic types such as the Anglo Nubian and Bhuj. While within the entire country, most established dairy breeds are no doubt present, they do not appear to be making a contribution in the Northeast. It has been suggested that the native types largely represent color variants. It appears necessary to proceed with selection in a few breeds because large scale breeding programs cannot be conducted with all breeds. The breed characterization studies, in addition to the crossing studies at Quixada, were designed as a means of doing this. Although the results are preliminary, the data appears to provide some basis for preliminary breed selections. Where weight or weight gains are used as a criterion, the exotics and the SRD, which contains Nubian influence, tend to show an advantage. Among these, the Anglo Nubian show distinct advantages over the Bhuj. While within the native types, the Moxoto is the most distinctive, it appears to perform less satisfactorily than some of the other breeds such as the Caninde. Thus, a basis appears to exist in which to make some preliminary choices of the types to be exploited. However, this decision may involve other factors or considerations. In addition, the Banco de Nordeste has provided assistance to establish preservation (and hopefully improvement) flocks of the various types at several sites in the region. A primary goal of the CRSP Breeding Project is to place these various flocks into a common data recording scheme which would facilitate both research and improvement programs. Since the flocks are maintained by different agencies, this is not easily or automatically accomplished.

In addition to selection within and between breed groups, the products to which breeding efforts are to be directed required attention. The various products which are or might be obtained from sheep and goats in the region are milk, meat, and skins. Fiber is not considered a likely product for exploitation. Few animals are milked. The emphasis on dairy products should be increased, but to date has not been a subject of investigation by the CRSP Breeding Project. However, Brazilian Collaborators have one project relating to breeding for milk production, and our efforts will be extended to collaboration in this effort. Some studies have been conducted in Brazil and in the US on meat and skins. Generally, work at both sites indicates that goats and tropically adapted hair sheep produce low yielding, bony carcasses which needs improvement. In Northeast Brazil, and in a number of LDCs, many of the dress-off items, as well as the carcass, are used as food. Under these conditions, carcass traits are less important than in areas such as the United States. Still there is a need to improve carcass traits to facilitate commercialization of the industry, particularly to the hotel and restaurant trade in coastal cities. In the case of skins, it is known that fiber producing types produce inferior skins. However, with this exception, genetic differences appear to be only a small source of variation in prices received for skins or the uses to which they are made. By contrast, defects originating both anti-mortem and post-mortem are a major cause of lowered value. Further studies relating to skins are planned.

Two years' data have been collected on a flock of Morada Nova sheep and SRD goats at Fazenda Iracema (EPACE) near Quixada. In the fall of 1981,

mating records were obtained on 426 Morada Nova sheep and 556 SRD, Caninde, and Moxoto goats. A total of 212 of the Morada Nova sheep are involved in selection lines, and this number is being increased to approximately 400. Data are being collected on an additional 200+ sheep of the same breed which are involved in other experiments, but from which data and surplus animals can be fed into the breeding experiment. The sheep in the genetic flock are divided into breeding lines on which selection is being practiced. However, initial efforts are concerned more with establishing the flocks and determining what traits are important to adaptation and performance in Northeast Brazil, including disease and parasite resistance. Longer range goals consist of creating superior genotypes and establishing general principles, such as the compatibility of adaptation and performance traits in specific and stressing environments. No attempt has been made to analyze the data collected, but some preliminary analyses may be undertaken in the coming year. More formal analyses in respect to both goals will be done by Brazilian graduate students who are only now initiating their studies.

The goats at Fazenda Iracema consist of newly established pure lines of Caninde and Moxoto as well as approximately 400 head of SRD goats. The latter are being mated to males of the various breeds. Initially, these data will also be utilized to determine what traits are desired, establish genetic parameters, and to provide data to make selections between breeds of sire when used on a common flock of does. Some of the data being collected include body weights, age, condition, color, presence of caseous lymphadenitis, birth weight, and type of birth and growth rate of offspring. Some preliminary analyses of the breed of sire has been completed. The more exotic sires (Anglo Nubian and Bhuj) generally sire larger and faster weight gaining kids. This is no doubt associated with their larger size. Within the endogenous types, differences tend to be small or insignificant. These data relate only to the F1 or first cross offspring sired by exotic males. It is equally important to determine the performance of the females of these crosses or when they are graded to exotic types. These represent second and third stages in these efforts.

Analyses of data relating to the environmental effects and traits of adaptive and economic advantage have not been undertaken. This will require additional years of data.

#### Work in the United States

##### Meats:

As previously stated, comparative studies involving goats, tropically adapted hair sheep (Barbados Blackbelly), fat-tail types and more conventional breeds such as the Rambouillet suggest a need for improved carcass traits of goats and hair sheep. However, these deficiencies are of much less importance if dress-off items are considered as food in many LDC sites. However, commercial exploitation would benefit from an improved carcass. These studies also indicated a very high total body fat content for the fat-tail types.

Palatability studies were conducted utilizing legs and loins from 1120 animals of various types of sheep (Rambouillet, Karakul and Barbado) and goats (Spanish and Angora) using US and foreign taste panels. Differences within species tend to be inconsistent. In terms of acceptability, sheep tended to

receive higher rankings than goat carcasses. Foreign panelists tended to be less critical, especially on such factors as tenderness and overall acceptability. In addition, most consumers in LDC areas likely consume meat in a more processed form. These factors suggest that in most LDCs, quality considerations are less important.

Anatomical measures on the live animals and slaughter data were collected and analyzed on 95 meat type male kid goats of known sires. Live animal measures included liveweight, chest width, chest depth, loin width and length, body length, and hip height. Carcass data collected included fabrication into leg, loin, rack, shoulder, shank, breast, and kidney and pelvic fat. Mean values are shown in Table 1.

Correlations between carcass traits in pounds tended to be high, but when expressed in percent, tended to be small and in some cases, insignificant. Correlations between live animal measures and carcass traits in percent tended to be low and insignificant, except that chest measures tended to be negatively related to leg weights. Sire differences tended to be small resulting in low and erratic heritability estimates.

#### Genetic Studies:

Breeding work is being carried on with approximately 600 head of Spanish or meat-type goats which are comparable to those found in many parts of the world. Data on Angora goats are available for comparison. No attempt has been made to analyze these data in order to obtain estimates of genetic parameters. Some ancillary studies have been conducted or completed. In one of these, 95 head have been slaughtered to evaluate carcass attributes. The data are reported elsewhere.

Milk production studies were conducted which included data on as many as 97 Spanish or meat-type does. The relation of estimated milk production and other variables (doe weight and age and growth rate of the kid) were analyzed. Doe milk yields were significant and important in terms of weight and growth rate to the kid to 30, 60, and 120 days. The importance of milk production decreased with advancing age of the kid. Doe size and kid birth weight also had important influences or relationships to weight of the kid produced. However, doe weight, birth weight of kids, and level of lactation were not necessarily unrelated. Doe age, within the range used in this study, did not influence lactation or kid production. These data appear to suggest that milk production of the doe is important to produce kids in marketable condition at weaning. It may also be important to improve weaning survival rate in more stressing conditions.

Breeding flocks of hair sheep (Barbado and Barbado x St. Croix) and fat-tail sheep are maintained in the project. Other more conventional breeds are maintained for comparisons. Analyses are underway detailing the breeding season and total productive potential of these types. Some physiological studies have been completed suggesting major differences in level of feed intake, rate of fat deposition, and in some cases certain blood parameters of the major types of sheep and goats. These data certainly have significance to potential adaptation and meat production. For instance, the fat-tail (desert adapted) types not only differ in the presence of the fat-tail, but in rate of feed intake and in total body fat deposits and it is probably these traits

that adapt them to periods of feed scarcity. By contrast, tropically adapted types appear to lack the tendency for heavy foraging during periods of food abundance, and do not deposit large body reserves which might be used in periods of feed scarcity. Major differences also appear to exist in spite of fat deposition (internally, subcutaneously or tail or rump fat) which may have significance to adaptation.

Extensive studies have also been conducted characterizing the grazing behavior of the various types of sheep and goats. These studies have confirmed major species differences, but have also shown within species differences, in diet selection. The primary differences which appeared to be of interest is that hair sheep tend to browse more than other types of sheep and meat-type goats browse more than Angora. Diet selectivity data have also been obtained on approximately 200 young male meat-type goats. Preliminary analyses have been made on these data to look at sire effects, and also the possibility of selecting for individuals which might consume a larger amount of undesirable species which present problems on rangelands such as mesquite (Prosopis glandulosa). Preliminary results do not appear very encouraging.

#### Reproduction:

The level of reproduction is an important component of production efficiency. Although physiology of reproduction is a CRSP component itself, improved reproduction in LDC environments is more likely to be accomplished through genetics (adapted genotypes), nutrition, disease control, and management. Thus, genetic studies must consider reproduction as one of the traits of interest. An early interest in developing a breeding strategy for stressing environments is to determine the amount of emphasis which should be placed on increased lambing or kidding rate. Any conclusions on this must be based on data obtained in the target environments which requires more data. However, in the US, there is little question of the desirability of increasing lambing or kidding rate. Selection for lambing rate based on reproductive history requires considerable time delay, and work under this project is concerned primarily with facilitating early identification of more fertile types, especially with young growing males. Considerable data have been collected on testicular size and endocrine levels, but this work has not proceeded to the point that formal recommendations can be made.

Another serious limiting factor to reproduction in many areas is seasonality of reproduction. Data have been collected to characterize breeding groups in a number of environments. At present, it appears that photoperiod or distance from the equator is the major factor and that genetic differences are minor. While efforts are being made to address this issue, studies have apparently not been completed to ascertain the possibility of changing this trait through selection.

Some studies on abortion have also been conducted. Abortion has long been recognized as a problem with Angora goats. More recently, it has been determined that abortion is also a problem with meat-type goats. In these studies, Angora goats were used as models to study abortion. Generally, it can be shown that low-blood glucose resulting from nutritional stress is a primary contributing factor. It seems reasonable that similar situations exist with other types of goats. Data also suggest that hyperadrenalism is also a contribution factor to some losses in Angora. It is not clear if this is the case with non-Angoras.

Table 1. Mean Values

<u>Trait</u>	<u>No.</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Range</u>
Live Weight, lb.	95	57.72	7.74	42.0 - 82.0
Chest Width, cm.	95	15.54	1.40	12.3 - 20.5
Chest Depth, cm	95	26.13	1.70	20.9 - 30.0
Loin Width, cm	95	8.47	0.72	7.2 - 11.0
Loin Length, cm	95	17.90	1.96	14.6 - 24.0
Body Length, cm	95	55.59	3.00	49.5 - 66.0
Hip Height, ca.	28	61.60	3.44	55.2 - 67.1
Hot Carcass Wt., lb.	95	28.64	4.73	20.2 - 49.2
Hot Carcass Wt., %	--	49.60		
Total Leg, lb.	95	9.08	1.38	6.7 - 14.8
Total Leg, lb. %	--	31.70		
Loin, lb.	92	2.36	0.52	1.5 - 4.5
Loin, lb. %	--	8.24		
Rack, lb.	92	2.42	0.48	1.5 - 4.0
Rack, lb. %	--	8.45		
Shoulder, lb.	95	9.98	1.77	7.2 - 18.4
Shoulder, lb. %	--	34.85		
Shank, lb.	95	1.91	0.32	1.4 - 2.9
Shank, lb. %	--	6.67		
Breast, lb.	95	2.64	0.55	1.2 - 4.3
Breast, lb. %	--	9.22		
Kidney & pelvic fat, lb.	94	0.28	0.07	0.2 - 0.5
Kidney & pelvic fat, %	--	0.98		

## Annual Report for 1981/82

1. Project Title: Rangeland Research for Increasing Small Ruminant Production
2. Institution: Utah State University
3. Principal Investigator: John C. Malechek
4. Funds allocated from:
  - Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$258,818
  - Matching Contributions from 1981/82 Subgrant: \$66,982
5. Statement of the Project Goals
  - \*A. Ecological assessment of range forage resource
    1. Determine successional status and productivity
    2. Determine ecological potential for important range sites
    3. Monitor plant community change in relation to climate and grazing
    4. Describe and delineate important soil taxonomic units and define edaphic limitations to forage production
  - \*B. Plant-animal relationships
    1. Determine animal diets and feeding behaviour
    2. Describe the annual forage cycle
    3. Ascertain forage intake in relation to nutritive requirements
  - \*C. Range improvement
    1. Determine applicability of brush management practices (e.g., controlled browsing, hand removal) for increasing forage production
    2. Determine effects of different cutting practices on resprouting responses of selected woody species
  - D. Establish controlled grazing trials to test applicability of improved range management technology developed in work under Objectives A-B above.
6. Description of Work Undertaken

Initiation of experiments under three of the major objectives has been realized during 1981/82. Additionally, two shortcourses and several other training objectives have been met. Details of specific technical accomplishments as well as the training and educational component are presented below.

\* Objectives noted by asterisk are those emphasized during year covered by this report.

## 7. Technical Accomplishments

### Precipitation and general growing conditions

Total precipitation for 1981 was only 68 percent of the long-term average for Sobral. Also, there were several unusual features in monthly distribution that probably had important impacts on forage production and decomposition. Most of the year's rainfall came during March, with all other months of the usual rainy season being highly sub-normal. About 25 mm were received during August, enough moisture to cause initiation of new leaves in sabia' (Mimosa caesalpiniaefolia) and (Croton sonderianus) and to cause germination in several annual herbaceous species.

Local residents call such off-season rains "chuvas do caju" or "rains of the cashew season" and maintain they are undesirable because they hasten decomposition of dry forage remaining from the previous growing season. This consideration, along with the occurrence of unusual early rains in December 1981, has led us to implement a new phase of research dealing specifically with the forage decomposition cycle and how it is affected by various environmental variables, including off-season rains. Bob Kimmse will be responsible for this sub-project and initial results of this work are presented under the following topic heading.

### Productivity and dynamics of native forage species

Native caatinga: Measurements of forage produced by native caatinga species began during January 1981, in the 45-ha Range Research Pasture at CNPC. This information is important for two reasons: Firstly, it is the basis for understanding how environmental factors such as precipitation and site potential affect the availability of forage for livestock production. Secondly, it is required as a baseline against which to evaluate the effects of caatinga manipulation practices such as clearing and introduction of so-called "improved" forage species.

Sampling was done on nine dates in 1981, corresponding to times when dietary collections were made from fistulated animals (see Objective B). For the leaf biomass of woody species, the following species were chosen for sampling, based on preliminary data from the animal diet study: pau branco (Auxema onocalyx), sabia', catingueira (Caesalpinia pyramidalis), and mororo (Bauhinia forficata).

Results of the forage production inventories indicate relatively low total forage yields due to generally droughty conditions during 1981. By July, availability of herbaceous species had declined to about nil. There was a relatively large contribution of dry tree leaves to the biomass of plant material available to grazing animals, and this material extended well into the dry season. The actual dietary importance of this material to animals must await completion of botanical analysis of esophageal fistula extrusa from Jim Pfister's dietary studies.

Tree density assessments showed an average 4,800 trees per ha in the Range Research Pasture. Of this, pau branco was the dominant species with 2,183 trees per ha, followed by sabia' with 1,117. Tree density is a component of the forage yield estimates presented above.

Studies were done on phenology and rate of leaf-fall for four important tree species. Leaf fall began in May and was essentially complete by late August. Pau branco was the major contributor and also the last species to complete leaf-shed. Dry leaves are probably an important component in dry season diets of animals.

Cleared vs. uncleared caatinga: As mentioned earlier, new work was initiated by Bob Kirmse in December 1981, to focus on the forage decomposition cycle. This study includes a comparison of both production and decomposition on cleared and uncleared caatinga. Three replicated pairs of pastures (.72 ha each) were delineated and fenced and half of each was cleared of its woody tree cover in December. Traditional local techniques were used, including hand-cutting and removal of marketable wood, followed by piling and burning of slash. Yields of herbaceous species are now being assessed on the two treatments. Initial results from this study indicate that yields from two of the three burned pastures are considerably greater than where the native, uncleared caatinga vegetation remains. A subsequent sampling conducted in April 1982 further emphasized this difference as the growing season has progressed. Average herbaceous biomass for all three cleared pastures was 1,833 kg/ha, compared to 467 kg/ha for the uncleared pastures. How this forage carries over into the next dry season and how clearing affects decomposition rates remains to be seen.

In addition to vegetation assessments, dietary samples are being collected monthly from esophageally-fistulated sheep and goats for short periods on these treatment pastures. The animals are allowed in the pastures for only a 30-minute period on the particular day when samples are taken, in order to exert only minimal grazing pressure. The objective of this effort is to assess the chemical composition of the available forage as the grazing animal would view it, and to see how this changes over time as a function of forage maturation (during the growing season) and decomposition (during the dry season).

#### Forage production and ecology support work

Herbarium: Bob Kirmse and EMBRAPA collaborator Luis Vale have collected, pressed, and identified over 250 species in the CNPC and surrounding areas. Most of these specimens have been verified by taxonomists at the Federal University of Ceara' Herbarium at Fortaleza. They are available for reference use in the herbarium at CNPC. Miss Sandra Silva, CNPC botanist, has returned to her post following a year's leave and will assume much of the responsibility for maintenance and continued building of the CNPC herbarium.

Plant Handbook: The handbook entitled "Woody Plants of the Northern Ceara' Caatinga" is now in final draft form (English version), having been accepted for publication as an EMBRAPA Technical Bulletin in March 1982. This handbook will also be published as a CRSP publication, and will be available for use by visiting and resident scientists and visitors to the CNPC.

#### Plant-animal relationships and range nutrition

The specific objectives of this project segment are to determine seasonal botanical composition, chemical content, and digestibility of diets selected by sheep and goats in native, uncleared caatinga. Additionally, daily forage

intake and allocation of time to horizontal and vertical feeding are being assessed for both species grazing on a common range (Range Research Pasture, CNPC). Work under this project segment is the responsibility of James Pfister, Utah State University. He has collaborated on various aspects of the work with Roberto Mesquita and Dr. Emidio Dias de Silva, both EMBRAPA researchers, and with Dr. Don Hansen, resident staff member on the University of California-Davis Animal Health Project.

Animal preparation: In March and April 1981, 11 sheep and 12 goats were gentled and surgically fitted with esophageal fistulae for use in these forage and feeding evaluations. Since April 1981, seven additional animals have been fistulated. As of April 1982, 10 goats and 10 sheep survive, five animals having died due to failure of the fistula, and five other deaths resulting from a variety of other problems. The assistance of Drs. Emidio Dias de Silva and Don Hansen is gratefully acknowledged.

Dietary analyses: Dietary samples have been collected from fistulated animals during ten periods. Each collection period consists of three consecutive days when sheep and goats are allowed to graze for about 30 minutes with fistula plugs removed and sample collection bags in-place. These grazing periods begin shortly after dawn each day to correspond to the time when animals normally begin their grazing activities.

Botanical analysis of dietary samples (by frequency-of-occurrence at 20-40X magnifications) has been partially completed for three dry-season periods. Even though these data are not yet complete (only about 75 percent of the diet is accounted for) and they have not yet been analyzed statistically, several trends are emerging. First is the importance of the herbaceous vine jitarana (*Ipomoea* sp.), particularly early in the dry season when it constituted roughly half of the diet for both sheep and goats. Secondly, no striking differences between sheep and goats are yet apparent. The selection of browse by goats appears to be somewhat greater than that by sheep later in the dry season when browse is more important to both animal species. Catingueira is obviously an important browse species.

Chemical composition: In addition to botanical and in vitro digestibility analyses, fistula extrusa samples are also being analyzed for the following chemical components: dry matter (DM), neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, ash, and nitrogen (N). To date, analyses are partially complete for three dry-season dates. Data from these analyses suggest no major differences between sheep and goats for any of the chemical components. Crude protein content was higher than anticipated for all three dates.

Digestibility: Digestibility of diets consumed by sheep and goats will be estimated using an in vitro technique. To date, only a small part of this work has been done, due to a delay in shipment of necessary lab equipment from the US. The apparent advantage to sheep in August needs further clarification.

Forage intake: Intake (I) will be determined as the ratio of fecal output (F) to forage indigestibility (1-D where D is the digestion coefficient estimated by in vitro disappearance). Fecal output is being determined regularly using intact animals fitted with fecal collection bags.

Animal weights: As perspective for the dietary and nutritional studies, liveweights of intact animals grazing the Range Research Pasture were measured on nine dates. Sample sizes are small (usually about 10 animals for each species), but the data offer a basis for relating nutritional responses in this pasture to larger flocks of animals on CNPC where weight responses are being measured by other CRSP and EMBRAPA researchers.

Feeding behavior: These studies are being pursued to ascertain possible differences in how sheep and goats exploit a common food resource. Two components are being analyzed: The use of vertical space (strato-orientation) and the use of horizontal space (zone-orientation).

#### Range improvement, brush management, and ecology

Research Associate Linda Howell Hardesty arrived in Sobral in early March, along with her husband Dan Hardesty, to initiate studies on brush management and ecology. She is presently locating study sites and formulating experimental designs and will be working in conjunction with Dr. Thad Box of Utah State University. Plans call for locating parts of this study both at CNPC and at the EPAGE station at Quixada. This work will involve aspects of using traditional cutting techniques to improve dry season forage and determining how time and method of cutting influences sprouting from stumps.

#### Ecological assessment of caatinga

Land units are distinct entities, just as plant and animal organisms are distinct and have different requirements and productive capacities. Thus, the first step toward improved land management is the recognition of variability in a region and classification of land units into relatively homogeneous groups. Then, an inquiry of how the specific soil and climatic environments support plant growth (both kinds and amounts) can proceed on a logical systematic basis. This component of work is being conducted by Mr. Joao S. de Queiroz and Dr. B.E. Norton, both of Utah State University, working jointly with EMBRAPA collaborator Luis Vale.

Classification of ecological units: A study area measuring roughly 70 x 20 km and comprising the CNPC station was selected for intensive study. This area contains sufficient variability in land form and vegetation to test a classification scheme adequately. It must be emphasized that the goal of this work is to devise a classification system suitable for the caatinga and not to actually conduct a broad-scale classification or inventory of the caatinga. This work has proceeded through the use of classical methods of soil and vegetation analysis, using available aerial photographs and topographic maps.

Field work was completed in December 1981, and Mr. Queiroz returned to the US in February 1982 to continue his work for the PhD degree. Details of the field work are provided in the exit report recently submitted to CNPC by Queiroz.

LANDSTAT imagery for caatinga classification: The potential exists for using satellite imagery data for a rapid, economical basis of classifying ecological units. With the specific "ground truth" information obtained in the field study described above, the applicability of this technique to the caatinga can be evaluated. Computer tapes of LANDSTAT data area now in-hand

and this phase of the work will be undertaken in the coming year. Norton and Queiroz are working with Dr. Roger McCoy, University of Utah, Salt Lake City, in this effort.

#### Graduate Education

US Students: Four people have been supported either partially or wholly on CRSP funds and have worked directly with project activities in Brazil. These people are all working on PhD projects.

EMBRAPA scientists: Two EMBRAPA researchers will begin graduate programs with Utah State University in the near future: (1) Roberto Mesquita will arrive at USU in August 1982, to begin coursework toward an MS degree in Range Science; and (2) Ederlon Oliveira will come to USU in August 1983 to initiate work toward a PhD in Range Animal Nutrition.

Federal University of Ceara: An additional program of graduate education has been negotiated for Miss Antonia Edna Nascimento who is pursuing an MS program at the Federal University of Ceara'. Her work will be supervised by Drs. Joao Ambrosio de Araujo Filho and Jose Gerardo de Oliveira, both professors at the Federal University, and by CRSP researchers Kimse and Pfister. This work will involve establishment of a reference collection of plant material and appropriate microscope slides of plant cuticle tissue with descriptions for use in microhistological analysis of animal diets.

The SR-CRSP Range Management Project (Utah) gave partial research support to three thesis and dissertation projects during the past year.

#### Specialized Training

Short-courses: Two short-courses were presented by the Range Management Project during the past year. The first, in May 1981, presented to 16 attendees, focused on methods and procedures for sampling caatinga vegetation.

The second short-course was held in March 1982 and focused on methods of diet analysis for free-grazing livestock. Nine people attended.

Technical training: On-the-job training in care, husbandry, and sampling procedures for fistulated sheep and goats has been completed by Mr. Valeslau Alves Costa, a Brazilian technician working for the Range Management Project. James Pfister has conducted this training.

## Annual Report for 1981/82

1. Project Title: By-Product and Crop Residue Utilization in Intensive Sheep and Goat Production Systems for Limited-Resource Farmers
2. Institution: North Carolina State University
3. Principal Investigator: William L. Johnson
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$269,057  
Matching Contribution from 1981/82 Subgrant: \$85,392

5. Statement of Project Goals

Since the inception of the Small Ruminant CRSP in 1978, the objectives for the nutrition and by-products utilization project have continued unchanged. They can be paraphrased as follows:

- A. Study the nutritive value of feeds available for hand-feeding or supplementary feeding to small ruminants in tropical environments.
- B. Develop guidelines for inclusion of such feeds in the diets of small ruminants, and to determine the expected productivity of animals which consume them.
- C. Study storage and treatment methods for crop residues and byproducts.
- D. Test the reliability of simple feedstuff evaluation procedures for predicting animal productivity.
- E. Generate information on nutritional requirements and comparative efficiencies of tropical small ruminant types and breeds, in the environment of their exploitation.

6. Summary of Accomplishments in Previous Years

In 1979 and 1980, workplans were agreed upon with collaborators in Brazil. Animal feeding trials were designed and implemented on the experiment stations at Sobral. Complementary research activities continued in Raleigh.

Early work in Northeast Brazil centered around the use of post-harvest residues of the maize plant (cultivated for grain) in dry season rations for the growing animal, in confinement. Daily rates of gain of 143 grams were obtained with Santa Inez wether sheep, initial weight 28 kg, when their complete blended ration included 51% maize byproduct, 28% cottonseed meal, 20% maize grain, and 1% salt.

7. Statement of Specific Objectives for 1981/82
  - A. Continue the evaluation of maize residue based rations for dry season feeding of growing lambs and kids in confinement.
  - B. Test the efficacy of a native legume hay ("mata pasto") as a protein supplement.
  - C. Plan research activities with dairy goats in Paraiba, in collaboration with the Paraiba State research enterprise (EMEPA) and EMBRAPA.

8. Description of Work Undertaken

Experiments Completed

1. Relative acceptability of maize crop residues and napier grass by goats.

Leaders: Nelson Barros, Ederlon Oliveira, W. L. Johnson

Location: CNPC, Sobral

Procedures: Eighteen weanling SRD wether kids were offered a choice of two of the following feeds: whole plant maize residue (stover), husks, cobs, or green napier grass (Pennisetum purpureum), all chopped. The six treatment combinations were offered to all animals, in six experimental periods, with recording of individual daily feed intake and weekly animal weights.

2. Partial substitution of cottonseed meal by "Matapasto" (Cassia sericea) hay in rations for growing lambs.

Leaders: Ederlon Oliveira, Nelson Barros, T. W. Robb, W. L. Johnson, Luis Vale

Location: CNPC, Sobral

Procedures: Twenty-four Morada Nova wether lambs 6 to 7 months old and weighing an average of 20.0 kg were individually fed one of four different rations in which the cottonseed meal of the first (51% chopped maize stover, 28% cottonseed meal, 20% ground maize grain, and 1% salt) was substituted by 5, 10, and 15% ground "Matapasto" hay. Matapasto is a leguminous annual which abounds during the rainy season, but is not readily consumed by grazing animals while in the green form. The experimental hay was harvested at the end of the rainy season (May 1981), sun-dried, chopped, sacked, and stored until fed. The feeding trial was carried out during the final portion of the prolonged dry season of 1981-82. Six lambs were assigned to each ration; six equivalent animals were maintained under grazing in native "Caatinga" vegetation with no supplementation. After a 70-day feeding period, all 30 lambs were slaughtered and standard carcass measurements were recorded.

3. Maize crop residues in rations for weanling SRD wether goats.

Leaders: Nelson Barros, Ederlon Oliveira, W. L. Johnson, T. W. Robb

Location: CNPC, Sobral

Procedures: Eighteen wether SRD goats, average initial weight about 18 kg, were assigned to one of three rations for a period of 98 days. Each ration contained 51% chopped maize crop residue (either whole plant, husks, or cobs) with 28% cottonseed meal and 20% maize grain. In addition to these treatments, 6 goats of similar age and weight were maintained on native caatinga; 6 more were given chopped napier grass (*Pennisetum purpureum*) ad libitum along with a mixture of ground maize cob (15%), cottonseed meal (49%) and maize grain (35%) with daily intake restricted to 2% of liveweight; and 6 goats were slaughtered at the beginning of the experiment for baseline carcass information. After 98 days, all animals were slaughtered.

4. Effect of energy levels on weight and age of puberty of Morada Nova ewe lambs.

Leaders: Nelson Barros, Ederlon Oliveira, W. L. Johnson, Aurino Simplicio, Simon Riera, T. W. Robb

Location: CNPC, Sobral

Procedures: Twenty-four lambs averaging 140 days old and 12.4 kg live weight were randomly assigned to 8 pens. Two pens were then randomly assigned to each of four energy levels, consisting of 50, 200, 350, or 500 grams of ground maize grain per animal per day, along with 150 grams of cottonseed meal and ad libitum offering of a ground maize fodder (70%) and corncob (30%) mixture. Estrus was checked twice daily by exposure to a Santa Inez teaser ram, penile-diverted. At the second and subsequent estrus, lambs were bred to a Morada Nova ram. After confirmed pregnant, all lambs were maintained on the feeding regime which included 200 grams of corn grain per day, until parturition.

5. Observations on the intake of minerals by goats and sheep.

Leader: Nelson Barros

Location: CNPC, Sobral

Procedures: Sheep of three breeds (Somali, Morada Nova, and Santa Inez) were offered a mixture of iodized salt and bone meal (1:1) over a period of a year: average consumption of the same mixture by a herd of 39 SRD goats were similarly recorded.

In a third observation, 12 SRD does were divided into treatment groups of six each. One group received only iodized salt while the other received the salt/bone meal mixture; individual intakes were recorded.

## Experiments in Progress

1. Evaluation of post-harvest residues from maize, bean and cotton plants as feeds for small ruminants.

Leaders: E. Oliveira, Nelson Barros, T. W. Robb, W. L. Johnson

Location: CNPC, Sobral

Procedures: Sampling procedures were established in farmers' fields in three states of the Northeast (Ceara, Rio Grande do Norte, and Pernambuco) with assistance of extensionists in local EMATER agencies. A total of 260 samples of different parts of the plant were obtained and are presently being analyzed for crude protein, total cell-wall fiber, cellulose, hemicellulose, lignin, and in vitro digestibility.

Status: Laboratory analysis began in October 1981, and is almost complete. As the nutrition laboratory gradually becomes fully operational, and analytical capabilities expanded, this set of samples has high priority for analysis.

2. Digestibility of rations containing maize crop residues by Santa Inez sheep.

Leaders: Francisco de Assis Arruda, Antonio Alves, Nelson Barros, W. L. Johnson, T. W. Robb

Location: Federal University of Ceara, Fortaleza, and CNPC, Sobral

Procedures: A conventional digestibility trial (total fecal collection) was conducted with 12 Santa Inez wether lambs. Diets consisted of 60, 70, or 80% ground corn fodder; 23, 13, or 3% ground corn grain; and 17% cottonseed meal were fed ad libitum to four different lambs in each of two experimental periods.

Status: The digestibility and intake data for dry matter, crude protein, and crude fiber have been summarized and will be published as an MS thesis by Mr. Arruda. The samples will then be analyzed for total cell wall, cellulose, hemicellulose and lignin at the CNPC laboratory, and digestibility coefficients will be calculated for these fractions.

## Experiments Planned

1. Further testing of "matapasto" hay and initial testing of "cunha" (Clitoria ternata) hay as protein sources for lambs confined during the dry season.

Leaders: Ederlon Oliveira, Luis Vale, Nelson Barros, T. W. Robb, W. L. Johnson

Location: CNPC, Sobral

2. Further testing of maize residue rations for SRD kids confined during the dry season, with emphasis on determining optimum levels of maize residues and testing the efficacy of adding molasses.

Leaders: Nelson Barros, T. W. Robb, Ederlon Oliveira, W. L. Johnson

Location: CNPC, Sobral

3. Sorghum and buffel grass hays, with energy supplement at different levels, for lactating dairy goats.

Leaders: T. W. Robb, Nelson Barros, Aldomario Rodriguez, Wandrick Hauss, Helaine Burstein, W. L. Johnson

Location: Fazenda Pendencia (EMEP), Soledad, Paraiba

Procedures: A tested forage variety of sorghum (*S. vulgare*) was planted early in 1982 at the Pendencia station. Buffel grass (*Cenchrus ciliaris*) pastures are already well established at the station. Both forages will be harvested as hay and stored for the beginning of the experiment, which will coincide with the kidding season (July - August 1982). Does will be separated from their kids, milked twice daily, and daily milk yield will be recorded. Animals of two dairy breeds will be used in the experiment.

4. Baseline survey of mineral nutrition status of goats and sheep in Northeast Brazil (to be initiated in the latter part of 1982).

Leaders: Nelson Barros, Jerry Spears, T. W. Robb

Location: CNPC, Sobral

### Facilities Development

The major advancement for the 1981/82 period has been the activation of the nutrition analytic laboratory at the National Goat Center (CNPC), Sobral. The leadership of Dr. T. W. Robb has been instrumental in this achievement, along with the energetic support of the Adjunct Technical Chief of the CNPC, Dr. Ederlon Ribeiro de Oliveira.

When Dr. Robb arrived in Brazil in August 1981, he found a bare room, equipment in boxes, a partial stock of reagents, and a mountain of samples awaiting analysis. Six months later, the laboratory is operational for quantity determinations of dry matter, ash, neutral detergent fiber, acid detergent fiber, cellulose, lignin, and crude protein (by macro-kjeldahl). This has been no small feat, involving installation of equipment, rewiring electrical circuits, building shelves and cabinets, shopping for reagents and minor supplies, sending emergency orders to Raleigh for a missing chemical, testing procedures, establishing a laboratory routine, and training technicians.

The laboratory is open to all nutrition-related disciplines at the center and will eventually have capacity for any procedure that does not involve sophisticated equipment. In addition to supporting the research objectives of the CNPC and of the SR-CRSP, the lab is supporting a training objective. Van

Soest fiber procedures, Tilley-Terry in vitro digestibility procedures, and others will be taught to EMBRAPA personnel as well as visitors from state research agencies or universities.

A second advancement in facilities development was to expand the capacity for extensive feeding trials. A third unit of pens was added, and the store-room/workroom doubled in size. Electricity was brought to this unit, and animal weigh-scales were installed.

For the laboratory and feeding pen development, financial contributions were shared between the CNPC and the NCSU grant.

An objective for the present year (1982) is to build workable metabolism crates for controlled feed intake and fecal and urine collection. A prototype has already been constructed. Depending on the speed with which EMBRAPA implements the next phase of building construction, which is intended to include a metabolism unit, it may be necessary to build a temporary structure (concrete floor and roof) to shelter the metabolism crates.

### Travel

During the period of this report, the Principal Investigator travelled to Sobral three times: May 1981, August-September 1981, and February 1982. In addition to his activities in evaluation and planning, he participated in the First National Symposium on Tropical Sheep and Goats in Fortaleza, May 1981, as an invited plenary speaker; he assisted the External Evaluation Panel during their visit in August; he consulted with the Associate Program Director Dr. Bill Weir, and the new CNPC Chief, Dr. Luis Carlos Freire, on administrative matters in February; he travelled to Paraiba with Dr. Tom Robb and Nelson Barros in September to help initiate a new research project; and he presented an invited seminar at the CNPC in February.

Other project-supported travel was for the posting of Dr. T. W. Robb in Sobral for a two-year assignment at the National Goat Research Center.

### Training Activities

Mr. Francisco de Assis Arruda, CNPC scientist, was given material and advisory support for his MS thesis research at the Federal University of Ceara, Fortaleza. His published thesis is expected to be available shortly, and he will be reinstated into the research team at Sobral.

Preliminary plans have been made for a PhD program for Mr. Nelson Barros. Dr. Jerry Spears of the Department of Animal Science, NCSU, will travel to Brazil in July 1982 to assist Mr. Barros with further plans for his doctoral program.

A short course in small ruminant nutrition has been planned for July 1982. Invitees will come from State research agencies and universities. Three days of lectures and field visits will be followed by a five-day hands-on program in laboratory procedures for a selected smaller group.

## Language Study

Dr. Robb was supported for Portuguese classes over a six-week period in Raleigh before his travel to Brazil, and for an additional four months after arriving in Sobral. His proficiency has reached a high level.

Mr. Nelson Barros was supported for English tutoring during a three-month period in 1981. His proficiency has improved, but he will need more intensive study before passing the TOEFL.

Ms. Helaine Burstein, PhD candidate at NCSU, has begun a program of tutoring in Portuguese, in preparation for her travel to Brazil during the summer of 1982.

## Personnel

### Centro Nacional de Pesquisa em Caprinos - EMBRAPA (Sobral)

#### Project Leaders

Ederlon Ribeiro de Oliveira, Animal Nutrition  
Nelson Barros, Animal Nutrition  
Thomas W. Robb (NCSU), Animal Nutrition

#### Collaborators

Francisco de Assis Arruda<sup>a</sup>, Animal Management  
Aurino Alves Simplicio, Reproduction  
Simon Riera Guzman, Reproduction  
Luis Vale, Forage Production

### Universidade Federal de Ceara (Fortaleza)

#### Collaborator

Antonio Alves, Animal Science

### EMEPA (Fazenda Pendencia, Paraiba)

#### Collaborators

Paulo Roberto de Miranda Leite, Technical Chief, EMEPA  
Aldomario Rodriguez, Animal Management  
Wandrick Hauss, Nutrition  
Aylton Azevedo, Sorghum Production  
Roberto Agra, Sorghum Production

<sup>a</sup>Graduate Student at Universidade Federal de Ceara, Fortaleza.

North Carolina State University (Raleigh)

Project Leaders

William L. Johnson, Animal Nutrition (Principal Investigator)  
Lemuel Goode, Animal Science  
Jerry Spears, Animal Nutrition

Collaborators

Sharon Rowe, Animal Science (Technician)  
Lynn E. Brown<sup>b</sup>, Animal Nutrition  
Helaine Burstein<sup>b</sup>, Animal Nutrition  
J. D. Pettyjohn, Animal Nutrition (Technician)

Student Assistants: Rex Gaskins, Jerry Phelps, Maury Todd, Karen Whitlow.

9. Technical Accomplishments

The data from several completed experiments, taken together, allow for some general conclusions about dry season feeding options for growing lambs and kids.

1. Maize crop residues can be used successfully for lambs, at levels of up to about 50% of dry matter when the remainder of the ration provides a readily available energy source and a protein source. Average daily gains of 100 grams or more can be expected.
2. For SRD kids, intake and performance on similar rations is much lower. Further tests are needed in order to devise ways to utilize maize crop residues for growing goats.
3. Morada Nova ewe lambs reach puberty at approximately 20 kg body weight. The age at which puberty is reached can be altered by adjusting the level of daily energy intake during the growth period from 10 to 20 kg. There is some indication, however, that accelerating puberty to occur before 300 days of age may lead to unacceptable reproductive problems.

Some further details of completed experiments are given below. The reader should refer to the list of publications for more complete reports of these experiments.

Digestibility of rations containing maize residues. Following is a summary of data provided by Francisco de Assis Arruda from his MS thesis (unpublished, Federal University of Ceara), with Santa Inez wether sheep at ad libitum intake.

<sup>b</sup>Graduate Students at North Carolina State University, Raleigh.

	Ration 1	Ration 2	Ration 3
<b>Ingredients (%)</b>			
Ground maize fodder	60	70	80
Ground maize grain	23	13	3
Cottonseed meal	17	17	17
<b>Intake</b>			
% of live weight	2.9±.3	3.0±.2	2.9±.2
g/BW <sub>kg</sub> <sup>.75</sup>	72±6	73±4	71±1
<b>Digestibility (%)</b>			
Dry matter	59±4	56±6	53±5
Crude fiber	61±5	56±6	54±4

Voluntary intake of these rations did not decline as fiber level increased. However, there was a trend toward lower digestibility, which if extrapolated to 100% maize fodder, would indicate 47 ± 5% digestibility for dry matter and 45 ± 5% digestibility of crude fiber. It is interesting to note that the non-crude-fiber portion of total dry matter in these rations would be almost identical to the crude fiber in its digestibility, once again demonstrating the futility of trying to use crude fiber as an index of indigestibility.

Relative acceptability of maize crop residues and napier grass by SRD kids. Eighteen goats weighing 9.9 ± 2.0 kg were offered all possible pairs of four chopped fodders: napier grass green chop, maize husks, maize stover and maize cobs. Voluntary intakes of dry matter were as follows (g/BW<sub>kg</sub><sup>.75</sup>/day):

Napier + maize husks	62
Napier + maize stover	57
Napier + maize cobs	49
Husks + stover	42
Husks + cobs	34
Stover + cobs	32

These abysmally low intakes could possibly be improved by protein supplementation, molasses addition, or longer experimental periods (adaptation).

Examining the intake of each ingredient when paired with each other ingredient, the relative palatability of each material was napier grass (36 g/BW<sub>kg</sub><sup>.75</sup>/day), stover (24), husks (20), and cobs (12). These levels of intake might be improved in blended complete rations.

"Matapasto" (Cassia sericea) hay in rations for lambs. Twenty-four Morada Nova lambs 6 to 7 months old and weighing an average of 20.0 kg were individually housed and fed four different rations in which the cottonseed meal of the first (51% ground corn fodder, 28% cottonseed meal, 20% ground corn grain and 1% plain salt) was partially substituted by 5, 10, and 15% of ground "Matapasto" (an annual legume). This trial was carried out during the final months of the dry season; six lambs of equivalent age and weight were maintained under grazing for comparison. The feeding period lasted 70 days, after which all 30 lambs were slaughtered. After 70 days, the animals on pasture had lost 11 g/day while the animals on treatments 1 to 4 gained 95,

106, 103, and 93 g/day, respectively; the confined group means were significantly different ( $P < .05$ ) from the pasture group. Feed consumption did not differ for the four groups in confinement, being 90, 90, 95, and 94 g/kg  $W^{.75}$  for treatments 1 to 4, respectively. Feed conversion also did not differ among the four groups and was 10.6, 9.6, 9.9, and 11.0 for groups 1 to 4, respectively. Mean carcass yield was 46.5% for all treatments and did not vary significantly among the five groups; however, the animals kept on pasture were generally inferior to the confined groups in all other carcass parameters considered.

SRD kids on maize residue rations. Rations which had given average gains of  $143 \pm 31$  grams per day in Santa Inez wether lambs (see 1980/81 Annual Report) were repeated with SRD wether kids, initial weight 18 kg. Results were as follows (six kids per treatment group).

Ration	Average daily gain	Daily dry matter intake	Carcass yield
	g	g/ $W_{kg}^{.75}$	%
51% maize fodder <sup>a</sup>	37	56	43
51% maize husk <sup>a</sup>	39	62	46
51% maize cobs <sup>a</sup>	19	48	41
Napier grass, cobs <sup>b</sup>	38	52	44
Native caatinga <sup>c</sup>	-25		41
Reference group <sup>d</sup>			39

<sup>a</sup> Plus 28% cottonseed meal and 20% maize grain.

<sup>b</sup> Napier grass *ad libitum* plus cobs 15%, cottonseed meal 49% and maize grain 35%, restricted to 2% of liveweight per day.

<sup>c</sup> Maintained on pasture.

<sup>d</sup> Slaughtered at beginning of experiment.

The low rate of gain for these animals indicates that the level of crop residue was too high, or that some other feeding strategy would be more appropriate. Further work on this problem is indicated.

Energy supplementation effect on age and weight at puberty, Morado Nova ewe lambs. Twenty-four lambs averaging 140 days old and 12.4 kg liveweight were randomly assigned to 8 pens; 2 pens were randomly assigned to each of 4 energy levels (table). All pens were offered 150 g/animal/day of cottonseed meal, plus free choice ground corn fodder (70%) and corncob (30%) mixture. As energy intake increased, age at first estrus generally declined ( $P > .05$ ) while weight at first estrus was relatively constant (table), implying the ewe lambs of this breed reach puberty when over 278 days of age and 20 kg weight. After confirmed pregnant, all lambs were fed diet 2 until parturition; during this phase one animal died in each of groups 3 and 4; also 2, 2, 1 and 2 ewes aborted in groups 1 to 4, respectively. Live births per ewe exposed decreased as energy intake increased; 5, 4, 4, and 3 lambs were born to groups 1 to 4 respectively. Further research on energy intake and its effect on lifetime reproductive performance is recommended for the breeds and feeding conditions of Northeast Brazil.

Treatment group	1	2	3	4
Ground corn/animal/day, g	50	200	350	500
Age at first estrus, days $\pm$ SE	326 $\pm$ 32	290 $\pm$ 16	305 $\pm$ 15	278 $\pm$ 16
Weight at first estrus, kg $\pm$ SE	19.6 $\pm$ 1.2	20.2 $\pm$ 1.2	21.6 $\pm$ 1.1	20.9 $\pm$ 1.3

Mineral utilization by sheep and goats . Field observations of mineral intake showed a much higher consumption by sheep than by goats. When a 1:1 mixture of iodized salt and bone meal was offered ad libitum, average daily intakes per animal were 32 grams for Somali sheep, 24 grams for either Morada Nova or Santa Ines sheep, but only 5 grams for SRD goats. These observations were made over periods of 13 months. No explanation is immediately available for these differences, but they may be linked to fundamental differences in rumen turnover rates or whole body water conservation.

A preliminary observation of the effect of bone meal supplement was made with 12 SRD doe kids, six of which received only iodized salt and six of which received a 1:1 mixture of iodized salt with bone meal, as supplement to native caatinga grazing. Mineral intakes averaged 6 grams per animal per day for both groups. Weight gains were lower for the group receiving bone meal; whether or not this was due to the bone meal cannot be determined. Both groups reached puberty at an average of 14 kg, but at 207  $\pm$  6 days of age for the salt-only group and at 252  $\pm$  13 days of age for the bone meal group.

Annual Report for 1981/82

1. Project Title: Improving Female Reproduction Performance of Small Ruminants in Least Developed Countries
2. Institution: Utah State University
3. Principal Investigator: Warren C. Foote
4. Funds allocated from:  

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$134,000
Matching Contribution from 1981/82 Subgrant:	\$61,875
5. Statement of Project Goals
  - A. To measure reproduction capabilities of the major genotypes of small ruminants and mechanisms of control of selected reproduction processes.
  - B. To determine the influence of environment, including climatic factors, and nutrition and other management factors on reproduction in selected genotypes of small ruminants and to develop alternative management programs to increase production.
  - C. To cooperate with other SR-CRSP components in reproduction-related programs.
  - D. To provide graduate and non-degree training programs to selected foreign collaborators and other program related personnel.
6. Summary of Accomplishments in Previous Years  

Refer to 1980/81 Annual Report
7. Description of Work Undertaken
  - A. Research Results

Reproduction capabilities of selected genotypes of goats in northeast Brazil (dissertation research for Aurino Simplicio's PhD program)

In this study, 108 does of the SRD, Marota, and Moxoto genotypes were allotted to nutrition/management treatments of natural pasture (no supplementation) or confined (supplemented). Does are not bred. Body weights are being recorded during the year. The incidence of estrus and ovulation and ovulation rate during the year are being measured using teaser bucks to check estrus and laparotomy/laparoscopy to observe the ovaries. This study will be completed in late Summer 1982 as a part of the requirements for Aurino Simplicio's PhD degree at Utah State University. A full analyses of all data related to the project will be completed including hormone

analyses to measure LH and progesterone profiles during different reproductive phases. Preliminary information on body weights, feed consumption (of confined does), estrus response and ovulation response are summarized in information available at Utah State. During much of the first year, the poor quality feed available to the confined does minimized their response to this treatment. It appears that under the improved nutrition conditions available, the combined goats did not respond more favorably than those kept on native pasture for any of the parameters summarized to date. It appears that there is a greater incidence of estrus during February-May than other periods of the year, particularly for does on native pasture. The months of August and September appear to be the months of lowest incidence of estrus. The SRD goats consistently had the greatest ovulation response of the three genotypes compared (SRD, Moxoto and Marota). This was true for percent of does ovulating and ovulation rate based on does ovulating and also on total does observed.

Reproduction and production performance of goats subjected to selected management practices at the producer level (cooperative with goat producers in Northeast Brazil)

This study is being conducted in six counties in Northeast Brazil with 2-4 flocks per county and a total of 20 flocks, involving 2,770 females and 737 males. One herd in each county serves as a control and is managed traditionally. Management in the other flocks are altered to include one improved management practice. An additional flock in two counties are altered to include all management practices. The improved management practices are (1) weaning, (2) culling of breeding does, (3) establishment of a limited breeding season, (4) selection of sires and exchange among producers, (5) disinfection of the navel with iodine. Control flocks received mineral supplementation and internal parasite control. In addition, color of animals and assumed genetic characteristics of supernumerary teats and hornlessness (polled) were recorded. Data obtained to date on pelt color, genetic defects and distribution of birth of kids during the first few months of the study is available upon request. The incidence of assumed genetic defects is variable among the producer flocks and high in several. Information also indicates the county (municipality), farm, practice, and number of goats involved. The study was initiated in the late spring, 1982.

This cooperative work with producers will not only provide essential baseline information for later use in the program, but is also expected to establish a working relationship with the producers which will provide for expanded cooperation in obtaining additional data and application of results.

The results of this study will be used by Jose Ubiraci for his MS degree.

The influence of feed supplementation during late pregnancy and early lactation on reproduction and production performance of producer owned Native (SRD) goats in Northeast Brazil

This project is underway and data are being collected according to the experimental design.

### Reproduction related data from the breed evaluation project with goats and hair sheep

We are assisting in the collection and analysis of data from the breed evaluation project which is an ongoing project.

The data provides information on parameters related to puberty in the available breeds of goats and hair sheep. The numbers are very small in some cases, but provide first estimates upon which subsequent data will be added.

These data indicate differences in breeds in age and weight at puberty and demonstrate that age at puberty may be a limiting factor in improving reproductive performance. This information also indicates that both sheep and goats experience ovulation without estrus before the occurrence of puberal estrus and ovulation.

### Demonstration of the use of pregnancy diagnosis in sheep and goats with ultrasound equipment

Ultrasound, as a principle for diagnosing pregnancy, has been promoted for several years and found to be a valid method under many conditions. A study was conducted at Sobral to measure and demonstrate its usefulness under local conditions. The results are summarized as follows.

Two hundred and three does and one hundred and three ewes submitted to breeding season from October 1 to November 19 in 1980, were used for an experiment to test efficiency of ultrasonic method in diagnosing pregnancy. The results are presented according to species and breeds of dams and also according to the age of fetus, when the diagnosis was carried out. In goats, when the mean age of the fetus was 109.5 days, the diagnosis was accurate in 93.10 percent cases; 84.27 percent in case of pregnant and 100.00 percent in case of non-pregnant does. In ewes, at 92.2 days mean age of fetus, overall accuracy was 91.95 percent; 100 percent in case of pregnant and 50.09 percent in case of non-pregnant ewes. Thus, in goats, the rate of accuracy was more in pregnant females, whereas in sheep it was more in non-pregnant females. The minimum age of fetus at which pregnancy diagnosis was possible was 53 days in ewes and 86 days in does.

#### B. Shortcourses

A second shortcourse on reproduction as a follow-up to the first shortcourse, which was held in the fall of 1980, will be held in the fall of 1982. This will be conducted primarily for extension workers to aid them in working with producers. It will be taught by personnel at EMBRAPA/CNPC, CSPU and USU.

#### C. Facilities Improvement, Equipment and Technology.

Goat facilities constructed during the first year for research with female reproduction have been further improved and major remodeling has been completed on the reproduction laboratory. Major equipment provided during the year includes a pickup for field work and a laparoscope to facilitate data collection on ovarian activity. Training has been provided on laparotomy and laparoscopy and on general research procedures.

D. Radioimmunoassay Laboratory.

The plans for an RIA laboratory at Bello Horizonte have not been realized because of their failure to complete an agreement among USU, EMBRAPA/CNPC and the University of Bello Horizonte. Plans are now underway to establish the laboratory at EMBRAPA/CNPC, Sobral.

E. Graduate Training Programs.

1. Aurino Simplicio is taking three months intensive English training provided by EMBRAPA and will come to USU to begin his formal PhD program in the summer of 1982. Research for his degree is being conducted in Brazil.
2. Jose Ubiraci plans to undertake a MS program at Utah State when the major portion of the research with producers is completed. Both Simplicio and Ubiraci have received English training at the center under the program arranged by the SR-CRSP.

Annual Report for 1981/82

1. Project Title: Improving Reproductive Capability of Small Ruminants in LDCs with Emphasis on Male Reproductive Physiology
2. Institution: California State Polytechnic University, Pomona
3. Principal Investigator: Edward A. Nelson
4. Funds allocated from:
  - Grant No. AID/DSAN/XII-G-0049 from 1980/81 Subgrant: \$97,761
  - Matching Contributions from 1981/82 Subgrant: \$65,365
5. Statement of Project Goals
  - A. To develop methods to improve the capability of collecting, processing, storing, and transporting viable sheep and goat semen to selected Developing Country locations.
  - B. To measure the reproductive potential of selected small ruminant male genotypes in the United States and Brazil. To coordinate the relative problems in developing countries.
  - C. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.
  - D. To provide the opportunity for qualified scientists and technicians to continue formal education and obtain special training in reproductive physiology and management of small ruminants.
6. Summary of Accomplishments in Previous Years

Summary of accomplishments to March 1981 are reported in previous annual reports.
7. Statement of Specific Objectives for 1981/82
  - A. To conduct a two-year study on measuring the reproductive characteristics of Somali rams.
  - B. To participate in the development of additional laboratory facilities or equipment for reproductive physiology work as needed.
  - C. To participate in a cooperative owner based management study as it addresses male reproductive problems.
  - D. To assist in developing and conducting a short course on reproduction.
  - E. To measure the characteristics relating to sexual development and aging of three breeds of sheep and three breeds of goats.

- F. To continue to develop techniques and procedures for extended time storage of goat and sheep semen.

## 8. Description of Work Undertaken:

Objective A has been satisfied by the study on the Somali rams being completed and a paper written, submitted, and accepted by the Journal of Reproduction and Fertility, Cambridge. Title: "Seasonal variation in semen and testicular characteristics of Brazilian Somali rams in the hot semi-arid climate of tropical Northeast Brazil." Authors are: A.A. Simplicio, G.S. Riera, E.A. Nelson, and K.P. Pant. (Note that the primary authors are reproduction counterpart scientists in Brazil.)

Objective B has been satisfied in the following manner. Reproduction project money has been used to modify the laboratory structures. Equipment in addition to that reported in the last annual report has been purchased and sent to CNPC Sobral, including a phase contrast microscope, pH meter, and water bath.

Objective C has been partially completed in the following ways. A producer study has been initiated involving five practices imposed in various combinations on 20 producer flocks. Data from this study are not yet available.

Objective D is being satisfied by the preparation of materials for a short course to be presented in October 1982. This course will be primarily for extension type personnel.

Objective E has been satisfied by conducting a puberty study on male goats which was initiated in Brazil during this project year. Eighteen males of the Moxoto breed born between 2/27/81 and 3/17/81, both twin and single births, were measured in the following ways: weight, separation of the penis from the sheath, first ejaculate (using the artificial vagina), volume and circumference of scrotum. This experiment showed that penis separation occurred approximately 8 days before first ejaculate and that the first ejaculate occurred at approximately 131 and 151 days, respectively, for single and twin produced kids.

## 9. Technical Accomplishments

Procedures for collecting processing semen have been established. Male goats at Cal Poly have been tested and certified free of disease, and semen has been processed for shipment overseas.

### Support Personnel

Aurino A. Simplicio, EMBRAPA  
G. Simon Riera, EMBRAPA/IICA  
Jose Ferreira Nunes, EMBRAPA  
Jose Ubiraci, EMBRAPA

Technicians are supporting this project at each location.

Annual Report for 1981/82

1. Project Title: Small Ruminant Flock/Herd Health Program in Smallholder Systems
2. Institution: University of California, Davis
3. Principal Investigator: Blaine McGowan
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$175,000  
Matching Contribution from 1981/82 Subgrant: \$59,827

5. Statement of Project Goals
  - A. To increase for human use the off-take of meat, milk, and hides from sheep and goats reared by smallholders in the northeastern section of Brazil by:
    1. Identifying the major animal health constraints to rearing sheep and goats.
    2. Adapting known control and prevention techniques to these constraints or developing new techniques where necessary.
    3. Developing herd health programs encompassing prevention and control techniques for the major disease constraints which will be useable, economically feasible, and acceptable to the animal owners.
  - B. To train Brazilian professionals and para-professionals in the animal health field in improved methods of diagnosis, control, and prevention of sheep and goat diseases.
  - C. To adapt and integrate herd health programs so that they constitute a positive supporting and additive role to the overall Small Ruminant CRSP (particularly collaboration with the projects on nutrition, management, and animal breeding).
  - D. To utilize the herd health project for graduate training of US professionals
  - E. To develop simple, inexpensive, and effective diagnostic techniques for sheep and goat diseases.
  - F. To develop a model systems approach for assessing health problems in a flock or herd.
  - G. To study inherited disease resistance.

## 6. Summary of Accomplishments in Previous Years

Equipment necessary for operating the pathology, microbiology, and clinical pathology laboratory was ordered and put into use during the last year. Dr. Don Hansen was hired with the specific intent of developing a survey and surveillance program in order to identify the more important diseases of small ruminants in northeastern Brazil.

An increased awareness of major diseases leading to economic losses in goats has come about since this program was initiated at Davis. Survey and surveillance programs have been established on a number of large and small goat operations in the Davis area. Clinicians, microbiologists, pathologists, parasitologists, theriogenologists, and clinical pathologists have developed programs to identify various causes of diseases of goats as well as study basic biological processes.

## 7. Statement of Specific Objectives for 1981/82

- A. To evaluate the seasonal variation of helminths and to determine if there are breed differences to resistance to gastrointestinal parasites.
- B. To determine the cause or causes of reproductive failure in sheep and goats.
- C. To identify the cause or causes of neonatal disease and death losses.

## 8. Description of Work Undertaken

Dr. Don Hansen continues to develop approaches necessary for obtaining meaningful animal health survey and surveillance activities in Brazil.

A microbiological diagnostic laboratory has been equipped and a technician hired to begin culturing tissues for bacteria. Dr. Hansen is overseeing the operation of this laboratory.

Equipment has been purchased for the clinical pathology laboratory at Sobral.

New and more highly refined diagnostic technology is being developed by faculty at Davis with the intent to transfer the technology to Sobral. These tests will be used in identifying diseases and studying disease processes.

The search continues for other causes of abortion in sheep and goats by Drs. Brooks, East, Olander, and Osburn.

Drs. Brooks and East are evaluating alternative vaccines and antibiotics for use in goats against various infectious agents.

## 9. Technical Accomplishments

### Brazil

Disease surveillance programs were established on 22 fazendas which included over 5,000 animals. The procedures for identifying, collecting, and analyzing the loss in off-take of meat, milk, and hides was established. Results of these studies indicated that the major production constraints are abortions 18-30%, and newborn deaths up to 4 months of age account for an additional 27%. These losses are four-fold greater than those observed in developed countries of the world. Prevalence rates for parasitism are 80%, pneumonias 3%, toxic plants 15%, and abscesses 5%.

A survey of over 5,000 serum samples from sheep and goats for brucellosis indicated that the incidence is approximately 0.2%. An effective control program of test and slaughter was implemented on the serologically positive animals. The conclusion from this study indicates that the organisms causing brucellosis are not of economic significance in sheep and goats in northeastern Brazil.

A new vaccine for caseous lymphadenitis developed at Salvadore is being tested for safety and efficacy.

### California

A survey of diseases of dairy goats was undertaken on selected dairies in California. The major causes of losses were abortions, stillbirths, death of newborn kids, and mastitis. The means of identifying the causes of losses was obtained through laboratory diagnostics including microbiology, serology, fluorescent antibody tests, animal inoculations, and histopathology. Abortions, stillbirths, and neonatal deaths were caused by toxoplasma, chlamydia and mycoplasma infections with secondary infections of streptococcus, staphylococcus, pasteurilla, and coccidial invaders.

In-depth studies on mycoplasma infections revealed that Mycoplasma mycoides subsp. mycoides (large colony type) is an important cause of newborn infection and death. Further, it was demonstrated that the principal means of transmission is through colostrum and milk to the newborn. This organism causes pleuropneumonia, polyarthritis and mastitis. Control measures which were developed consisted of identifying and withholding infected milk and colostrum and substituting non-infected colostrum and milk for the newborn. A treatment regime for infected kids was evaluated.

Another cause of mastitis in goats was identified. The organism was characterized as Mycoplasma putrefaciens.

Epidemiologic studies for bluetongue virus infection in sheep and goats indicates that 53% of the sheep and 32% of the goats have been exposed to virus. The most important causes of infection are serotype 11 in both species followed by serotype 17.

Improved diagnostic technology is underway for culturing and identifying mycoplasmas and bluetongue virus. The enzyme-linked immunosorbent assay (ELISA) system has been developed for bluetongue, pili on Bacillus nodosus, corynebacterium, and progesterane.

Treatment and control measures are being adapted for goats for vibriotic, chlamydial and bluetongue infections. Vaccines for each of these organisms have been tested for safety and efficacy. Antibiotic control and treatment for chlamydial infections has been accomplished. An effective management control measure for toxoplasmosis infections has been effected.

Persistence of border disease virus in sheep is being characterized as it relates to infected cells and the effects on the immune system. Diagnostic tests are also being developed.

## Annual Project Report for 1981/82

1. Project Title: Intensive Management of Dairy Goats
2. Institution: Tuskegee Institute
3. Principal Investigator: Nancy M. Stott
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$115,000
Matching Contributions from 1981/82 Subgrant:	\$38,395
5. Statement of Project Goals
  - A. To study the effects of management regimes on milk production, growth, and reproduction in goats.
  - B. To evaluate management systems for raising young kids for meat production.
6. Description of Work Undertaken
  - A. Approval of revised work plan by EMBRAPA in Brasilia and at CNPC, Sobral.
  - B. Visits to Quixada and Fazenda Pendencia during which plans were made for involvement of Tuskegee Institute in research efforts at these stations.
  - C. Plans were formulated and arrangements made to begin research efforts at Fazenda Pendencia.
  - D. A full-time, professional scientist was employed by Tuskegee Institute to carry out the research objectives in Brazil.
  - E. Commitment was made by Ederlon Oliveira for the assignment of a Brazilian counterpart to be involved in Tuskegee Institute management project.
  - F. Carlos Zometa travelled to Brazil and initiated research efforts.
  - G. Continuation of improvement of the facilities for conducting research with goats.
  - H. Renovation and construction of pasture and housing facilities for the Tuskegee Institute breeding herd.

### Travel Activities

Visit to Sobral, Quixada and Fazenda Pendencia by Principal Investigator, June 5 - July 1, 1981.

Attendance at III International Conference on Goat Production and Disease, Tucson, Arizona, by Principal Investigator, Carlos Zometa, and six graduate students from Tuskegee Institute.

Travel to Sobral by Principal Investigator and Carlos Zometa, May 1982.

## Annual Report for 1981/82

1. Project Title: Sociological Analysis of Small Ruminant Production Systems
2. Institution: University of Missouri - Columbia
3. Principal Investigator: Michael F. Nolan
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$76,721

5. Statement of Project Goals

The principal goal of the SR-CRSP Sociology component is to develop an understanding of the social and cultural context in which small ruminant production occurs. This will be necessary in order to evaluate specific technological interventions in relation to their social soundness and their likelihood of acceptance by the population at large.

Among the issues that the project will address are the social organization of livestock production, particularly vis a vis crop production, institutional constraints on production including credit, markets, and extension services, and the values and attitudes of the population toward the adoption of new technology.

6. Summary of Accomplishments in Previous Years

The Sociology Project initiated its major activity in Brazil in 1981/82. Prior to this time, our efforts consisted of collecting and reviewing literature related to animal production in northeast Brazil and identifying a student for graduate training. Actual on-site research began September 1981.

7. Statement of Specific Objectives for 1981/82

- A. Initiate a study of the relationship between land tenure, animals, crops, and climate. The initial effort will be descriptive and form the basis for choosing more specific topics to follow.
- B. Continue the MS training program of Ms. M. Neumaier that began in June 1981. Ms. Neumaier will begin her thesis data collection in Brazil during the summer of 1982.

8. Description of Work Undertaken

Dr. George Primov of the Sociology Project spent September 1981 - February 1982 in Brazil where he conducted our first baseline data collection effort. His primary activities involved taking intensive field observations of goat production in the northeast, specifically in the state of Ceara. In addition, he conducted in-depth interviews with the farmers used in the Economics Project sample. Interviews focused on the social organization of sheep

and goat production and supplemented the economics data which had already been collected. Dr. Primov will return to Brazil in July 1982 for three months, which will allow for the collection of some additional follow-up data.

Ms. Marisa Neumaier, our Brazilian trainee, has nearly completed the coursework for her MS degree and will be traveling to Brazil in July 1982 to undertake her fieldwork for her MS thesis. It is anticipated that this project will be conducted at Fazenda Pendencia in the state of Paraiba and will focus on dairy goat producers in that region. Ms. Neumaier has already completed a proposal for her research which is in the hands of EMBRAPA.

## 9. Technical Accomplishments

Dr. Primov has prepared a 60-plus page report based on his six months of fieldwork in 1981/82. The following points represent a brief summary of some of the major conclusions of that report.

- A. The poorest sector of the rural population, who are principally landless producers, raise few animals and do not have the opportunities to increase their livestock production.
- B. The smallest stratum of landowners, 25 ha or less, does produce animals, but individual herd sizes are very small and their composition is rather stable (very few cows and fifteen to thirty sheep).
- C. Those landowners owning 25 ha or less, avoid goat production because these animals require either constant supervision or fencing. However, they are quite aware that goats survive droughts better than sheep.
- D. The relative importance of small ruminants within the total production strategy of small and medium sized farmers, tends to vary considerably between dry and wet years. During dry years, small ruminant production is much more important, with the animal serving as both a subsistence and cash crop. During wet years, cotton and cattle are seen as much more profitable, and small ruminants are thus more expendable.
- E. The sample regards the lack of pasture, forage, and water as the main problems facing livestock production and the main constraints on increasing their production. As the animals are not seen as problematic, there is little perceived need to invest time or energy in more sophisticated production techniques.
- F. The only perceived need in relation to the animals is the desire to improve their genetic characteristics. This desire is expressed in the need for "stronger" animals, particularly in relation to sheep.
- G. It appears that the demand for small ruminants is much greater than the supply. Thus, producers are confident that they can market whatever animals they produce. Therefore, little incentive exists to upgrade animals for marketing purposes.
- I. Marketing small ruminants is largely determined by the financial needs of the household rather than external market conditions. Increases in price and/or demand are unlikely to stimulate increased production.

Producers, particularly the smaller landowners, cannot increase production without sacrificing the flexibility they need in order to cope with alternating dry and wet years.

- J. Small ruminant production does not seem to be associated with status enhancing functions. The animals are regarded much more as capital.
- K. Farmers operate their land on a very individual basis. There are no significant mechanisms for exchanging or sharing labor, land, or capital.
- L. Non-household labor is almost fully monetized (that is, paid in currency). Therefore, there is a significant increase in cost for any labor demands beyond those supplied by the household.
- M. Lack of adequate fencing, both perimeter and internal, and available water sources, either wells or dams, are regarded as the principal constraints on production within the farm.

Although in most cases the smallest landowners have a few animals, their worries exceed concern over their sheep or goats. Any recommendations we give them cannot contain any increases in inputs, not even marginal ones. For the "poorest of the poor" we can do little because they are landless and the terms of their various forms of tenancy usually do not include the possibility of having more than a handful of animals, usually destined solely for household consumption. Thus, it would seem that we are faced with the distinct possibility that the only individuals we might be able to help are the land-owning peasants who have at least some resources which can be developed.

Annual Report for 1981/82

1. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Brazil
2. Institution: Winrock International Livestock Research and Training Center
3. Principal Investigator: A. John DeBoer
4. Funds allocated from:  

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$200,000
Matching Contribution from 1981/82 Subgrant:	\$78,310
5. Statement of Project Goals
  - A. Provide a well trained group of professional agricultural economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multidisciplinary research on small ruminants and their producers.
  - B. Provide an improved data base for guiding research and providing policy guidelines for improving small ruminant productivity and farmer incomes.
  - C. Strengthen the overall research capacity of selected host country research institutions by providing leadership in conducting interdisciplinary research, conducting training programs, and publishing research results.
  - D. Publication and dissemination of research results representing a wide variety of research and which will contribute to a better understanding within the scientific community of small ruminants and their place in selected rural economies of developing countries.
6. Summary of Accomplishments in Previous Years
  - A. Nestor Gutierrez was resident in Brazil for 19 months, carried out baseline survey and started long-term monitoring survey in collaboration with other disciplines.
  - B. Two MS students at Federal University of Ceara were chosen to carry out thesis research topics related to small ruminants in NE Brazil.
  - C. Baseline data analyzed and published in three separate papers.
  - D. Computer software development, Federal University of Ceara.

7. Statement of Specific Objectives for 1981/82
  - A. Generate basic bioeconomic data to serve multidisciplinary teams at EMBRAPA/CNPC.
  - B. Improve local research capacity through MS thesis advice and support.
  - C. Complete first year monitoring survey and analyze data for model construction.
  - D. Construct formal bioeconomic simulation model for economic analysis of property development and technology adoption options.
  
8. Description of Work Undertaken
  - A. Periodical Survey of 32 farms in Ceara State: Questionnaire Construction, June 1981
    - 1st round. August-September 1980
    - 2nd round. December-January 1980/81
    - 3rd round. April-May 1981
    - 4th round. August 1981
    - 5th round. December-January 1981/82

Data coding, card punching and storage on tape completed for first 4 rounds in September 1981.
  - B. Marketing and price formation for sheep, goats and their products in Ceara State. Two MS theses completed in 1981/82. The research involved collection of primary and secondary data and computer analysis at the Federal University of Ceara using the software packages provided by the project.
  - C. Baseline Survey: Data analysis of 127 farms completed and published.
  - D. Farm Modelling: The results of baseline and periodical surveys have been used to begin construction of various typical mixed farming situations. A combination simulation-linear programming model is being developed to analyze investment-technology combinations.
  - E. International Travel
    - John De Boer to Brazil, August 1981.
    - Nestor Gutierrez and family return to USA, October 1981.
    - Nestor Gutierrez to Brazil, November - December 1981.
  - F. Personnel
    - Abel Ponce de Leon, EMBRAPA/CNPC-IICA
    - Janete Santa Rose, EMBRAPA/CNPC
    - Mario Amin, Federal University of Ceara
    - Jose Ubiraci, EMBRAPA/CNPC

## Trainees

Odorico de Moraes, Federal University of Ceara  
Valderi Vieira da Silva, UEPAE/Federal University of Ceara  
Fatima Moura Fe, Federal University of Ceara  
Jose de Souza Neto, Federal University of Ceara

## 9. Technical Accomplishments

### A. Baseline Survey Results

The 1976 crop/livestock Census of Ceara State indicated that 7 of the 22 micro regions in Ceara contained over 50 percent of the sheep and goats. Within each of the 5 micro regions selected, two counties were selected. An average of 15 questionnaires were filled out per county. One county was subsequently discarded. The general pattern was mixed crop-livestock farms with large populations of cattle. Table 1 gives the distribution of agricultural activities by the surveyed farmers. Seven groups of small ruminant owners were distinguished: landowners, manager-sharecroppers, sharecroppers, land settlement scheme farmers (parceiros), cash renters, communal owners, and employees or permanent workers. In general, landowners (64 percent of the small ruminant owners sampled) have large holdings which are jointly utilized by themselves, sharecroppers and permanent or temporary wage laborers. Average size of goat herds was 116 head, and for sheep flocks, 142 head. Most specialization occurred in sheep (39%) rather than goats (3%). Fifty-eight percent had both species (Table 2). Levels of management varied, but most producers had corrals, full-time herdsman, used studs, and castrated. Controlled breeding was rare, however.

The baseline data was then used to delineate farms into large and small categories based on median farm size within the county sample. The 62 farms in the small grouping had an average of 172 ha, the 65 large farms averaged 1165 ha, while the sample mean was 680 ha. Linear regression was used to test hypotheses about land-livestock relationships. The major factors hypothesized as influencing total animal units (A.U.) per farm were farm size, total man equivalents of labor available per farm, and percentage of farm perimeter area fenced. The first two variables were highly significant, but total variation in A.U.'s explained by the equation was small.

B. Periodical Survey - Two studies have been completed. The first examined capital structure and income generation on the 33 sample farms while the second defined general marketing practices and utilization of small ruminants.

Capital Structure - Analysis concentrated on capital assets, income generation, variable costs, and income/capital ratios between the small farm/large farm groupings. Results were much different between large-small groupings depending upon whether herd/flock size or farm size was used as the delimiter. Small herd/flock holders realized 40 percent of their net farm income from small ruminants while large herd/flock owners had only 19 percent of net income from small ruminants and 50 percent from cattle. Conversely, small landholders

had 71 percent of their net income from cattle and 10 percent from small ruminants while large landholders had income almost equally divided between cattle, small ruminants and crops (Tables 3 and 4). Overall, there was good correspondence between levels of capital invested in cattle, expenses on cattle, and income derived from cattle. This did not hold for small ruminants, however, reflecting their subsistence orientation as a ready source of food and a species on which very low levels of capital investments or current inputs are used. The ratio of income generated to capital invested is thus very favorable for small ruminants in this region.

### C. Marketing and Price Formation

Analytical results from the two MS theses completed in this area are currently being summarized and will be reported in detail next year. This request covers only general marketing practices in Ceara State.

Sheep and goats are disposed of through home consumption and commercial sales. Commercial sales are composed of surplus males (1-1 $\frac{1}{2}$  years old), cull females, and cull male breeding stock. In Ceara, there are two markets for live animals -- rural and urban. The rural market consists of sales to local farmers and farm laborers as well as sales to the small towns scattered throughout the rural areas. The rural markets are the main outlet for sheep and goats because mutton/chevon is cheaper and because of the convenience factor related to small carcass size and regular availability. During the periodical survey, data on sales, home consumption, animal prices and disposition of animals/animal products was collected for three periods covering December 1979 to March 1981. Table 5 gives some summary data from these farms. The results indicate that on-farm consumption of sheep and goats is common, with 28 of the 29 sheep producers consuming an average of 16 sheep per family over the 16 month period, and 18 of the 19 goat producers consuming an average of 9 goats over the same period. Sales were about twice the level of home consumption for each species. Offtake over the 16 month period was 43% for sheep flocks [(16 consumed + 27 sold)/99 head] and 41% for the goat herds [(9 + 17)/64].

On a yearly basis, offtake averaged 24%. About 40% of this offtake was home consumption and 60% sold off the farm. The offtake for sheep was marginally higher than for goats (25% vs. 21%), but percentages of total herd home-consumed were identical. Therefore, home-consumption is in direct proportion to flock/herd size. This is because larger farms have larger flocks/herds; they also have larger labor forces to feed or to whom home-slaughtered meat can be sold.

Selling strategies favored sales directly at the farm. Farmers cited more flexibility and better bargaining power as well as the cost and inconvenience of taking animals to market. Of the remainder, 24% sold to local markets, and 2% cited other outlets. Purchasers were local middlemen (70%), other producers (24%), and urban middlemen (6%). Sales were "by head", not by weight, and an average price for a lot of animals is arrived at. Almost all sales were on a cash basis.

Table 1. Distribution of Major Agricultural Activities by Survey Farmers

County	Farms with crops, sheep and goats	Farms with cattle, sheep and goats	Farms with crops, cattle sheep and goats
	-----%		
Granja	87	87	80
Sobral	94	88	81
Crateus	93	85	85
Independencia	100	93	93
Taua	94	94	87
Parambu	100	100	100
Quixada	100	100	100
Quixeramobim	100	89	89
Morada Nova	94	94	87
Average	96	92	88

Source: Gutierrez, et al. (1981), p. 14.

Table 2. Characteristics of Small Ruminant Populations on Sample Farms

County	Average Small Ruminant Population/farm (head)			Producers with only goats (%)	Producers with only sheep (%)	Producers with Sheep and Goats (%)
	Goats	Sheep	Sheep and Goats <sup>a</sup>			
Granja	163	149	271	13	13	74
Sobral	60	115	145	0	56	44
Crateus	49	172	194	0	54	46
Independencia	213 <sup>b</sup>	173	233	0	71	29
Taua	262	218	448	0	13	87
Parambu	90	49	118	0	14	79
Quixada	94	165	209	0	47	53
Quixeramobin	57	133	161	0	44	56
Morada Nova	58	108	121	6	40	54
Average	116	142	211	3	39	58

<sup>a</sup> The average sheep and goat population does not equal the average of the two preceding columns, since not all farms had both species.

<sup>b</sup> A very small number of farms had goats.

Table 3. Average Net Farm Incomes by Activity and by Farm Type in 1980 (US\$)\*

Activity	All farms		Small herd/flock farms		Large herd/flock farms		Small landholder farms		Large landholder farms	
	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)	(\$)	(%)
Cattle	880	42	516	28	1110	50	1064	71	823	36
Sheep/goats	544	26	736	40	422	19	155	10	686	30
Crops	663	32	589	32	689	31	284	19	777	34
Total	2087	100	1841	100	2221	100	1498	100	2286	100

Small herd/flock farms = 13

Large herd/flock farms = 20

Small landholder farms = 9

Large landholder farms = 24

\* Official exchange rate, December 1980 was cr 64 = \$1US

Source: Periodical Survey, 1980

Table 4. Components of Gross Income by Activity

A. By Total Farm Income

Component	Activities			
	Cattle	Sheep & Goats	Crops	All
	-----%			
Sales	46	12	13	71
Farm Consumption	--	7	9	16
Seeds	--	--	1	1
Animal Feed	--	--	3	3
Payment in Kind	--	1	8	9
Total	46	20	34	100

B. By Activity Gross Income

	Activities		
	Cattle	Sheep & Goats	Crops
	-----%		
Sales	100	60	38
Farm Consumption	--	35	26
Seeds	--	--	3
Animal Feed	--	--	9
Payment in Kind	--	5	24
Total	100	100	100

Source: 1980 Periodical Survey

Table 5. Sheep and Goat Populations, Animal Disposals and Product Prices for 33 Sample Farms, Ceara State, 1980-81

	N*	Range	Mean	sd
Total farm area (ha)	33	10 - 800	265	236
Sheep population, May 1980	29	21 - 260	99	59
Goat population, May 1980	19	2 - 129	64	40
Total sheep and goat population, May 1980	33	38 - 273	124	68
On-farm consumption, December 1979-March 1981:				
Sheep	28	1 - 45	16	12
Goats	18	1 - 19	9	6
Number sold, December 1979-March 1981				
Sheep	28	1 - 155	27	34
Goats	16	1 - 44	17	9
Prices of Meat sold from Farm (\$/kg)				
May 1980	16	1.00-2.39	1.68	0.40
September 1980	21	1.20-2.06	1.51	0.27
December 1980	17	1.57-2.19	1.75	0.20
March 1981	21			
Prices of Skins sold from Farms (\$/piece)				
Sheep: May 1980	15	1.00-3.60	2.95	0.40
September 1980	18	1.54-2.57	1.84	0.26
December 1980	13	1.72-2.82	2.22	0.28
March 1981	22			
Goat: May 1980	14	3.00-3.60	3.13	0.30
September 1980	15	1.72-2.57	2.04	0.27
December 1980	10	1.88-2.66	2.21	0.25
March 1981	10	2.66-3.44	3.07	0.17

\* N refers to the number of farms in each category of data. For example, 29 farms had sheep, 19 had goats, and 28 farms slaughtered one or more sheep for home consumption during the 16-month period. The means and standard deviations (sd) for each category are computed using the n appropriate to that category, not the n=33 for the entire sample.

## Annual Report for 1981/82

1. Project Title: Systems Analysis and Synthesis of Small Ruminant Production
2. Institution: Texas A&M University
3. Principal Investigator: T. C. Cartwright
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$66,667

5. Statement of Project Goals

The broad objective is to increase productivity of small ruminant production systems in Brazil and in LDCs in order to improve the standard of living and level of nutrition, especially of the smallholder in semi-arid areas. This objective will be accomplished by utilization of a systems analysis approach to evaluate practical application of research results and recommended practices by the smallholder. Additionally, the sheep and goat models will be available for utilization by all SR-CRSP projects. The specific objectives are:

- A. To develop dynamic, comprehensive, mathematical models, based on biological functions, for goat and sheep production systems.
  - B. To obtain parameters needed to model production systems in both moderate and low rainfall areas of Northeast Brazil; to validate the models and input parameters for these areas; and to use the validated simulations as baselines for simulations.
  - C. To examine, through modeling and simulation, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objectives of the Brazilian CRSP.
  - D. To supply input/output data of goat and sheep production systems for use in economic analysis and sociological assessment.
  - E. To evaluate, through simulations, the response of goat and sheep production systems to alterations or interventions requested or agreed upon by personnel of CNPC.
6. Summary of Accomplishments in Previous Years
    - A. Development of both a sheep and a goat production system model was the major effort for the previous year. This activity required a major effort by several people at Texas A&M University over an extended period of time. It required an extensive and intensive review of literature, development of functional biological relationships and programming for computer application as well as continuous adjusting and balancing among components as additional data become available.

- B. T.C. Cartwright and J.O. Sanders (Co-Investigator) traveled to Brazil to visit sheep and goat research centers and farms to develop an increased understanding of small ruminant production in Northeast Brazil. The sheep and goat models were conceptually outlined and communicated with research workers at the CNPC. As an extension of this trip, flocks of sheep were observed on St. Croix, US Virgin Islands. In a later trip, Sanders visited research centers in Mexico where the Tabasco sheep were being evaluated.

#### 7. Statement of Specific Objectives for 1981/82

- A. Field test sheep production systems model.
- B. Evaluate alternative sheep management strategies for low and moderate rainfall areas of Northeast Brazil.
- C. Complete development of a goat production systems model.
- D. Contact prospective Brazilian graduate students for study at Texas A&M.

#### 8. Description of Work Undertaken

T.C. Cartwright and J.O. Sanders were in Brazil for two weeks in May-June 1981. Most of the time was spent with Elsio Figueiredo discussing the Systems Analysis Project, reviewing research at the CNPC, and visiting research sites (research stations and private cooperating farms). On the last day of this visit, Cartwright and Sanders met F.A. Melo Lima and discussed the Systems Analysis Project with him.

In February 1982, Luis Carlos visited Texas A&M and discussed the development of the sheep and goat models with G.M. Smith, T.C. Cartwright and J.O. Sanders.

Also in February 1982, Elsio Figueiredo visited Texas A&M and reviewed the recent developments on the sheep and goat models.

Work continued at Texas A&M University to complete the sheep and goat production system models and to validate them for use in individual animal simulation. Dr. Norman Graham, from Australia, spent two months at College Station assisting in the development of the nutrition component of the models.

Planning and preparation for presenting a workshop at CNPC on Animal Breeding, Systems Analysis and Statistical Methods was completed; J.O. Sanders and G.M. Smith are designated participants. This workshop is collaborative with the SR-CRSP Breeding Project and CNPC Co-PIs and other collaborators.

#### 9. Technical Accomplishments

The sheep and goat models were completed for individuals and partially validated; i.e., validation was with limited data sets. Verification and completion of flock dynamics capabilities is expected during the summer of 1982.

PART IV  
PARTICIPATING INSTITUTION ANNUAL REPORTS  
INDONESIA

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Annual Report For 1981/82

1. Project Title: Genetic Improvement of Sheep and Goats for Smallholder Production Systems

2. Institution: University of California, Davis

3. Principal Investigator: G. E. Bradford

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$328,984\*  
Matching Contribution from 1981/82 Subgrant: \$79,063

5. Project Goals

A. To characterize the performance of the major types of Indonesian sheep and goats under experiment station and village conditions.

B. To compare the performance of sheep and goats on different rations (collaborative with Nutrition/Forages Project).

C. To evaluate the effects of amount of wool on performance of sheep in Indonesia.

D. To develop genetic improvement plans for sheep and goats in Indonesia.

E. To provide training opportunities for Indonesian scientists.

6. Summary of Accomplishments

The Breeding Project in Indonesia was relatively inactive during 1981/82, due to the absence of a full-time CRSP scientist on-site. The main activities were:

Sponsorship of Mr. P. Sitorus of BPT to attend the Third International Conference on Goat Production and Disease and present a paper on performance of Indonesian goats. Mr. Sitorus also visited the Davis campus and Hopland Field Station, and conferred with Drs. E. Bradford, N. Thomas, S. Quirke, and Mr. M. Bell on plans for the program in 1982/83.

Sponsorship of graduate study for Mr. Subandriyo, who entered the MS program in Animal Science at Montana State University in March 1982.

Sponsorship of Mr. Rahmat Setiadi in a Master's Program at IPB, Bogor.

Recruitment of Mr. Monte Bell, Sheep Specialist in the California Cooperative Extension Service, to spend 1982/83 in Bogor on the Breeding Project.

\* includes carry forward

## Annual Report for 1981/82

1. Project Title: By-Product and Crop Residue Utilization in Intensive Sheep and Goat Production Systems for Limited-Resource Farmers
2. Institution: North Carolina State University
3. Principal Investigator: William L. Johnson
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$269,057  
Matching Contribution from 1981/82 Subgrant: \$85,392

5. Statement of Project Goals

Since the inception of the Small Ruminant CRSP in 1978, the objectives for the nutrition and by-products utilization project have continued unchanged. They can be paraphrased as follows:

- A. Study the nutritive value of feeds available for hand-feeding or supplementary feeding to small ruminants in tropical environments.
- B. Develop guidelines for inclusion of such feeds in the diets of small ruminants, and to determine the expected productivity of animals which consume them.
- C. Study storage and treatment methods for crop residues and byproducts.
- D. Test the reliability of simple feedstuff evaluation procedures for predicting animal productivity.
- E. Generate information on nutritional requirements and comparative efficiencies of tropical small ruminant types and breeds, in the environment of their exploitation.

6. Summary of Accomplishments in Previous Years

In 1979 and 1980, workplans were agreed upon with collaborators in Indonesia. Village survey activities were initiated in West Java; animal feeding trials were designed and implemented on the experiment stations at Bogor. Complementary research activities continued in Raleigh.

The village baseline surveys in West Java revealed a long list of feedstuffs which potentially should be studied. Cassava tops, maize plant tops, banana leaves, and native grasses were noted with high frequency of use. A comparative palatability trial with sheep and goats showed cassava tops to rank well above sweet potato vines, banana leaves and napier grass in acceptability by both animal species.

7. Statement of Specific Objectives for 1981/82

- A. Summarize results of village baseline survey.
- B. Initiate monthly monitoring of selected small ruminant enterprises in highland and coastal village locations.
- C. Continue feeding trials at the Bogor station, to obtain data on animal gain as related to intake and digestibility of feedstuffs of potential importance for village producers.
- D. Initiate a feeding demonstration trial at the Margawati animal breeding station.
- E. Initiate an assessment of the mineral nutrition status of small ruminants in the survey villages.

8. Description of Work Undertaken

Experiments Completed

1. Baseline survey of small ruminant production in West Javan villages

Leaders (Nutrition component): Neil Thomas, Wayan Mathius,  
Andi Djajanegara

Location: Ciburuy, Cirebon, and Garut, West Java

Procedures: More than 100 farm families were surveyed in each village; a criterion for inclusion in the survey was the presence of a sheep or goat production activity. This was a comprehensive activity involving all disciplines of the SR-CRSP. Within the feeding and nutrition area, data was collected on cropping systems, types of feed used, source of feed (purchased or home-produced) and animal inventories.

2. Cassava leaves as a protein source for lambs and kids in confinement.

Leaders: Andi Djajanegara and Wayan Mathius

Location: Balai Penelitian Ternak, Bogor

Procedures: Graduated levels of cassava leaves were used in rations for growing lambs (West Java thin-tail) and kids (Kambing Kachang), with initial weight of about 10 kg. Individual animal intakes and weight gains were measured. At the close of the trial, total fecal and urine collections were made (in metabolism crates) for digestibility and nitrogen balance estimates.

## Experiments in progress

### 1. Monitoring village small ruminant production systems.

Leaders: Wayan Mathius, Neil Thomas, Andi Djajanegara, Achmad Prabowo, Soekanto, W.L. Johnson, Budiman, Bambang, and staff of village workers

Location: Ciburuy, Cirebon and Garut, West Java; BPT laboratories, Bogor

Procedures: Thirty families in each of the three village sites are being monitored on a monthly basis. A total of about 575 animals are being held by these families. The monitoring is a joint activity of all disciplines represented by the SR-CRSP. Data on gross aspects of the feeding system are being recorded, including feed type, source, availability, and amounts offered, and individual animal weights. Feeds are separated and identified by species. Samples of all feeds encountered are collected and dried in the villages, in force-air ovens. Analyses on these samples are performed at the BPT laboratory, including dry matter, crude protein, total cell wall (NDF), lignin, cellulose, and in vitro digestibility (estimate of energy availability). Selected samples are prepared in Bogor for shipment to Gajah Mada University, Jogjakarta, where they will be analyzed for macro and micro mineral elements.

### 2. Substitution of cassava meal for commercial concentrate as a supplement for chopped napier grass in growing lambs.

Leader: Hamzah Pulungan

Location: Margawati Breeding Station, Garut

Procedure: Thirty lambs, initial weight about 12 kg, were randomly assigned to one of five treatments: cassava root meal and a commercial 14% CP concentrate in graduated proportions of 150 and 0, 100 and 50, 75 and 75, 50 and 100, or 0 and 150 grams per day. All animals receive chopped green napier grass ad libitum. Animal weights and feed intakes are recorded, and feeds are sampled for chemical analysis. The trial will continue for nine months until September 1982.

### 3. Tree legume foliages as supplements for chopped napier grass for growing lambs and kids in confinement.

Leaders: Andi Djajanegara, Wayan Mathius, Achmad Prabowo

Location: Balai Penelitian Ternak, Bogor

Procedures: Groups of West Java thin-tailed sheep and "Kambing Kachang" goats, about 10 kg initial weight, are fed ad libitum napier grass plus graduated levels of a legume supplement. This series of trials is designed to give specific performance estimates from a variety of protein sources and protein levels, from each trial; and also, across all trials, to generate data to help determine optimal

levels of protein intake to support the maintenance and growth requirement of animals of these breeds and age class.

### Work planned

At a planning session in Bogor held in April 1982, it was decided that the following activities would have priority for the coming months.

<u>Activity</u>	<u>Leaders</u>
Analysis of village monitoring data -Feed supply -Energy and protein as limiting nutrients -Mineral status	Wayan Mathius, Neil Thomas Hamzah Pulungan, Marudin Sitorus, J. van Eys Achmad Prabowo, Soekanto, J. van Eys
Evaluating health status of village animals	A. Prabowo and BPPH staff
Reproductive performance of village animals as influenced by nutrition levels	J. van Eys; nutrition and breeding groups
Socio-economic constraints to improving nutritional status of village animals	Wayan Mathius; socio-economic group
Modeling the village farming system	Neil Thomas and Rangkuti
Growth performance studies (Bogor)	Wayan Mathius, Marudin Sitorus, Achmad Prabowo
Reproduction and lactation performance studies (Bogor)	J. van Eys; nutrition and breeding groups
Plant/animal interaction studies	W. L. Johnson, J. van Eys, and nutrition group
Digestive physiology and metabolic parameters	W. J. Croom and nutrition group

A timetable for completion of part of this work was set as follows:

May 1982	- Develop models for statistical analysis of village monitoring data
July 1982	- Determine objectives and procedures for second year, Monitoring program
September 1982	- End first year of data collection, village monitoring program. Start data summary
Early 1983	- Finish laboratory analyses, village feed samples
Mid 1983	- Final summaries, Year One village monitoring data

## Facilities Development

During the year covered by this report, a contribution was made to the analytical capacity of the BPT laboratories in Bogor, in the form of equipment which had been purchased with site development funds. When completely installed, this contribution should help greatly in handling the increased volume of samples generated from village and station activities.

## Travel

The Principal Investigator made two trips to Indonesia for project evaluation and planning, during the year of this report. The first was in October 1981, the second in April 1982.

Dr. Neil Thomas, SR-CRSP Liaison Officer and part-time NCSU nutrition project coordinator, travelled to the United States in May 1981 and January 1982. On both occasions, valuable consultation and planning was possible with the PI.

Andi Djajanegara of the BPT nutrition and feed evaluation group was also in the United States twice during this period. His first trip was sponsored as far as California by another program. The NCSU project financed an extension, in July and August 1981, for Mr. Djajanegara to spend one week in the laboratories of Dr. P. J. Van Soest at Cornell University; four days attending the American Society of Animal Science meeting in Raleigh; and an additional two weeks in Raleigh for consultation with NCSU administration, animal science faculty, graduate students, and the Principal Investigator.

Mr. Djajanegara's second trip was on the occasion of the Third International Conference on Goat Production and Disease, Tucson, Arizona, January 1982, where he presented a paper from the village baseline survey. This trip was financed entirely by the NCSU project and included organized visits to Winrock International, in Arkansas, and the Texas A&M University research programs in Sonora and San Angelo, Texas. He also visited dairy goat production units in Arkansas and meat goat, mohair, and sheep production units in Texas. His itinerary also included attendance at the SR-CRSP Technical Committee meeting and the University of California campus, Davis.

Ms. Sorta Silitonga, MS candidate at the University of Minnesota, and Mr. Budi Haryanto, MS candidate at NCSU, Raleigh, also participated in the travel to the International Goat Conference and intermediate visits in Arkansas and Texas. Other NCSU personnel who made the overland trip were Lynn Brown, Helaine Burstein, Margaret Dentine, and Jean-Marie Luginbuhl (graduate students) and W. L. Johnson (PI).

In February 1982, Mr. Wayan Mathius and Dr. Neil Thomas were supported for travel to Singapore, to attend a workshop on farming systems for Southeast Asia, sponsored by the Canadian Institute for International Agricultural Development.

## Training

A part-time graduate assistantship has been provided for Ms. Sorta Silitonga, candidate for the MS degree in Animal Nutrition at the University

of Minnesota. Dr. John Donker is her advisor. Her program is on schedule for completion in December 1982.

Mr. Budi Haryanto has an IADS-administered (World Bank funded) fellowship for his MS program at NCSU. Additional research support is provided for Mr. Haryanto through the NCSU subgrant. It is expected that his MS program will be completed by January 1983; however, a proposal has been forwarded to Bogor for Mr. Haryanto to continue toward a PhD, with SR-CRSP support for thesis research in Bogor (including travel expenses).

Mr. Wayan Mathius has applied to NCSU for admission as a candidate for the MS program. In addition, two other BPT personnel have expressed a preliminary interest in NCSU for future graduate study.

#### Language study

The Principal Investigator has begun study of Bahasa Indonesia, with a tutor in Bogor. His progress to date, however, must be described as minimal.

Dr. Thomas has offered informal classes in English to members of the nutrition group at Bogor. This has been a useful exercise.

Plans have been finalized for more formal classes to be taught by Mrs. Carol Knipscheer, specifically for the younger nutrition staff, during June, July and August 1982. These lessons will be financially supported by the NCSU subgrant.

#### Personnel

##### Balai Penelitian Ternak (Bogor)

#### Project Leaders

S. Rangkuti, Animal Nutrition  
Neil Thomas (UCD and NCSU), Village Farming Systems  
Hamzah Pulungan, Animal Nutrition  
Andi Djajanegara, Animal Nutrition and Feed Evaluation  
Wayan Mathius, Village Farming Systems and Animal Nutrition  
Achmad Prabowo, Animal Nutrition  
Marudin Sitorus, Animal Nutrition  
Busniar Betta, Feed Evaluation

#### Collaborators

M. E. Siregar, Forage Agronomy  
Abdul Rais, Feed Evaluation  
Rosasri, Feed Evaluation

##### Gajah Mada University (Jogjakarta)

#### Collaborator

Dr. Soekanto, Animal Nutrition

Bogor Agricultural Institute (Bogor)

Dr. Toha Sutardi, Animal Nutrition

North Carolina State University (Raleigh)

Project Leaders

W. L. Johnson, Animal Nutrition (Principal Investigator)  
W. J. Croom, Rumen Physiology

Collaborators

Sharon Rowe, Animal Nutrition (technician)  
Lynn Brown, Animal Nutrition (graduate student)  
Budi Haryanto, Animal Nutrition (graduate student)  
Jean-Marie Luginbuhl, Animal Nutrition (graduate student)

9. Technical Accomplishments

The information reported below focuses on the preliminary results of village monitoring activities. When the monitoring data is more complete, it is expected to serve as a roadmap for future research emphases in the Indonesia project.

Sampling populations - Monitoring activities were carried out on 30 farms in each of two sites selected for the SR-CRSP studies. The study farm population was selected from the much larger farm population (Garut - 145, Cirebon - 101) used for the baseline survey. The latter covered a stratified sample of the SR producers in Garut, and the total population of SR producers in Cirebon. Major differences exist between farms in the upland and lowland locations in terms of the animal species used, and the type of management found. Garut farmers are sheep producers, the latter being fully confined and fed by a cut-and-carry forage system. Cirebon farmers are either sheep or goat producers, sheep being grazed, and goats kept confined. In Cirebon, sheep and goats are hardly ever found together on the same farm. During this first phase, monitoring visits have been made to each farm monthly, the village cadre in each location visiting up to two farms daily.

Feed supply - Over the first five months of the survey, sheep farmers in Garut collected an average of 29 kg of fresh feed per day; the range across farms was from 11 to 59 kg. During September and October 1981, about 37% of the feed collected (fresh weight basis) was native grasses, and an equal amount was some form of crop by-products. The remainder was classified as "other" and includes tree foliage and legumes. In the period from November 1981 to January 1982, the "other" category was almost completely replaced by native grasses; crop by-products were used at about the same level as before. This change seems to coincide with the onset of the heaviest rains.

The goat farmers in Cirebon collected less total feed per farm (about 25 kg per day), including 28% native grass and virtually no crop by-products.

In both instances, the mean amount of green feed available ranged from 250 to 300 grams per kg of animal liveweight. If we assume the feeds used to have an average dry matter concentration of 20%, the feed available would amount to about 50 to 60 grams of dry matter per kg liveweight, which would indicate no grass shortage of feed compared to animal requirements.

It is interesting to note that the total animal inventory averages about 100 kg liveweight per farm.

Animal performance - For the purpose of evaluating changes in animal liveweight, the sample population was stratified into 3 groups: <20 kg, 10 to 20 kg, and >20 kg liveweight. For the first interval of survey (September to October 1981 in Garut, and October to November in Cirebon), the smallest animals gained about 75 grams per day; the older lambs and kids (10-20 kg) gained about 30 grams per day; and the heavier group gained about 20 grams per day. The calculations were made from records only of those animals which appeared in both months. As the survey continued in the third, fourth, and fifth month, the regression of rate of gain on body weight continued to be linear, negative, statistically significant, and consistent between locations.

The reasons for apparently low rates of gain for animals of post-weaning age need to be examined. Of particular interest will be the digestible energy concentrate in the diet which is made available to these animals, and whether or not they are offered sufficient feed to satisfy their appetite.

Mortality - A major problem was noted with regard to sheep mortality in Cirebon (grazing system). Of the original 108 animals in the study, almost 25% died within the first four to five month period. Consequently, there has been no net increase in total inventory through births. In Garut, no deaths have been recorded of mature animals within the monitoring period, and only 15% of newborn lambs have died. Goat mortality in Cirebon similarly is low, with only three mature animals and three kid litters being reported lost. If such a high level of mortality is a continuous problem in sheep being grazed under lowland conditions, obviously a much larger inventory of ewes must be maintained to achieve a turnover that compares to that in Garut.

Farm resources - In order to determine whether the farm flock is related to the size of farm or the quantity of labour that a farmer has available, a brief regression analysis was carried out of flock size (on the basis of the number of mature animals) and the variables farm size and family size. Neither variable proved useful in explaining differences in flock size.

The monitoring data suggest that, between locations at least, the major reason for a difference in flock size may be the risk attached to the particular feeding technology used (i.e., the difference in mortality between confinement and grazing). If this does not operate to place an upper limit on flock size (e.g., probably not in Garut), some socio-economic parameter is likely to be more useful in explaining this.

## Annual Report for 1981/82

1. Project Title: Sociological Analysis of Small Ruminant Production Systems
2. Institution: University of Missouri - Columbia
3. Principal Investigator: Michael F. Nolan
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$76,721

5. Statement of Project Goals

The principal goal of the SR-CRSP Sociology component is to develop an understanding of the social and cultural context in which small ruminant production occurs. This will be necessary in order to evaluate specific technological interventions in relation to their social soundness and their likelihood of acceptance by the population at large.

Among the issues that the project will address are the social organization of livestock production particularly vis a vis crop production, institutional constraints on production including credit, markets, and extension services, and the values and attitudes of the population toward the adoption of new technology.

6. Summary of Accomplishments in Previous Years

Field research in Indonesia was initiated in 1980-81, and the first data became available in the summer of 1981. This was a large survey undertaking in two West Java villages--one in the highlands where the dominant animal species were sheep raised in confinement and one lowland village where both sheep and goats were found, with sheep being grazed and goats being kept in confinement. In addition to the baseline data for the Economics, Nutrition and Breeding components and subsequent monitoring activities, a sociological questionnaire was developed and administered to the sample of producers in each village.

The graduate training program for Mr. Kedi Suradisastra of BPT/Bogor began in January 1981 and is expected to be completed by the end of 1982. Mr. Suradisastra will write his Master's thesis using the sociological data that has been collected in Indonesia.

In addition, collaborative relationships were established with the social scientists at Satya Wacana University in Central Java. That group put together a survey questionnaire similar to that used in West Java and administered it in two villages in Central Java.

## 7. Statement of Specific Objectives for 1981/1982

- A. Continue support of studies undertaken by Dr. John Ihalauw and the staff/students of Satya Wacana University. Efforts this year will focus on describing different forms of ownership/management arrangements for animals.
- B. Continue training program for Mr. Suradisastra.
- C. Begin analysis of initial baseline survey data collected in West Java villages. Focus attention on role of family members, attitudes towards new technology, and the nature of farmer contact with institutions.

## 8. Description of Work Undertaken

Analysis of the survey data collected in West Java has begun and one paper has been prepared for presentation at the Annual meeting of the Rural Sociological Society. The data are completely coded and available in a form for easy access through the computer at the University of Missouri. Further analysis of this data will be done as part of Mr. Suradisastra's Master's thesis which is targeted for completion in December 1982.

The Satya Wacana group has finished their analysis of the initial data collected from the two Central Java villages. They have prepared a report on that analysis which is being circulated in Indonesia.

## 9. Technical Accomplishments

A number of interesting relationships were deduced from the data analyzed from the highland survey site (the villages of Sindangratu and Tenjonegara in the Regency of Garut). One hundred forty-five farmers who raise sheep were interviewed in these villages. Most families own two, three, or four sheep, and all animals are raised under intensive zero grazing conditions with forage cut and carried to the animals.

Saving money was the main reason given for raising sheep. This was true for all farm sizes. Only one person indicated that he raised sheep for family consumption. Thus, these animals are serving as a form of "banking on the hoof" and are valued for their ease of liquidity. While not as strong, the same trend also holds true for poultry.

Although there was a direct relationship between farm size and use of sheep for religious holidays, the dominant response in all farm strata was that sheep meat was never used. Sixty-one percent of the farmers stated that they never used sheep meat from their own animal for home consumption.

The pattern for the use of poultry meat was quite different. Poultry, mainly chicken, was a less expensive source of protein. In addition, because of its size, slaughtering and consuming poultry was not such a problem. Interestingly, the vast majority of the families viewed the serving of meat in the household as important. This was particularly true for the larger farms.

As a small-scale enterprise, farms in the study area had to rely on family labor not only because they could not afford to hire labor, but also because of the surplus of unemployed family labor. Of interest here is whether farm labor tasks were stratified among family members, either by sex or age. Also, given the small size of farms, many families have been forced to have one of their members seek wage labor off the farm.

Husbands and wives equally share the responsibility for farming activities, although there is a slight tendency for women to be less involved with animal care. The role of a son in both crop and livestock farming was more prevalent than that of a daughter.

Interestingly, most families were engaged in off-farm work with both husbands and wives participating. With the introduction of modern harvesting techniques, the need for female harvesters decreased and many were displaced as the new jobs required more physical strength than most women possessed. That freed up many women to seek wage labor.

Decision-making in livestock production showed the authority of the husband and also some interesting differences. Almost every activity in sheep raising was decided by the head of household, whereas the wife played the key decision making role in poultry production. This reaffirms the importance of sheep as a capital resource to these families.

Further evidence on the dominance of the husband as the head of household was seen in the process of decision-making regarding the use of money received from selling farm products, sheep being one. In 69 percent of the households, the head of the house decided how to use the money received.

Differences did arise when the issue of how money from the sale of farm products (including sheep) was spent. The larger the farm size, the greater the tendency to save some of the cash from the sale of a commodity, whereas the smallest farmer tended to spend everything the day he received it. Only a few farmers saved all of the money after they sold their products, which further reinforces the idea that sheep are kept as a form of liquid capital to be used in times of need.

Annual Report for 1981/82

1. Project Title: Economic Analysis of Small Ruminant Production and Marketing Systems in Indonesia
2. Institution: Winrock International Livestock Research and Training Center
3. Principal Investigator: A. John DeBoer

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/1982 Subgrant: \$200,000  
Matching Contributions from 1981/1982 Subgrant: \$78,310

5. Statement of Project Goals

- A. Provide a well-trained group of professional agricultural economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multi-disciplinary research on small ruminants and their producers.
- B. Provide an improved data base for guiding research and providing policy guidelines for improving small ruminant productivity and farmer incomes.
- C. Strengthen the overall research capacity of selected host country research institutions by providing leadership in conducting interdisciplinary research, conducting training programs and publishing research results.
- D. Direct the focus of research towards a farming systems approach in which relevant research institutes collaborate in attempting to develop new technology to meet farmers' needs.
- E. Publication and dissemination of research results representing a wide variety of research and which will contribute to a better understanding within the scientific community of small ruminants and their place in selected rural economies of developing countries.

6. Summary of Accomplishments in Previous Years

Program Year 1 (October 1, 1978 - April 1, 1980)

- A. Visited Indonesia as leader of SR-CRSP Asian Site Selection team and made initial scientific and institutional contacts.
- B. Visited Indonesia in March 1980 and finalized Phase III work plans for agricultural economics. Discussion of overall project research plans, training needs, and survey procedures to be applied to small ruminant producers.

- C. Began organization of "Sheep and Goat Production Short Course" scheduled for June-July 1980.

Program Year 2 (May 1, 1980 - September 30, 1981)

- A. Selected counterpart scientist (M. Sabrani) and jointly formulated the Phase III Work Plan.
  - B. Conducted a training program to orient all Indonesia project participants to the SR-CRSP, set out the plan of activities for each research project, discussed research techniques, and oriented village enumerators to the field survey program and field survey techniques, June 23 - July 18, 1980.
  - C. Set up and implemented a farm survey program, including procedures for village selection; farmer selection; frequency of enumeration; data checking, processing, storage, retrieval, and analysis.
  - D. Constructed survey instruments for village selection, farmer selection, initial survey and a monthly monitoring survey and implemented these studies.
  - E. Supported Mr. Steve Mink in Indonesia for 13 weeks, June - September 1980, while he studied Indonesian, participated in the BPT/SR-CRSP training program and conducted field research in a transmigration area of Sumatra.
  - F. Identified Mr. Agus Muljadi as a candidate for long-term formal training (MS, Texas A&M), beginning study in June 1981.
  - G. Established a formal training component in an Indonesian university (Institute Pertanian Bogor) by supporting a local student's (Ing. Sugiyanto) research on small ruminants, beginning study in June 1980.
  - H. Consultancy of Jerry Perkins to FAO headquarters for five weeks (October - November 1980) where he assisted in revising the FAO Farm Management Services Division Farm Management Data Collection and Analysis System (supported by FAO).
7. Statement of Specific Objectives for 1981/82
- A. Complete analysis of the baseline survey data.
  - B. Continue with the implementation of the monitoring (monthly) surveys and begin analysis of the economic monitoring data.
  - C. Conduct a profile evaluation of the small ruminant marketing system serving Garut and Cirebon (producers, collectors, slaughter houses, butchers) to describe the marketing structure, sales volume, and the importance of marketing as a constraint to increasing production.
  - D. Identify interventions to increase small ruminant production for testing on farmers' herds/flocks.

## 8. Description of Work Undertaken

### A. International Travel

J. DeBoer and H. Knipscheer to Indonesia for three weeks to assist in project implementation, September 1981.

H. Knipscheer recruited and arrived with his family in Indonesia to begin long-term assignment at BPT/Bogor, December 1981.

M. Sabrani to Tucson to present a paper at the III International Conference on Goat Production and Disease, January 1982, and spent a week at Winrock International to plan future project activities.

H. Knipscheer, J. DeBoer, M. Sabrani, and R. Bernsien (Co-Investigator) to Singapore to participate in IDRC funded conference on Livestock Development in Asia, March 1982.

R. Bernsten to Indonesia for six weeks to assist in project implementation, February - March 1982.

### B. Domestic Travel

Agus Muljadi, J. DeBoer, and R. Bernsten participated in the III International Conference on Goat Production and Disease, Tucson, AZ, January 1982.

C. Data analysis of the Baseline Survey completed and published in Indonesia.

D. Sheep and goat marketing profile completed and written up as a draft.

E. Monthly monitoring data is being summarized and analyzed by MS candidate Sugiyanto.

F. Discussions were held with BPT/Bogor (SR-CRSP) and BPT staff to identify technologies that could be tested on farmers' livestock at SR-CRSP sites and an appropriate experimental design was identified.

## 9. Technical Accomplishments

### Goat Production in a Transmigration Area

This study, entitled "Prospects for Small Farm Goat Production in a Transmigration Area of Indonesia: Results of a Survey," by Stephen Mink, reports on research that was conducted in one of the older transmigration areas in Southern Sumatra; the Way Abung II project in Northern Lampung Province. A total of 60 farmers were interviewed; 30 in Daya Sakti village and 30 in Tirta Kenjana village. Actual survey work was conducted during July - August 1980. Data analysis was carried out at Princeton University in September. The survey work concentrated on three aspects: The background of transmigrant goat producers, characteristics of transmigrant farming systems, and growth potential and research needs of goats in transmigration areas. The

study described land use, labor use, feed supplied, cropping technology, livestock technology, and livestock marketing.

This study identified a number of specific constraints on expanding goat populations and goat productivity. The author concluded that goat production is profitable under current practices and many non-producers expressed an interest in this enterprise. A major constraint to increasing production is the low level of farm income which forces farmers to liquidate their breeding stock when cash is needed. The introduction of improved male breeding stock through farmers' groups, the introduction of improved forages, and the provision of female breeding stock are possible strategies for increasing goat production. Any effort should be coupled with an applied research program to assess alternatives.

The final report (revised) on this project was completed in February 1982, and transmitted to Indonesia. The Woodrow Wilson School, Princeton University, provided international airfares.

#### Small Ruminant Production System

A survey of 100-145 small ruminant producers per location was conducted during 1981 at two SR-CRSP field sites. Garut was selected to represent the upland and Cirebon the lowland. At each site, respondents were stratified in terms of farm size, including a strata of landless producers. In both locations, the family is the primary source of labor, primarily the father and his sons (Table 1). The availability of labor to cut feed for the animals appears to be a major constraint to increasing herd size.

In each location, the average size of holding was small (0.31 - 0.36 ha), although in Garut farmers have opportunities to rent and contract (share in) land (Table 2). The number of small ruminant animal units varied between the strata, but there was no trend relationship between farm size strata and number of animals held (Table 3). In both ecological zones, the number of animal units held by the landless was roughly the same as by landowner. Although most producers owned their animals, informal credit and animal sharing arrangements were important--especially among smaller landowners.

While the cut-and-carry system predominates, sheep are occasionally grazed on harvested lowland rice fields in lowland Cirebon. At both sites, native grasses are the principle feed source, with the diversity of feeds supplied being greater in upland Garut (Table 4).

#### Marketing Profile

In an attempt to rapidly identify socioeconomic constraints, a methodology for constructing a profile of the small ruminant marketing system was developed. At each site, key informants were interviewed at each stage of the marketing chain--producer, animal collector, butcher, meat seller, and market officials. Data collected from these individuals was consistent with official market data, in terms of sources of animals, volume slaughtered, and seasonal price fluctuations.

In general, sheep and goats originated in villages near the market. Numbers of small ruminants slaughtered greatly exceeded the number of cattle,

since smaller animals reduced the likelihood of the butcher having unsold meat at the end of the day.

The number of small ruminants slaughtered was influenced by the religious calendar, with about double the average monthly volume slaughtered during the feast month. Prices received for animals are also influenced by the crop cycle--low prices in the wet season when farmers sell because they need money for land preparation, and high prices in the dry season when the crop is harvested and cash is more available.

Of particular interest was the identification of several animal collectors who purchased young sheep in the village, fattened these animals on tempe (bean curd) by-products and sold them to the butchers.

Table 1. Frequency Distribution of Family Members Performing Selected Small Ruminant Production Tasks (%)

Family Labor Source	<u>Tending Animal</u>		<u>Feed Collecting</u>		<u>Animal Feeding</u>		<u>Water Animal</u>		<u>Bathe Animal</u>	
	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut
Husband	78.34	12.50	57.80	51.97	58.97	58.86	83.58	41.60	68.99	48.79
Wife	1.11	9.29	5.44	12.40	10.27	10.80	0.90	18.97	0.89	9.68
Son	16.39	69.47	24.39	35.63	19.21	30.34	15.52	39.43	22.18	41.53
Daughter	4.16	0	2.85	0	2.00	0	0	0	0	0
Others	0	8.74	0.52	0	9.55	0	0	0	7.94	0
Total	100	100	100	100	100	100	100	100	100	100

Table 2. Average Size of Land Owned and Farmed by Holders of Small Ruminants by Location (ha)

<u>Strata</u>	Cirebon			Garut		
	<u>Owned</u>	<u>Farmed</u>	<u>N</u>	<u>Owned</u>	<u>Farmed</u>	<u>N</u>
Landless	0.01	0.01	19	0.01	0.01	10
Subsistence	0.04	0.04	30	0.06	0.11	21
Smallholder	0.21	0.21	2	0.16	0.21	37
Medium Holder	0.34	0.55	35	0.38	0.53	71
Large Holder	1.12	1.92	14	1.33	1.67	6
Weighted Average	0.29	0.48		0.29	0.40	

Table 3. Small Ruminant Ownership by Farm Size Strata

Farm Size Strata	Owned (%)		Combination of* Own and Share (%)		Share (%)		Average Animal Units Held as Small Ruminants Per Household	
	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut
Landless	46.74	30.00	20.11	60.00	33.15	10.00	0.33	0.43
Subsistence	27.79	19.05	51.95	42.86	20.26	38.10	0.47	0.43
Smallholder	42.86	70.27	57.14	24.32	0	5.41	0.14	0.40
Medium	45.70	78.57	45.25	10.00	9.05	11.43	0.48	0.57
Large	95.57	100	0	0	2.43	0	0.34	1.03

\* Some farmers' animals are owned and some are produced on shares.

Table 4. Sources of Fodder (%).

Strata	Purchase Fodder		Cut From Own Land		Cut From Public Land or Other Farmer's Land		Barter		Total	
	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut	Cirebon	Garut
Landless	--	--	--	64	84	36	16	--	100	100
Subsistence	3	--	9	65	67	32	21	3	100	100
Smallholder	--	--	33	70	67	30	--	--	100	100
Medium	4	--	18	70	64	30	14	--	100	100
Large	17	--	17	75	50	25	16	--	100	100

Annual Report for 1981/82

1. Project Title: Systems Analysis and Synthesis of Small Ruminant Production
2. Institution: Texas A&M University
3. Principal Investigator: T. C. Cartwright
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$66,667

5. Statement of Project Goals

The broad objective is to increase productivity of small ruminant production systems in Indonesia and other LDCs in order to improve the standard of living and increase nutrition of the smallholders in these countries.

This project was not active in Indonesia as agreed upon and approved by the Technical Committee, Management Entity, and Board of Institutional Representatives.

6. Summary of Accomplishments in Previous Years

Assisted Agus Muljadi in his graduate program at Texas A&M. (Muljadi is sponsored by the Winrock International Economics Project.)

7. Statement of Specific Objectives for 1981/82

None.

8. Description of the Work Undertaken

Completion of both sheep and goat model functions and validation was accomplished. These models are now available for use in systems analysis of Indonesia production systems as required by active SR-CRSP projects in Indonesia.

9. Technical Accomplishments

Simulations models for both sheep and goats have been completed and validated with limited data sets. Verification of the flock dynamics accounting will be completed before September 1982.

PART IV  
PARTICIPATING INSTITUTION ANNUAL REPORTS  
KENYA

## Annual Report For 1981/82

1. Project Title: Genetic Improvement of Sheep and Goats for Smallholder Production Systems

2. Institution: University of California, Davis

3. Principal Investigator: G. E. Bradford

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$328,984\*  
Matching Contribution from 1981/82 Subgrant: \$79,063

5. Project Goals:

A. Compare indigenous breeds, and crosses between dairy and indigenous breeds of goats with regard to milk and meat production, health status, and suitability for different environments and production systems in Kenya.

B. Develop breeding plans for genetic improvement of dual purpose goats for smallholder production systems.

C. Participate in development of genetic improvement plans for other classes of small ruminants in Kenya.

6. Summary of Accomplishments

### Project Activities in Country

During 1981/82, the goat pens at Ol Magogo, designed by Mr. Berger, were built. The UCD Breeding Project purchased materials, and the MLD provided labor. The facilities include holding/breeding pens, cutting chute, dip, buck facility, and milking stalls. All are now in use.

Purchase of East African and Galla does for the project is nearly complete. As of April 1, 1982, there were 440 females in the flock, with only a few more Gallas to be purchased to complete the planned flock of 480.

Mating of the first 250 does was originally scheduled for May 1981. Unfortunately, an outbreak of sheep pox brought in by animals from another project resulted in the loss of some animals and a five-month quarantine of the remainder at Ngong Farm. Mating of these does to dairy bucks imported from the US was therefore planned for October/November, following the expected return of the does to Ol Magogo.

The shipment of goats from the US for the Breeding and Production Systems Projects, planned from the inception of the Kenya SR-CRSP, was nearly ready to

\* includes carry forward

go in summer 1981, with the cooperation of Heifer Project International (HPI), when the condition that only CAE-serologically negative animals could be shipped was imposed by the MLD. This eliminated over 80% of the animals scheduled for shipment. Plans were then made for a smaller shipment, consisting of CAE-negative bucks, and 19 CAE-free does purchased from the Washington State Caesarian-derived herd. A permit for the small shipment was received by UCD and plans for shipment finalized, when the permit was revoked by the MLD.

At about the same time, an outbreak of foot and mouth disease in Kenya led to a ban on all livestock movement in the Nairobi/Naivasha area, and thus the does could not be returned to OI Magogo. Since there were neither breeding bucks nor bucks for estrus detection at Ngong Farm, it was decided to do set-time artificial insemination on synchronized does. This was done in November under the supervision of Dr. E. A. Nelson of Cal Poly, Principal Investigator for the SR-CRSP Reproduction Project. Semen used was Alpine, Nubian and Toggenburg, frozen at Davis by Dr. Nelson, and East African and Galla collected and frozen in Kenya by Dr. Nelson and Mr. Charles Ngugi of CAIS, Kabete. Unfortunately, in spite of apparently good post-thaw motility, conception rate was extremely low, with only 2 kids from the 277 does on which set-time AI was used, and 4 from 45 does inseminated on return to estrus. Reasons for the low kidding rate have not been identified.

The entire herd is now assembled at OI Magogo, and the does are currently (May 1982) being mated. Forty were inseminated with semen left over from November. The remainder were mated naturally to East African, Galla, and local dairy and dairy crossbred bucks. A requirement that any additional semen imported from the US must be not only from bucks free of CAE but also from herds free of CAE, was included in the semen permit sent in April. Since there are no goat herds without some CAE serologically positive animals known to exist, no goat semen can be sent to Kenya at this time. Based on evidence from the Washington State University project that CAE is not transmitted by the male or by semen, a permit without this restriction has been requested.

The situation on the Breeding Project in Kenya, therefore, is that the facilities are ready, the experimental doe herd has been assembled, and a sizable technical labor force has been allocated by the MLD to the project. Staff are being trained in research recordkeeping, estrus detection, AI procedures, and milk recording methods. The first large group of kids should be born in late 1982. If the appropriate semen import permit is issued, semen from bucks of estimated superior breeding value for milk production will be shipped from UCD for future use in the Breeding Project.

### Training

Mr. William Odenya, FAO Fellow from the Sheep and Goat Development Project, is continuing work towards the MS degree at Davis. He is using SGDP sheep data for his research. Estimated completion of the MS degree is Summer 1982. Nine years birth and weaning weight data on Dorper and Dorper-Masai crosses have been edited and used to estimate correction factors for type of birth and rearing, age of dam and season, and for age at weaning. Analyses of the relationship between degree of wool cover of the ewe and weight of her lambs are in progress; preliminary results suggest a marked negative association.

Mr. Alfeyo Okeyo-Mwai of the MLD staff entered the MS program in Animal Science at UC Davis in September 1981. He is sponsored by a CRSP traineeship, and has successfully completed two quarters of coursework. He should complete the MS in March or June 1983.

Mr. Edward Rege of the University of Nairobi also enrolled at UCD in the MS program in September 1981, supported by a World Bank Fellowship. Although not formally a part of the SR-CRSP, his enrollment at Davis was recommended by Dr. David Kimenye, Co-PI on the CRSP Breeding Project.

#### Other

A paper on the potential of goats for milk production in tropical countries was presented at the APSK Annual Meeting and Symposium in Nairobi in November 1981. Plans for research on response of different breeds and crosses of goats to trypanosomiasis challenge have been developed in collaboration with Washington State and ILRAD scientists.

A decision was made in April 1982 to transfer the Kenya Breeding Project to Texas A&M, with the exception that UCD may continue to provide buck semen for use in Kenya. This decision was taken in order to free PI time and resources to meet the request for a CRSP Breeding Project in Morocco. Some time has been spent during the year in planning the Morocco project.

Assuming that the impediments to introduction of dairy germ plasm can be removed, the SR-CRSP Breeding Project at Texas A&M should be in a position to make key contributions to achievement of overall program goals of the Kenya CRSP.

Annual Report For 1981/82

1. Project Title: Genetic Improvement of Sheep and Goats for Smallholder Production Systems
2. Institution: University of California, Davis
3. Principal Investigator: G. E. Bradford
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$328,984\*  
Matching Contribution from 1981/82 Subgrant: \$79,063

5. Project Goals

The long term goals of the US component of the project are:

- A. To provide training in sheep and goat breeding and management for persons from participating countries, other developing countries, and the US.
- B. To support analysis and publication of data from the project and of other sheep and goat data with a view to increasing the knowledge base on these species.
- C. To utilize US dairy goat DHIA records for genetic evaluation purposes, and to use the resulting information to select superior sires for use in the overseas components of the program.
- D. To compare ranking of sires in the US and in a tropical country such as Kenya, to add to knowledge of genotype-environment interaction and thus to develop more effective breeding programs for tropical countries.
- E. To provide backup support for overseas activities.

6. Summary of Accomplishments

The UCD Breeding Project has been active in the training area and in analysis of sheep and goat data from several countries during 1981/82. Work in Indonesia has been limited by delay in filling the position for a full time person on-site due to lack of applicants. However, the position has been filled effective July 1, 1982. Work in Kenya has been severely hampered by a series of diseases and associated constraints.

The US component of the UCD Breeding Project has emphasized the following areas:

\* includes carry forward

- A. Development of the goat research and teaching facility.
- B. Analysis of US and Venezuelan goat data, and UC and Kenya sheep data.
- C. Training.

Work at the goat facility during the past year included purchase of bucks, based on our genetic evaluation from DHIA records, for shipment to Kenya. As indicated above, permission to ship these was granted and then rescinded, and the majority had to be sold because of lack of space and funds to maintain them. However 10 good bucks, including 6 CAE negative bucks, were kept and are being used to produce semen for freezing. Ms. Erma Drobnis, PhD student in Physiology, is carrying out research on methods of preserving goat semen.

The 19 CAE-free does purchased from Washington State for shipment to Kenya have been kept, and are providing milk for all kids in the herd. WSU is testing the kids for CAE, to determine if in fact they are CAE free, as it is expected they will be, based on the fact that the disease is transmitted primarily through the milk. If this is successful, it will indicate a practical way of developing CAE-free herds.

The goat facility is providing opportunities for several students to obtain work experience each quarter, and is attracting a surprisingly large number of visitors from the US and other countries.

The Breeding Project has provided funds for the analysis of a large data set from a goat crossbreeding experiment in Venezuela by Dr. Omar Garcia, who presented two papers on this at the International Goat Conference, Tucson. The project also supports the analysis of the Kenya SGD sheep data by Mr. William Odenya. Analysis of US DHIA goat data was continued.

A paper on relationships between production and milk production was presented in Tucson, and is now in press in the Journal of Dairy Science. Work on a second buck evaluation, using current DHIA records, is underway.

Data from a long-term UC sheep experiment on selection for growth rate and multiple births is being analyzed by three PhD candidates, from Chile, Uruguay and the US. The project has also provided some support for research on the ovulation rate of these lines of sheep by Dr. J. F. Quirke of the Irish Agricultural Institute, who is spending 1981/82 on sabbatical leave at Davis. Dr. Quirke has provided training in reproduction research to UCD graduate students from at least six countries, participated in the Prolific Sheep Workshop and has contributed to development of the Morocco program, and plans to go to Indonesia during 1982/83 to work on the CRSP Breeding Project there.

Training activities have been mentioned in connection with activities at the various worksites. Currently the Breeding Project is providing all support for three trainees (Okeyo, Setiadi, Subandriyo) and has provided computing support during the past year for five (Odenya, Kenya; Garcia, Venezuela; Gonzalez, Uruguay; Neira, Chile; Lasslo, US).

Annual Report for 1981/82

1. Project Title: Improvement of Goat and Sheep Production by Reduction of Disease Loss
2. Institution: Washington State University
3. Principal Investigator: Francis R. Abinanti
4. Funds allocated from:
  - Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$175,000
  - Matching Contributions from 1981/82 Subgrant: \$80,923
5. Statement of Project Goals
  - A. To assess the prevalence and economic significance of major small ruminant diseases and ectoparasites.
  - B. To adapt and modify known successful control and prevention programs, to develop new research and development approaches to small ruminant diseases, and to initiate a program of improved animal health management, chemoprophylaxis, and therapeutics.
  - C. To coordinate information regarding small ruminant diseases, nutrition, genetics, animal husbandry, and land management in the establishment and implementation of a Herd Health Program.
  - D. To expand the technologies within Kenya through interaction with their scientists and provide graduate education for selected students from Kenya.
  - E. To assist Kenya in training existing personnel in disease control programs, diagnostic, extension, and research techniques.
6. Summary of Accomplishments in Previous Years
  - A. Identified collaborators in Kenya.
  - B. Designed and implemented small farm animal health investigation.
  - C. Implemented graduate training program.
  - D. Implemented research on goat diseases at WSU that would interface with the training and research program in Kenya.
7. Statement of Specific Objectives for 1981/82

The veterinary objectives continue to be as originally enumerated. The overall aim is to expand and improve methods of maintaining health and maximum productivity of small ruminants in the more humid and densely populated areas

of Kenya and to apply these methods, in particular, to dual purpose milk and meat goats.

These objectives are to be achieved in conjunction with scientists in Kenya and with an extensive program of training for Kenya professional and paraprofessional staff, both within Kenya and graduate training at WSU.

An additional objective is to promote interest and activity in research on diseases of goats and sheep by WSU, College of Veterinary Medicine Staff to provide needed information for the control/prevention of diseases in Kenya.

## 8. Technical Accomplishments

### Part I - Graduate Student Training Program

#### A. General Description of the Graduate Program

An important component of the SR-CRSP, as agreed between the Ministry of Livestock Development (MLD) of Kenya, and Washington State University, was the training of selected graduate students to the level of a Master of Science (MS) degree. Following extensive discussion between representatives from both countries, including personnel from the Washington State University Graduate School, a procedure for the program was agreed upon and established in 1981. The procedures were designed to ensure that the students would receive the best training available while in the United States, and would then be able to apply that training directly and meaningfully to field problems existing in Kenya's small ruminant herds. To guarantee that the program of study chosen by the trainee would fit the faculty interests and technical facilities available at WSU, as well as the field and laboratory opportunities available in Kenya, each trainee, under the guidance of an advisor, was to choose a suitable topic and work throughout the study in close accord with an MS Committee formed of both Kenyan and US representatives. Following some preliminary field experience in Kenya, the initial year was to be spent doing course and laboratory work in the United States and the second year doing field research related to the thesis topic in Kenya. Such a system has worked to the benefit of both countries as Kenyan expertise is shared with WSU faculty while the participant is in the US, and US training in specific techniques has been carried back to Kenyan counterparts during the research phase.

#### B. Summary of the activities of graduate trainees in SR-CRSP program

##### 1. Dr. Johnson Bari (DVM - Ministry of Livestock Development, Kenya)

Thesis proposal: To develop and establish a serologic diagnostic test for detection of contagious caprine pleuropneumonia (CCPP) infection of goats.

Advisors in Kenya: Drs. Bell, Waghela, Heinonen, Kariuki

Current Status: Dr. Bari came to the US in February 1981, following some preliminary work with SR-CRSP personnel in the Small Farm Animal Health Survey, and enrolled as an MS student in the Department of Veterinary Microbiology and Pathology in the spring semester. He completed his year of studies in the spring of 1982, and

has now returned to Kenya to complete research development and data collection relevant to his thesis.

2. Dr. Stanley Mbwiria (DVM - Ministry of Livestock Development, Kenya)

Thesis proposal: Determination of whether selenium and other mineral imbalances are creating a disease problem for goats in selected ecologic zones of Kenya.

Advisors Drs. Bell, Said, Ruvuna, Waghela

Current Status: Dr. Mbwiria worked with SR-CRSP personnel in Kenya, prior to his arrival in the US in 1981. He enrolled as an MS student in the Department of Veterinary Comparative Anatomy Physiology and Pharmacology in the spring semester of that year, and completed his year of studies in the spring of 1982. He has now returned to Kenya to complete field work related to his thesis.

3. Dr. J. Njanja (DVM - Ministry of Livestock Development, Kenya)

Thesis proposal: Not final at present, will be in the area of "Control of Haemonchus infections in exotic crossbred goats in Kenya."

Advisors: Dr. R. Wescott is the major advisor and a committee in Kenya is being selected.

Current Status: Dr. Njanja arrived in the US and enrolled as an MS student in Veterinary Parasitology in the spring of 1982. He has completed that semester successfully, and is working with Dr. Wescott and Kenyan scientists on final selection of his research proposal.

4. Dr. D. Mwamachi (DVM - Ministry of Livestock Development, Kenya)

Thesis proposal: Not final at present, will be in the area of "Trypanosomiasis control in goats."

Advisors: Dr. T. McGuire will act as advisor prior to final committee selection from the MLD and ILRAD staff.

Current Status: Dr. Mwamachi is scheduled to arrive for the spring semester, 1983, with return to Kenya in January 1984.

#### C. Outline of Program for Kenya Master of Science Degree Candidates

1. Candidates selected and approved by Ministry of Livestock Development, SR-CRSP faculty, and graduate school admissions office of WSU.
2. MS Committee formed at WSU.

3. Candidates conduct preliminary field/laboratory work in Kenya with SR-CRSP personnel/MLD staff.
4. Candidates develop thesis and academic recommendations with assistance of committee and sub-committee.
5. Course work in US - approximately one year - academic preparation and development of thesis topic.
6. Return to Kenya and completion of field and laboratory work for thesis, writing of thesis.

## Part II - Small Farm Animal Health Investigation

### A. General Background

As the primary objective of the Washington State University Animal Health component of the SR-CRSP project is the improvement of herd health in Kenya, an important prerequisite to the development of meaningful research directions is an understanding of the common health problems existing in a typical small farm herd. An investigation protocol was developed in response to this need for quantified baseline information on the incidence and prevalence of disease in small ruminants in Kenya. The survey was first suggested in 1979, after a site visit by Drs. Abinanti and Huber, and a detailed workplan was developed in February of 1980, after extensive discussion between Dr. Abinanti and personnel from the Ministry of Livestock Development (MLD), FAO-Sheep and Goat Development Project, and other SR-CRSP units, particularly the Economics unit of Winrock International. The survey was initiated in December 1980, under the general direction of Dr. Paul Sayer, WSU field director in Kenya, with valuable assistance, both in the field and in the laboratory, from MLD and SR-CRSP staff. The objectives of the survey are summarized briefly below:

### B. Objectives

1. Assess the incidence and prevalence of infectious and non-infectious diseases in goats/sheep in small farms in Kenya.
2. Establish baseline data for use in final evaluation of herd health improvement at the conclusion of the SR-CRSP project.
3. Provide administrators and investigators with a list of priorities for use in the development of future research proposals and trainee programs. Also to provide an indication of the specific types of technical assistance that might be required to implement such research.
4. Assist Washington State University personnel in the development of a strong working relationship with staff members from the other SR-CRSP units, the MLD, and other agencies currently operating in Kenya.

5. Provide information which might be useful to other SR-CRSP units and professionals in the small ruminant health field.

#### C. Brief Description

The following summary is given in this progress report as an aid to the reader in quickly reviewing the principal facts concerning the study.

The investigation was conducted as proposed, starting in December 1980. A total of 495 goats and sheep on 69 small farms in the Siaya and Kakamega districts were examined. Three hundred and forty-four (344) of them were followed for the entire period, December 1980 - October 1981, each farm receiving 3 visits. The farms were selected on the basis of local recommendations, with the consultation and advice of personnel from the MLD, and other SR-CRSP units. Care was taken to choose representative farms within a wide range of ecological characteristics, which would allow for the maximum amount of cooperation, and minimum amount of interference with other ongoing studies by other groups.

All of the animals examined by a team of SR-CRSP and MLD personnel, including trainees selected for the MS program at WSU (Drs. Bari, Njanja, and Mbwiria), were tagged for identification, aged by number and condition of teeth, sexed and assessed for general health. External parasites were noted and enumerated, and samples of blood and feces taken for later analysis.

#### D. Summary of Progress toward original objectives.

1. The "Small Farm Health Survey" was completed in October 1981 and publications are being prepared.
2. Baseline information on small ruminant health in Kenya is now established.
3. The information gathered has already been put to use in the designing of research proposals for the four Kenyan trainees, and for the current research plan, and will be used in the development of future projects.
4. WSU personnel have benefited directly from the experience of working with other professionals from MLD, SR-CRSP units, and other agencies and feel strongly that they progressed to a sound working relationship with their colleagues in Kenya.
5. The information available from the survey will be supplied to others working in Kenya, and should be applicable to related projects.

### Part III - Research Assistance

#### A. Consultation and research provided by Dr. Scott Adams.

In December of 1981, Dr. Scott Adams, Veterinary Medical Pathologist of the Animal Disease Research Unit, USDA and the Department of Veterinary Microbiology and Pathology, Washington State University, provided research assistance to the Government of Kenya in the emergency situation resulting from the

appearance of caprine arthritis-encephalitis virus (CAEV) in Kenya goats. Because the indigenous African goat population was serologically negative to this virus, the incidence of CAE virus was thought to be the direct result of the importation of exotic goat breeds from the United States and/or Europe, where CAEV is endemic in the goat population. In addition to the direct dangers to the native goat population in Kenya and surrounding countries, the appearance of the disease had wide political ramifications that threatened the continuation of several small ruminant research and improvement programs.

Dr. Adams made an initial stop in the Netherlands, where he discussed the situation with scientists at the Central Veterinary Institute in Lelystad. He conducted tests for CAEV antibodies on goat sera from France and Switzerland to confirm the generally held view of the rate of infection in European goats (65-77%). In Kenya, he discussed the problem with scientists and officials from the SR-CRSP program, the Ministry of Livestock Development, and other research units operating in Kenya. He then spent 2 1/2 weeks conducting tests for CAEV on the sera of 936 goats from Kenya, 100 from the Sudan, and 102 from Somalia. His work clearly demonstrated that transmission of CAEV from goats imported from the US was appreciably nil (one + reaction), and had been well contained. In addition, the results indicated that horizontal transmission was not a problem, the virus apparently not passing from buck to doe via breeding. Nor did there seem to be any evidence for vertical transmission via sperm to kids. Officials from the MLD, ILRAD, SR-CRSP program and other research programs had a final meeting with Dr. Adams to discuss the results and future courses of action necessary to prevent a reoccurrence of the infection. At that seminar, Dr. Adams shared information concerning related work on CAEV currently in progress at WSU, as well as technical aspects of research procedures used in that work.

On his return from Kenya, he stopped in Washington, DC, to report on the successful resolution of the CAEV problem to USAID officials. The research assistance provided by Dr. Adams during that time was of great benefit to both countries, and resulted in the establishment of lasting improvements and increased vigilance in small ruminant importation procedures. A paper fully discussing CAEV transmission results from this trip and has been submitted for publication.

- B. Technical Research Assistance provided by visits of Mr. Steve Schmidt, Veterinary Physiology and Mrs. Karen Farnsworth, Veterinary Parasitology, June-July 1981.

In June and July of 1981, two technicians from the College of Veterinary Medicine, Washington State University, travelled to Kenya to assist scientists and technicians at the Veterinary Research Laboratory in Nairobi in the establishment of specific research techniques.

1. Steve Schmidt, veterinary physiology technician at WSU, and a specialist in spectrophotometry, examined the equipment available at the Veterinary Research Laboratory to assess its suitability for use in selenium, molybdenum, and copper analysis. Unfortunately, he found the unit was inoperable, and in need of major and expensive repair and alteration. During the remainder of his visit, Mr. Schmidt made extensive inquiries in the local area as to the availability of other spectrophotometers, located some usable equipment both for purchase

and/or loan use, made repair cost estimates and arrangements, performed some minor repairs, and instructed the technical staff in the care and operation of the machine, as well as details of sample collection and tissue preparation. Upon his return, he presented his findings to Drs. Abinanti and McGuire, and counseled Dr. Stanley Mbwiria as to what would be available for his use during the research phase of his training. Dr. Mbwiria took detailed instructions, and lists of contacts with him when he returned to Kenya in the spring of 1982. The technical recommendations were used by Dr. McGuire in planning the proposed budget, and it is expected that the improvement in equipment and technical expertise resulting from this trip will assist Dr. Mbwiria and many others in Kenya.

2. Karen Farnsworth, veterinary parasitology technician, travelled with Mr. Schmidt to the Veterinary Research Laboratory, and personally delivered a Titertek Multiscan ELISA Reader (Flow Lab) and accessory equipment for use in ELISA testing. She instructed the staff in the details of the ELISA procedure, including sample preparation and use of the equipment. In addition, she visited the parasitology laboratories and offered suggestions for updating and improving some of the routine methodologies. Mrs. Farnsworth also presented an introduction to the techniques used in testing for caprine arthritis and encephalitis (CAE), and delivered a small supply of the reagents necessary for these procedures. This equipment and exposure to specialized laboratory techniques will be useful to the staff at the Veterinary Research Laboratory, who will be working with ELISA and CAE tests increasingly as the projects funded by the SR-CRSP Herd Health Component progress.

## Annual Report for 1981/1982

1. Project Title: Dairy Goat Production Systems for Smallholder Agriculturists
2. Institution: Winrock International Livestock Research and Training Center
3. Principal Investigator: H.A. Fitzhugh
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$252,940
Matching Contribution from 1981/82 Subgrant:	\$103,773

5. Statement of Project Goals

The goal of the dual-purpose goat production systems project, including the feed production component, is to improve the welfare of small scale farm families in high potential tropical regions of developing countries. This goal will be attained by improving the nutritional status of family members and providing additional income from the sale of animal products.

An additional goal is to develop technical and scientific personnel interested and qualified in multidisciplinary research relevant to the needs of developing countries.

6. Summary of Accomplishments in Previous Years

Foreign activities in Program Year 1 were primarily devoted to design and initiation of a research program on dual purpose goat systems for small farms in the humid tropics. Principal accomplishments were administrative (assignment of facilities, personnel; arrangement of work permits, banking, vehicles, insurance, housing) rather than technical. The essential groundwork was laid for initiating the research program.

In October 1980, the Small Farm Systems Survey was initiated to characterize small farms and evaluate potential for dual-purpose goat production. This survey encompassed a full production year. The Ministry of Livestock Development assigned land, facilities, and personnel at the Maseno Veterinary Station and preliminary experiments on the nutrition and management of cross-bred (dairy-East African) goats began in May 1980. Initial results from the Farm Survey and Station experiments are reported in following sections. Conclusions from a kid rearing experiment at Winrock's Petit Jean Goat Dairy (Morrilton, Arkansas) were that commercial milk replacers were not appropriate for rearing kids but that partial suckling and/or feeding cold goat milk were satisfactory practices. A computer based bibliography of international goat literature was established.

## 7. Statement of Specific Objectives for 1981/82

### Nutritional Strategies

- A. Develop practical means of meeting year-round feed requirements for goats utilizing low-cost feed resources available to small farmers in humid tropics.
- B. Evaluate performance of dual-purpose goats on rations based on low cost feed resources.
- C. Compare feed requirements, preferences, and efficiency of goats and cattle for dual-purpose production.

### Small Farm Systems Survey (in collaboration with Health, Sociology and Economics Projects).

- A. Characterize small scale farm systems in Kenya, including biological, economic, and human resources and constraints.
- B. Evaluate interaction between resources, especially potential competition between livestock and cropping activities for land, labor, and capital resources.
- C. Identify priorities for research to develop and implement a viable dual-purpose goat component for small scale farm systems.
- D. Provide baseline data for assessment of biological, economic, and sociological interventions in small farm systems.

### Training

- A. Provide training in multidisciplinary systems research methods.
- B. Identify and support qualified candidates for training at US or Kenyan academic institutions.

In October 1981, a sub-project, "Feed Production Systems for Dual-Purpose Goats on Small Farms," was added to the Production Systems Project. Objectives of this subproject include:

- A. Evaluate feed (by-products, residues) and food productivity of typical cropping systems in western Kenya.
- B. Evaluate interactions (competition, complementation) between food and forage crops and between crop and animal components of farming systems.
- C. Design and test interventions to cropping systems to improve feed production for dual-purpose goats.

## 8. Description of Work Undertaken

Principal activities initiated in Kenya were:

### A. Small Farm Systems Survey

- Characterize small farm systems in western Kenya
- Identify priorities for on-farm and on-station research
- Provide baseline data for assessment of interventions

### B. Nutrition and Management of Goats

- Evaluate requirements and performance of goats utilizing feed resources available on small farms
- Compare requirements and productivity of alternative types of dual-purpose ruminants, goats, and cattle

### C. Feed Production

- Analyze crop and forage production systems currently used by small farmers
- Develop and test interventions to improve production of feed without decreasing food crop production

### D. Feed Preservation

- Develop and evaluate methods for preserving feed surplus from wet season for use in dry season

Procedures and preliminary results from these activities are reported under Technical Accomplishments.

Personnel involved in research in Kenya included (all are based at Maseno):

Ministry of Livestock Development: M. Mathuva, M. Nderito, K. Otieno, M. Salim

Winrock International: K. J. Boor, D. L. Brown, S. R. Russo, M. W. Sands

H.A. Fitzhugh and R.D. Hart (Co-Investigator) spent August 1981 and March 1982 in Kenya to assist in the design of experiments and the development of work-plans.

Enumerators for the Small Farm Systems Survey were H. Kiguhi, P. Amuhinda, L. Ongecha, O. Evans, E. Ochieng, and J. Onyodhomenya. They were provided by the Central Bureau of Statistics, Ministry of Finance and Economic Planning.

J. N. Kibuchi is completing requirements for the MS degree (Ruminant Nutrition) at Tuskegee Institute with financial support from the Production Systems Project.

## 9. Technical Accomplishments

### Small Farm Systems Survey

This survey was a joint activity of the Production Systems, Economics, and Sociology Projects of the SR-CRSP in Kenya. Principal collaboration for this research was with the Ministry of Livestock Development and the Central Bureau of Statistics of the Ministry of Finance and Economic Planning.

Initial work focused on Western and Nyanza Provinces. Kakamega District is agriculturally a high potential area. Rainfall is typically bimodal with an annual fall between 1750 and 2100 mm (Figure 1). Altitude ranges from 1400 to 1800 m. The most important food crops are maize and beans, usually intercropped. Other food crops include sorghum, cassava, sweet potatoes, and bananas. The principal cash crops in the area are trees, tea, and coffee. Principal livestock species are grade and zebu cattle, hair sheep, East African goats, and poultry. The dominant tribe in the rural areas is the Abaluhya. There is an extremely high land pressure of 328 people/km<sup>2</sup>.

Siaya District is considered a medium potential zone. Rainfall is bimodally distributed with an annual mean of 1000 to 1300 mm (Figure 2). Altitude ranges from 1140 to 1500 m. Natural vegetation is dominated by invasive shrubs and poor quality grasses. Principal food crops include maize and beans, cassava, sorghum, sweet potatoes, bananas, and minor pulses. Cash crops include trees, cotton, and sugar cane. Grade cattle are rare in Siaya, but there are large numbers of zebu cattle, hair sheep, East African goats, and poultry. The 1979 census indicates there are approximately 185 people/km<sup>2</sup>. Luo is the dominant tribe of Siaya.

### Methodology

The survey was comprised of several distinct components. Single point questionnaires included a baseline module; modules on sociological attitudes; animal management practices; and labor utilization. The other major component was a 28-day cyclical monitoring survey.

Baseline data included:

1. Household consumption
2. Description of land and crops
3. Numbers and use of buildings
4. Livestock numbers
5. Other capital resources

The monitoring survey included:

1. Changes in household composition
2. Changes in land and capital resources
3. Purchases of crop or livestock inputs
4. Status of field crops
5. Changes in livestock herd
6. Status of individual animals

7. Labor utilization of last 7 days
8. Animal feeding of last 7 days
9. Milk production over last 7 days

Quality changes in livestock feed resources and prices at local livestock markets were monitored.

Enumerators were chosen from the respective tribes in the selected clusters. All enumerators lived in or nearby assigned clusters. The sample frame used was part of a nationwide stratified sample previously used in the Integrated Rural Surveys. This frame stratified the entire smallholder area of the country into agro-ecological zones.

## Results

Table 1 shows mean farm size by class and district. Siaya farmers tended to have slightly larger farms (2.70 acres) than Kakamega farms (2.42 acres). The average household size in Kakamega and Siaya Districts were 7.95 and 4.65 persons, respectively (Table 2).

A brief summary of the major long rains crop combinations is presented in Table 3. The maize and beans intercrop is the most important long rain crop; 80 percent of all farms grow at least some maize and bean during the long rains. Cassava was grown equally across all farm sizes; but cassava was much more common in Siaya (63 percent of farms) than in Kakamega (23 percent of farms). Cassava is viewed as a reserve crop to be used during the dry season or after maize crop failures. All farms utilized approximately 60-70 percent of their total land area for the production of food crops. Cash crops are of varying importance. In Siaya, almost none exist. In Kakamega, however, 45 percent of the farmers grow at least one cash crop. Land available for grazing occupies between 25 and 30 percent of the farm area across all farm size classes. This land is typically the yard area around the house and fallow land in the food crop rotation.

Livestock represent an important component of small farms in Western Kenya. Some type of livestock are seen on almost all farms. Poultry were found on 83 percent of all farms. Ruminant livestock were found on 61 percent of all farms (Table 4). Cattle are the most valued livestock. In Kakamega, there has been some influence of the national artificial insemination programs. Crossbred cattle were found on 15 percent of the Kakamega farms. No farms in Siaya kept crossbred cattle. Crossbred cattle numbers increased with farm size. Sheep and goats play a lesser role on the farms in both districts. All sheep were of the native hair type, with either fat tails or fat rumps. Goats were of the small East African breed. They are considered difficult to control and to keep out of crops. Numbers of all types of livestock increased with increasing farm size.

Within all species, the herds typically have between 60 and 74 percent females. Females of reproductive age represent 39 to 45 percent of the herd or flock. Only Siaya had any castrated animals. The oxen are kept for plowing while the goats are kept for later slaughter. Animals are typically castrated at older ages (3-4 years old). The liveweights of the animals were low. Mature weights and other production coefficients

are presented in Table 5. Parturition intervals were calculated for all animals that had at least two parturitions that the farmer remembered. The milk yield of cattle above that used by the calf was calculated by extrapolating from a 7-day test period field across months of lactation.

The principal constraint on livestock production on small farms in Western Kenya is undoubtedly inadequate nutrition. DM production from farm grazing areas was estimated. Then, using quality analyses on samples taken over the year, Mcal of Digestible Energy (DE) produced for every farm was computed. This was supplemented by the DE from maize stover. Maize stover DE provides 45 percent of the total in Kakamega, but only 33 percent of the total in Siaya. No farmer in the survey ever bought commercial feed for his ruminants. However, all farmers took their cattle, sheep, and goats off the farm to graze at some time. Usually animals would be released from the night boma in the morning and tethered on the farm for the remainder of the morning. Around noon, the animals would be herded off the farm to be watered and fed along public ways until about five or six in the evening, when they would be returned to the night boma.

Feed production is principally from low quality grasses. Stover production is low and not sufficient to warrant the extra labor required to cut and transport to a confined goat herd. With only .93 workers per acre, there is not sufficient additional labor to support the large amounts of time required for a cut and carry system in an area with such low productivity. In explaining why so few goats are kept in Kakamega, farmers explain that the animals are difficult to herd and threaten the growing crops. Thus, a goat production system in this area would require at least partial confinement. With maize stover now producing about 45 percent of the farm DE and enough labor (1.73 workers/acre) to harvest it, crop residues could potentially be utilized in a semi-confinement system.

### Conclusions

Principal constraints to dual-purpose goat production on small farms in western Kenya include:

- A. Availability of sufficient amounts of adequate quality feed on a year-round basis. Farm sizes are small, family sizes are large; and the demand for food crops supercedes production of feed crops for livestock. Thus, strategies are needed for meeting nutrient requirements from food crop residues and forages on marginal lands and for preserving seasonal surpluses for use in dry season.
- B. Health constraints to the dual-purpose goat component were evaluated by the Health Survey conducted by the Animal Health Project. A factor which will influence the acceptance of dual-purpose goats is their susceptibility to disease and parasites relative to the susceptibility of cattle and sheep.
- C. Management constraints include the need to control goats, especially keeping them out of growing crops, and to protect them from climatic stresses, predation, and theft. Housing must be simple and low cost. Processing milk products to preserve nutrient value and safety for human consumption are also a management concern.

- D. A major constraint is lack of a genotype capable of producing sufficient milk to rear kids with surplus for human consumption which is also adapted to the production environment. The Breeding Project is addressing this constraint.
- E. Socioeconomic constraints to acceptance of dual-purpose goats include competition for labor, prejudices against goats and/or goat products, lack of credit, extension, and marketing infrastructure.

## Nutritional Strategies for Dual-Purpose Goats

### Goat Nutrition

From July 4, 1981, to August 5, 1981, six lactating, mature East African x Toggenburg does were fed fresh unchopped sweet potato vines and milked at 0700 and 1530 hours each day. They had no access to free water or mineral supplements. The second trial was similar to the first and involved five of the same crossbred does. This group of animals was fed chopped sweet potato vines and offered fresh water, free choice.

The third trial involved the performance of thirteen 4-6 month old East African x Toggenburg cross does during three time periods. During the first period (August 27 - October 7), a mix of chopped sweet potato vines and ground maize and cobs was fed ad lib with fresh water and "Macklic Plus" (a mineralized salt containing Ca and trace minerals). During the second (October 7 - 31) and third periods (October 31 - November 24), the goats received only sweet potato vines. During these latter two periods, fourteen dry, mature does were fed sweet potato vines without supplement in the same manner as the kids.

Lactation performance is summarized in Table 6, growing kid performance is summarized in Table 7, and dry doe performance is summarized in Table 8. Dry matter intake as a percentage of body weight was lowest (2.5 - 2.8%) for dry does, highest (6.1 - 6.8%) for lactating does and intermediate (3.9 - 4.8%) for young growing does. Table 9 compares estimated nutrient requirements to actual nutrient consumption. Free choice feeding of sweet potato vines clearly exceeded the NRC 1981 Energy and Protein requirements of goats during growth, modest lactation, and maintenance. These results suggest that feeds of lower nutrient concentration (such as maize or sorghum stover) could be substituted for part of the sweet potato vines in the diets of these three animal groups.

### Feed Preservation

From August to December 1981, trials were conducted at Maseno to evaluate procedures for preserving small batches of forage. Two hundred-liter barrels were employed to make silage from maize and sorghum stovers with and without the addition of sweet potato vines. About 50% of maize silage made with mud and metal lids spoiled, 75% of silage made without lids spoiled, and all the sorghum stover silage spoiled. In addition, all batches heated dramatically. These losses were attributed to poor packing at the time of ensiling, inadequate anaerobiosis, low moisture content, and "prespoilage" due to exposure of substrate to rainfall.

A formal experiment was carried out in December. Two maturity levels of maize stover (green vs. mature) and three levels of sweet potato vine additions (0%, 20%, and 40% of wetweight) were arranged factorially and replicated three times. All substrate was continuously packed by stamping while the barrel was being filled. The barrel was covered with a plastic sheet (available at local markets) and metal lid. No major spoilage or heating has been detected. Analysis will include: Total spoilage loss, pH, ADF-N, Ca/P, dry matter, nitrogen, cell wall, and in vitro cell wall digestibility.

## Feed Production Systems

Forage research has been conducted for several decades in Western Kenya. In 1980, a collaborative project was initiated by the Ministry of Livestock Development and Ohio State University. The responsibility for the forage and feed resources component of the SR-CRSP in Kenya was transferred from Ohio State University to Winrock International in October 1981.

### General Strategy

Farming Systems Research (FSR) methodologies have been applied. FSR methodologies include the following basic steps:

1. Identification of the target area
2. Initial characterization of current production systems
3. Identification of physical, biological, and socioeconomic constraints
4. Identification of potential alternatives
5. Evaluation of potential alternatives on stations and selected farms
6. Evaluation of best alternatives on many farms
7. Mass transfer of technology to the target area

Much of initial characterization (step 2) has been done by a survey conducted by the Production Systems, Economics, and Sociology Projects. In order to complement the information available from the survey, the scientists responsible for the Feed Production Project interviewed farmers and technicians in both districts to form a general overview of the farming systems in the target area.

### Farming Systems, Cropping Systems, and Feed Production Systems

The first step in the identification of potential feed production systems was to identify the inputs, outputs, components, and interaction among components within the farm system. Figure 3 is a diagram of the system studied. The system has four subsystems; cut-and-carry forage crops, cropping systems, feed storage, and the animals. The inputs to the system are listed on the left of the diagram and the outputs of grain, milk and meat on the right. The different flows among the subsystems are depicted by arrows.

The feed production component of the project has the responsibility for the cropping systems and cut-and-carry subsystems of the total system shown in Figure 3. Initially, at least, the strategy adopted is to

attempt to increase animal feed output without a decrease in the output of food crops.

In much of Western Kenya, the rainfall has a bimodal distribution with a long dry season from December to March. The rainy season from March to December is interrupted by a dry period in August. The rainy period from March to August is commonly referred to as the "long rains", and the period from September to December is called the "short rains". Most farmers visualize their cropping patterns (chronological and spacial distribution of various crops) as starting at the beginning of the long rains and extending through the short rains.

In Kakamega, maize and beans intercropped are the dominant long rains crops. Finger millet is also planted in this season. During the short rains, intercropped maize and beans, maize and sorghum, sorghum and beans, and sorghum in monoculture are planted.

In Siaya, the rainfall distribution is significantly different from Kakamega. Not only is total rainfall lower, but the dry period between the long rains and the short rains is much more pronounced and drought is a major constraint during the short rains. The cropping patterns in Siaya reflect this rainfall distribution problem. Cassava is an important crop.

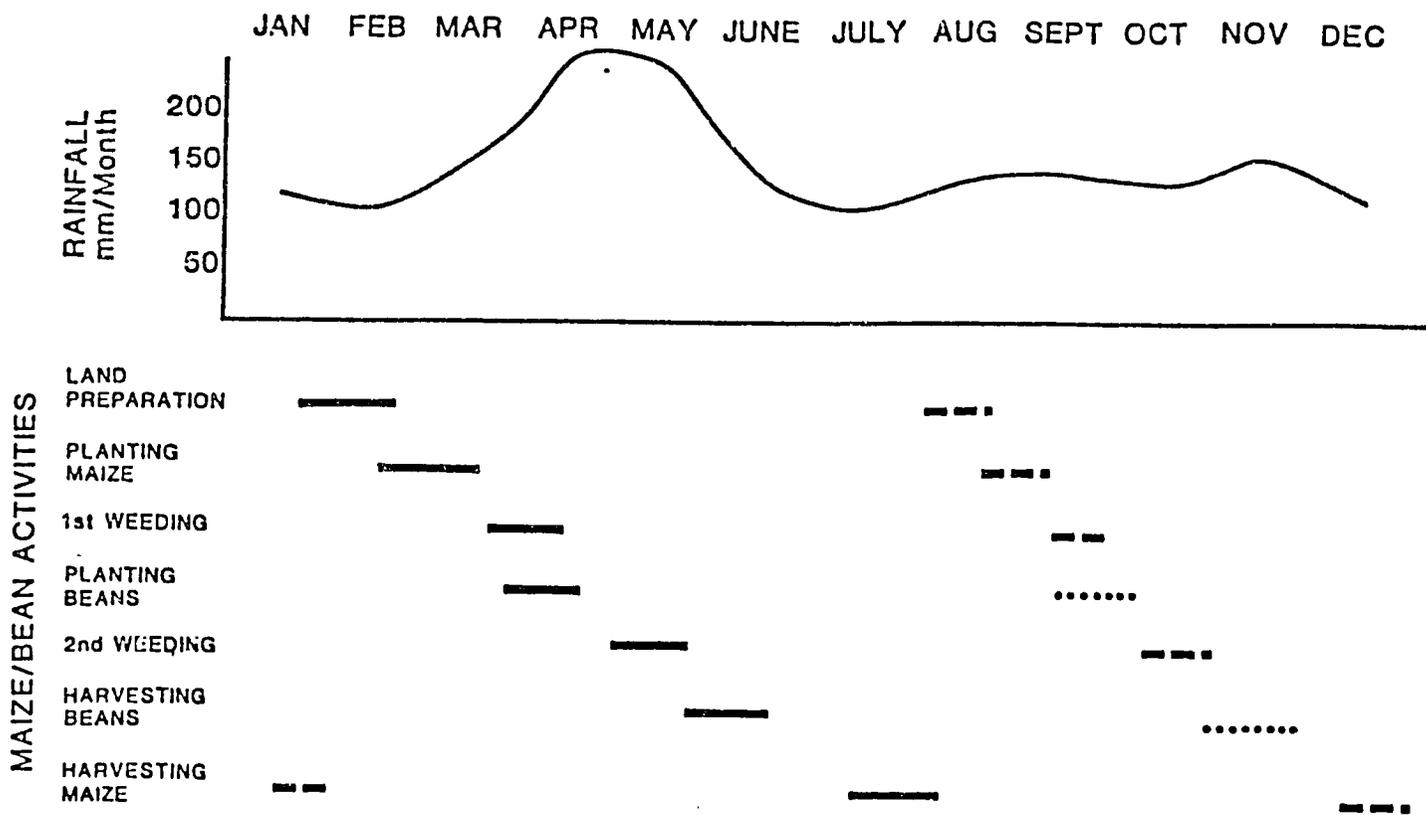
In addition to identifying predominant cropping patterns in Kakamega and Siaya, an attempt was made to subjectively characterize predominant farm system types. The farm system information was summarized in diagram form. The diagram indicates inputs (circles), outputs (arrows at the upper left) from the farm, the production systems (both crop and animal) and the commodities that are stored (tank symbol) on the farm. The diagrams indicate flows of materials, energy (solid lines), and money (dotted lines flowing in opposite direction to materials and energy).

Figure 4 is a diagram of a predominant farm system in Kakamega. Farmers sell maize, sorghum, beans, and cattle, and family members work outside the farm. They buy maize to eat, as well as hybrid maize seed, salt, tea, sugar, etc. Off-farm labor is required for planting. Common cropping patterns are intercropped maize and beans, followed by either intercropped maize and beans, or sorghum monoculture. Small plots of sweet potatoes are maintained continuously, as well as small plots for household vegetables. Farms typically have 10-20 chickens and 2-4 cows.

Figure 5 is a diagram of a predominant farm system in Siaya. Farmers generally sell the same commodities as in Kakamega. The cassava that is included in the cropping patterns is consumed on the farm. Farmers seldom buy hybrid maize seed. Farms in this area generally include some fallow land and the sheep and goats are tethered in this area, as well as off-farm in communal grazing areas.

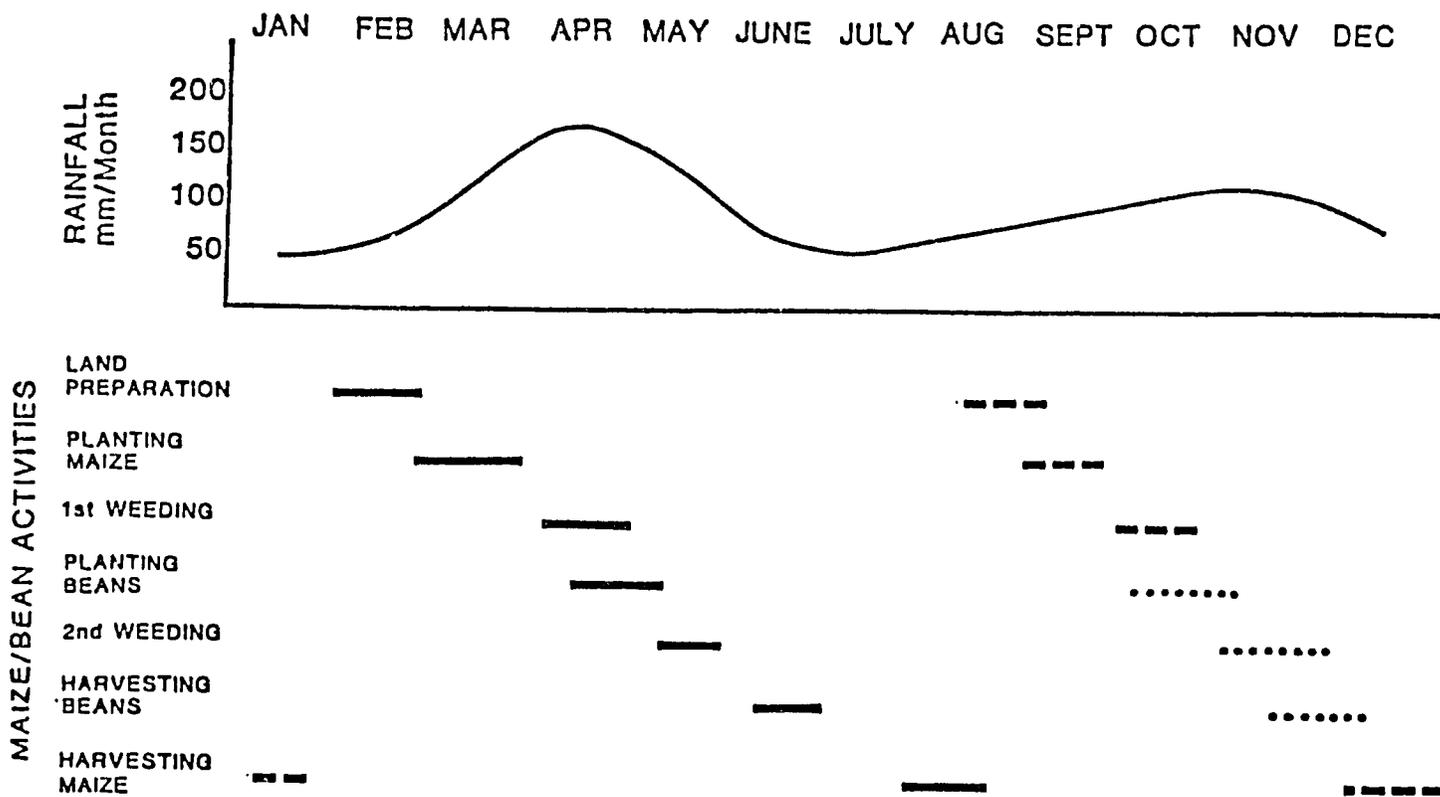
The following activities were begun during the short rains and dry season period of 1981:

1. A relatively large experiment on the Maseno field station that includes the dominant cropping systems in Kakamega and Siaya as main treatments and potential forage - increasing interventions as sub-treatments.
2. A monitoring of plots marked within farmers' fields in Kakamega that are planted to the same cropping systems included in the Maseno experiment.
3. A monitoring of plots marked within farmers' fields in Siaya that are planted to the same cropping systems included in the Maseno experiment.
4. A forage species screening experiment in Maseno.
5. An evaluation of the potential of goat manure as a crop fertilizer.
6. Evaluation of the forage production potential of maize by stripping and trimming during the growing season.
7. Evaluation of a sweet potato - maize relay cropping system.
8. A monitoring of the feed farmers select to feed goats that will be given to selected farmers as part of the animal nutrition project.
9. Relay cropping forage species with cassava, using both the forage and cassava for goat feed.
10. Evaluation of sweet potato vines as a source of animal feed.



Mean Monthly Rainfall and Maize/Bean Cropping Activities in Kakamega District

Figure 1



Mean Monthly Rainfall and Maize/Bean Cropping Activities in Siaya District

Figure 2

Table 1. Average Farm Sales of Surveyed Farms (Acres)

<u>Farm Size Class</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Number of Farms</u>	<u>Percentage of Sample</u>
Less than 1 acre	0.65	0.31	22	28
1-2 Acres	1.58	0.32	21	26
2-3 Acres	2.45	0.31	11	14
3-4 Acres	3.37	0.17	9	11
Over 4 Acres	5.90	1.89	17	21
<hr/>				
Siaya	2.70	2.19	40	50
Kakamega	2.42	2.08	40	50
<hr/>				

Table 2. Household Demographic Characteristics and Capital Resources

Demographic Variable	Farm Size Class					District	
	Less Than 1 Acre	1-2 Acre	2-3 Acre	Over 3-4 Acre	4 Acres	Siaya	Kakamega
Total Household Members	4.91	5.62	6.36	8.33	7.82	4.65	7.95
Male Members	2.65	2.94	3.27	4.00	3.53	2.23	3.68
Female Members	2.62	3.14	3.09	4.33	4.18	2.43	4.27
Workers <sup>a</sup>	1.41	1.10	1.09	2.00	2.35	1.05	2.05
Dependents <sup>b</sup>	3.50	4.52	5.27	6.33	5.47	3.60	5.90
Proportion of Households with Male Heads	32%	42%	55%	44%	53%	45%	43%
Total Members/Acre	11.53	3.80	2.64	2.47	1.42	4.01	6.21
Workers/Acre	3.32	0.75	0.45	0.59	0.44	0.93	1.73
Dependents/Acre	8.21	3.05	2.19	1.88	0.98	3.09	4.49
Panga and Jembe Value (Ksh)	56.86	57.33	66.64	57.11	73.59	45.32	78.50
Total Agricultural Implements Value (Ksh)	148.77	116.71	169.00	135.78	213.65	134.07	176.85

<sup>a</sup> Workers are members between the ages of 15-40.

<sup>b</sup> Dependents are members below the age of 15 or older than 40.

TABLE 3  
MAJOR LONG RAINS CROP COMBINATIONS AND PERCENT OF AREA IN CROP

FARM SIZE CLASS	MAIZE		MAIZE/BEAN		CASSAVA		CASSAVA/MAIZE		OTHER CEREALS		SWEET POTATO		TREES		GRAZING AREA		CASH		FOOD	
	N	RATIO <sup>a</sup>	N	RATIO	N	RATIO	N	RATIO	N	RATIO	N	RATIO	N	RATIO	N	RATIO	N	RATIO	N	RATIO
SIZE CLASS LESS THAN 1 ACRE	12	.28	14	.43	6	.21	2	.37	3	.18	1	.02	4	.22	22	.28	4	.26	22	.66
1-2 ACRES	9	.26	20	.42	9	.27	1	.24	3	.19	5	.04	5	.15	19	.26	5	.22	21	.72
2-3 ACRES	5	.17	8	.36	5	.24	1	.07	5	.29	2	.07	0	-	11	.36	0	-	11	.64
3-4 ACRES	4	.24	9	.37	5	.13	0	-	3	.11	3	.03	2	.06	9	.28	2	.19	9	.67
OVER 4 ACRES	12	.22	13	.33	9	.24	3	.08	3	.02	4	.08	17	.25	9	.11	17	.64		
SIAYA	29	.22	29	.32	25	.28	4	.20	15	.16	5	.04	1	.14	39	.30	2	.10	40	.70
KAKAMEGA	13	.29	35	.45	9	.07	3	.16	2	.38	11	.04	16	.13	39	.26	18	.19	40	.64

<sup>a</sup> ratio =  $\frac{\text{area of crop}}{\text{total area of farm}}$

Table 4. Animal Resources.

<u>Farm Size</u> <u>Class</u>	<u>Zebu</u> <u>Cattle</u>	<u>XBred</u> <u>Cattle</u>	<u>Cattle</u>	<u>Sheep</u>	<u>Goats</u>	<u>Poultry</u>	<u>TLU</u>	<u>TLU/</u> <u>Acre</u>
< 1 Acre	1.45	--	1.45	.41	.14	7.40	.99	1.52
1-2 Acres	1.04	.10	1.14	.52	.14	8.85	.65	.42
2-3 Acres	2.36	--	2.36	1.82	.91	10.33	1.57	.64
3-4 Acres	2.80	.22	5.00	1.22	.67	7.14	3.07	.91
> 4 Acres	2.00	.53	2.53	1.06	.06	14.60	1.41	.24
Siaya	2.40	--	2.40	.90	.42	12.31	1.58	.59
Kakamega	1.52	.33	1.85	.82	.15	7.53	1.04	.43

Table 5. Livestock Production Coefficients.

Variable	Siaya	Kakamega
<b>Cattle</b>		
Mature Weight (kg)		
Cows	174.0	214.0
Parturition Interval (mo) <sup>a</sup>	21.3	19.6
Lactation Milk Yield (kg) <sup>b</sup>	525.0	610.0
Lactation Length (mo)	9.8	10.9
<b>Sheep</b>		
Growth Rate (g/days) <sup>c</sup>	43.0	90.0
Mature Weight (kg)		
Rams	23.8	27.5
Ewes	20.9	26.1
Parturition Interval (mo) <sup>a</sup>	9.8	9.1
Lambs/Parturition	1.0	1.0
<b>Goats</b>		
Growth Rate (g/day) <sup>c</sup>	70.0	--
Mature Weight (kg)		
Bucks	31.3	28.2
Does	23.6	23.4
Parturition Interval (mo) <sup>a</sup>	11.0	10.0
Kids/Parturition	1.1	1.0

- a Parturition interval is calculated only for animals having at least two parturitions.
- b Over and above that taken by calf.
- c From birth to 180 days.

Table 6. Mature Crossbred Does -- 1981 Lactation Performance

Period	Milk Production (kg/day/doe)	Vines Consumed (kg dm/day/doe)	Body Weight (kg)	Dry Matter Intake (kg dm/kg BWx100)
July 4 -	0.8 ± 0.2	2.2	31.7 ± 5.8	6.8
August ±5	(198 goat days)	(33 pen days)	(6 does)	
August 6	0.5 ± 0.1	2.1	33.8 ± 6.1	6.1
August 19	(65 goat days)	(13 pen days)	(5 does)	

Table 7. Growing Crossbred Does -- 1981 Dry Period

Period	August 27- October 7	October 7- October 31	October 31- November 24
Body Weight (kg)	17.9 ± 2.2	17.6 ± 2.3	21.3 ± 4.2
Body Weight Gain (kg)	2.2 ± 1.3	-0.3 ± 1.5	2.9 ± 1.1
Free Water Intake (kg/day/doe)	?	0.14	0.07
Food Water Intake (kg/day/doe)	1.5	3.0	4.1
Sweet Potato Vine Dry Matter Intake (kg/day/doe)	0.4	0.7	1.0
Ground Maize and Cob Dry Matter Intake (kg/day)	0.3	X	X
Total DM Intake (kg/day)	0.7	0.7	1.0
DM Intake as % BW	3.9	4.0	4.8
N	13.0	13.0	13.0

Table 8. Mature Crossbred Does -- 1981 Dry Period.

Period	August 27- October 7	October 7- October 31
Sweet Potato Vine Dry Matter Intake (kg/doe/day)	0.8	0.9
Body Weight (kg)	31.2 ± 5.9	30.4 ± 6.3
Body Weight Gain (kg)	-0.4 ± 0.6	-0.4 ± 0.5
Free Water Intake (kg/day/doe)	0.18	0.18
Food Water Intake (kg/day/doe)	3.2	3.6
Dry Matter Intake (% BW)	2.5	2.8
N	14 goats	14 goats

Table 9. Comparison of Intake with Project Requirements for Nutrients.

	Dry Does	Growing Does	Lactating Does
DM Intake (kg)	0.8 - 0.9	0.7 - 1.0	2.1 - 2.2
*NE Intake Mcal	1.07 - 1.21	0.94 - 1.35	2.82 - 2.96
NE Required (1981 NRC)	0.92	0.88	1.64
CP Intake (g)	160 - 242	107 - 200	420 - 440
CP Required (1981 NRC)	62	60	159

NE, derived from ADF by:  $NE, (Mcal/kg) = 0.866 - (0.007 \times \%ADR) \times 2.204$

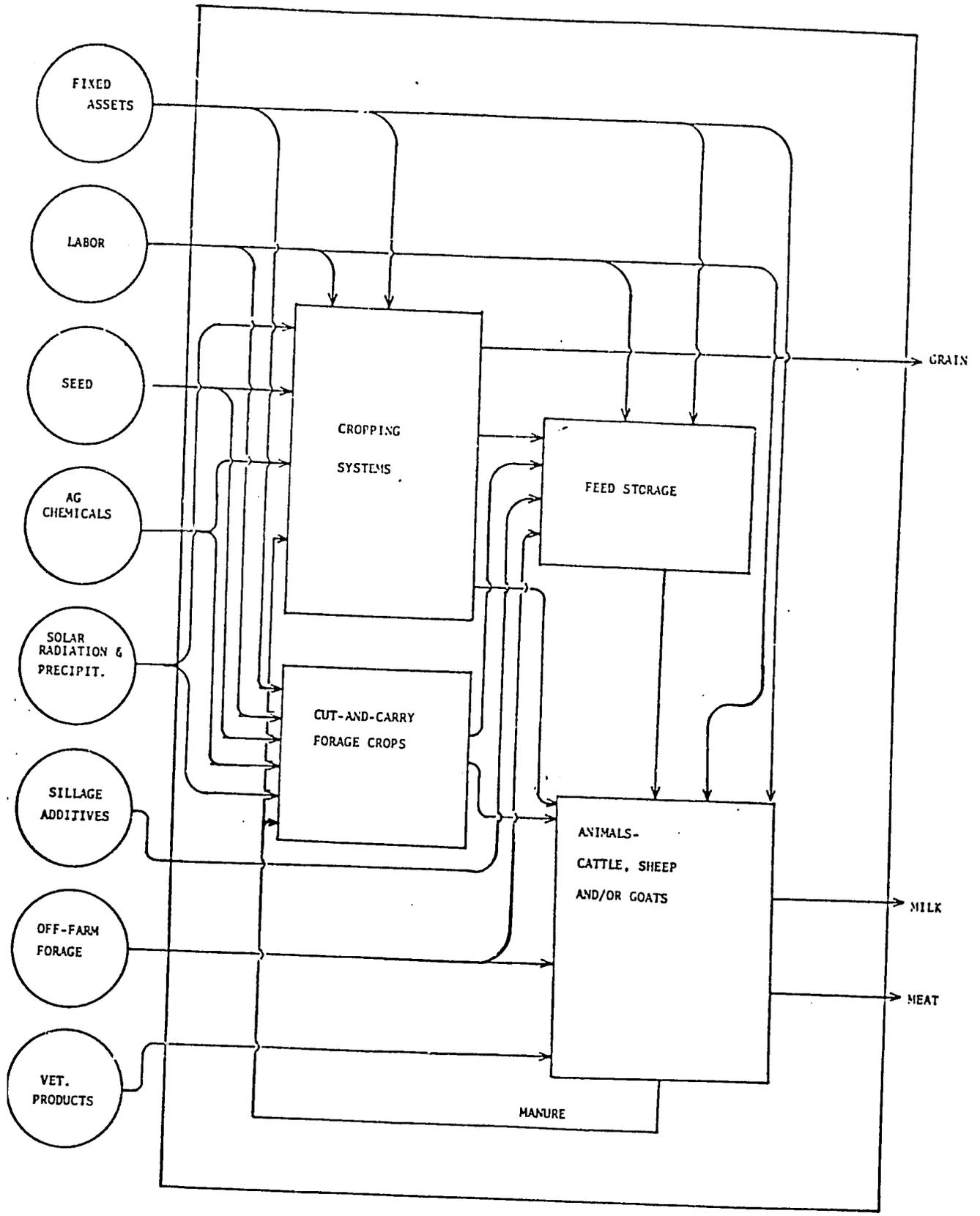


FIGURE 3: A qualitative description of a crop/animal production system found on small farms in western Kenya.

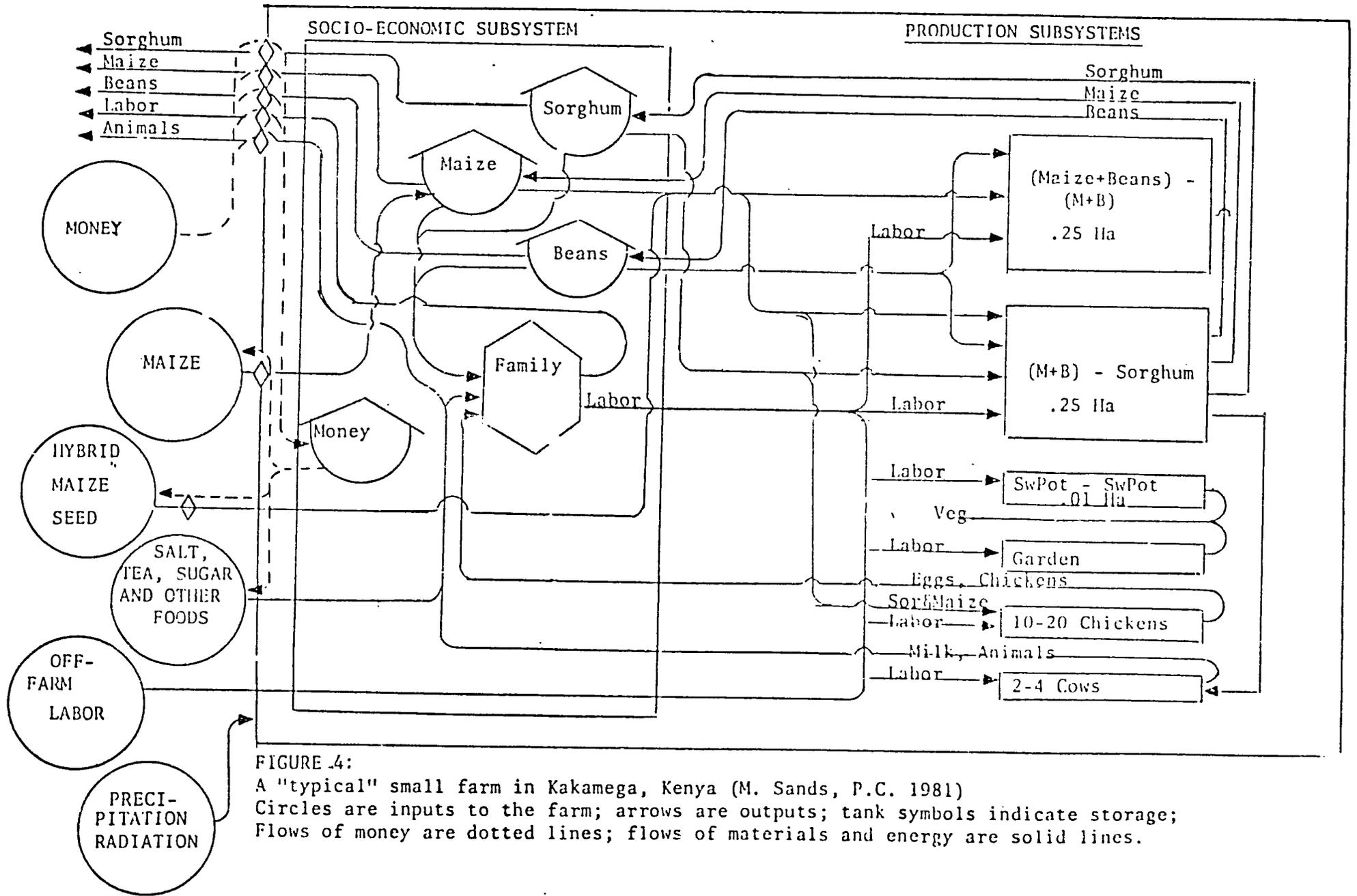


FIGURE 4:  
 A "typical" small farm in Kakamega, Kenya (M. Sands, P.C. 1981)  
 Circles are inputs to the farm; arrows are outputs; tank symbols indicate storage;  
 Flows of money are dotted lines; flows of materials and energy are solid lines.

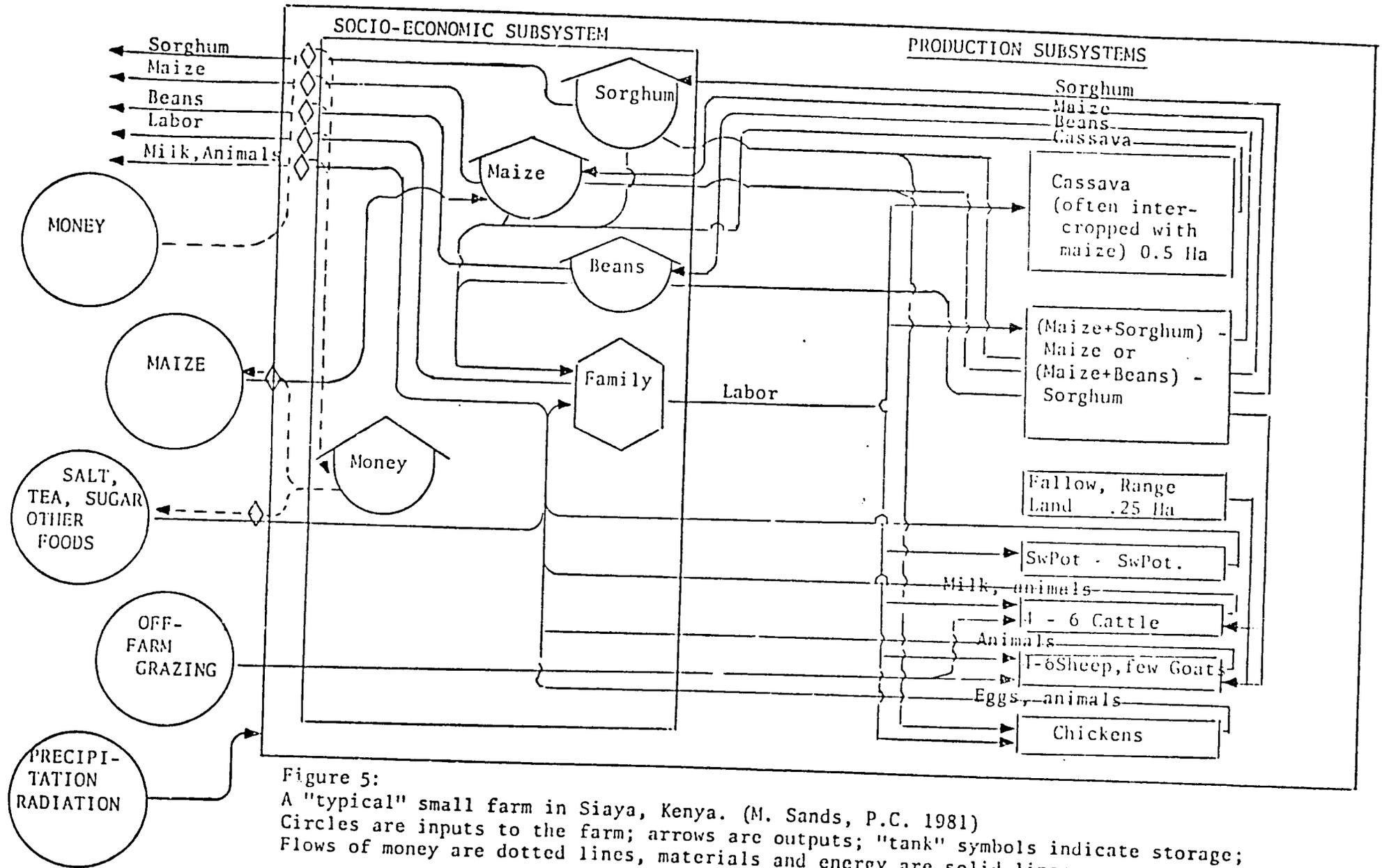


Figure 5:  
 A "typical" small farm in Siaya, Kenya. (M. Sands, P.C. 1981)  
 Circles are inputs to the farm; arrows are outputs; "tank" symbols indicate storage;  
 Flows of money are dotted lines, materials and energy are solid lines.

## Annual Report for 1981/82

1. Project Title: Sociological Analysis of Small Ruminant Production Systems
2. Institution: University of Missouri - Columbia
3. Principal Investigator: Michael F. Nolan
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 subgrant: \$200,000  
Matching Contributions from 1981/82 subgrant: \$76,721

### 5. Statement of Project Goals

The principal goal of the SR-CRSP Sociology component is to develop an understanding of the social and cultural context in which small ruminant production occurs. This will be necessary in order to evaluate specific technological interventions in relation to their social soundness and their likelihood of acceptance by the population at large.

Among the issues that the project will address are the social organization of livestock production, particularly vis a vis crop production, institutional constraints on production, including credit, markets and extension services, and the values and attitudes of the population toward the adoption of new technology.

### 6. Summary of Accomplishments in Previous Years

Since 1980, the Sociology Project has undertaken two major activities: participation in the baseline survey work on the small farm sample in the Siaya and Kakamega Districts, and a study of the women's dairy goat group in the Samia area near Lake Victoria. The Samia dairy goat project is now completed and the final report (and thesis by Amanda Noble) should be available in the summer of 1982. The analysis of the survey data is proceeding and some preliminary results are available.

In addition, we supported the thesis research of Mr. A. Aboud of the Ministry of Livestock Development, who studied the extension range management system in several provinces in Kenya. This study has been completed and a report should be available in 1982. Mr. Aboud has completed his thesis and MS degree program at Ohio State University in Rural Sociology.

### 7. Statement of Specific Objectives for 1981/82

- A. Begin analysis of baseline survey data. Initial attention will be geared toward the role of various families' members in small ruminant production, attitudes toward new technology, and extent and nature of contact with institutions.
- B. Collaborate with Central Bureau of Statistics in the inclusion of a sociology module in their countrywide data collection effort.

- C. Initiate further studies in Western Kenya in collaboration with the Ministry of Livestock Development.

## 8. Description of Work Undertaken

Coding and preparation of the survey data from Kakamega and Siaya has been underway this year and is nearly completed. Some analysis has begun and it is anticipated that the bulk of the analysis will be carried out after June 1982.

The research project on range management extension programs in Kenya was undertaken in 1981 and completed that summer, with the results written and Aboud's thesis defended in 1982.

The study on the women's dairy goat cooperatives was completed in June 1981, and the technical report and thesis by Amanda Noble will be finished by December 1982.

## 9. Technical Accomplishments

The following points represent a summary of the more salient findings from the West Kenya survey and the field study of the Samia women's goat project.

- A. Both the survey and observational data indicate that ruminant livestock production in study areas is not high and goat production is particularly low. Knowledge about milking goats is essentially non-existent. Compared to cows, goats are considered a low status animal. In addition, the use of intensive livestock management systems is relatively unknown, with the Samia goat project as the one notable exception.
- B. Those individuals who currently raise goats do not raise them for personal consumption. Instead, goats are primarily kept as a source of liquid capital to be sold as needed for cash, although they are occasionally slaughtered and consumed for ceremonial purposes.
- C. Some data suggests that negative perceptions regarding goats continue to exist. A significant portion of the sample believe that goat meat, among other things, causes leprosy, upset stomach, constipation and swelling of the body. In addition, there are some cultural prohibitions against the drinking of goat milk for certain groups; older women, for example.
- D. Although the size of farms in the West has been declining, there is not necessarily more on-farm labor available for goat production because of the substantial out-migration of men seeking wage labor elsewhere and a substantial rise in the number of children attending school. Many households are headed by women who have to assume responsibility for both household and agricultural work.
- E. There are certain strong cultural norms regarding the suitability of various activities for women, particularly in the areas of livestock production. We have considerable evidence which indicates that

livestock production, with the exception of poultry, is not considered part of the women's domain. Traditionally, women do not care for livestock, and to the extent they do, all major management decisions and buying and selling, are reserved for the male head of household. While some of these traditions may be eroding in the wake of male out-migration, changes in norms and role definitions always lag behind changes which have impact on the structure of the family. Thus, West Kenya is an area exhibiting many residual norms inveighing against women caring for livestock. Yet, if livestock are to be cared for, they will have to be tended, in many cases, by women.

- F. An equity issue exists which should be considered. If an intensive management scheme where forage is cut and carried, is part of the goat management system recommended, then it seems clear that this will place disproportionately more burden on the shoulders of women than on men. While herding may traditionally be in the male domain, cutting and transporting forage is clearly in the scope of the women's domain, as this is more analogous to crop production than animal production. This would have the effect of placing more work on a group which already carries primary responsibility for household work, including the fetching of firewood and water. Women, with increasing male out-migration, have assumed more responsibilities for crop production as well.

Overall, complete knowledge of all the socio-cultural aspects of the agricultural production systems in Western Kenya is lacking, and we cannot say for sure whether the dual purpose goat scheme that is being proposed will succeed. However, it appears that such a new technology will have to simultaneously confront many constraints--some may feel too many. We are talking about introducing a system which will have to manipulate no fewer than six key variables, including: a new commodity, cultural food preferences, sex roles, status distinctions, labor supply, and a change in the traditional management system. Most successful development projects usually only address one or two of these issues at a time. In addition, the observations of the Samia goat project indicate that for such an undertaking to have any chance of success, a considerable amount of technical backstopping will be necessary. Yet the survey data indicated that farmers in the sample had little or no contact with extension except the animal health officer. We need to carefully consider whether a complex intervention, which a dual purpose goat represents, can be made to work within the context of the existing technical support infrastructure. If not, then alternatives which would require less technical support and which would tamper with fewer elements of the existing situation will need to be considered. While it may be possible to develop a dual purpose goat package that is technologically sound, economically viable, and socially acceptable for some segment of the West Kenya farm population, it remains to be seen whether this group will constitute a significant proportion of that population. Our goal for the future will be to evaluate alternative packages with the intent of identifying potential beneficiaries and non-beneficiaries.

Annual Report for 1981/82

1. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Kenya
2. Institution: Winrock International Livestock Research and Training Center
3. Principal Investigator: A. John DeBoer
4. Funds allocated from:  

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$200,000
Matching Contribution from 1981/82 Subgrant:	\$78,310
5. Statement of Project Goals
  - A. Provide a well trained group of professional agricultural economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multidisciplinary research on small ruminants and their producers.
  - B. Provide an improved data base for guiding research and provide policy guidelines for improving small ruminant productivity and farmer incomes.
  - C. Strengthen the overall research capacity of selected host country research institutions by providing leadership in conducting interdisciplinary research, conducting training programs, and publishing research results.
  - D. Publication and dissemination of research results representing a wide variety of research which will contribute to a better understanding within the scientific community of small ruminants and their place in selected rural economies of developing countries.

6. Summary of Accomplishments in Previous Years

Program Year 1 (October 1, 1978 - April 1, 1980)

Developed Phase III Work Plan, staffed project, developed questionnaire.

Program Year 2 (May 1, 1980 - September 30, 1981)

Mr. Morgan Job served as Research Associate July 1980 - September 1981; participated in Small Farm System Surveys; helped develop additional survey modules; preliminary evaluation of suitability of Central Bureau of Statistics Integrated Rural Survey data for suitability on CRSP research; participated in Small Ruminants CRSP Seminar, Nairobi, September 1980.

Ms. Danna Mortimer, resident in Kenya September 1980 - January 1981, to carry out collaborative field survey with Washington State University Animal Health Project. Completed survey work and data analysis.

Recruitment for replacement Agricultural Economist completed. Mr. Richard Matthewman placed in Kenya September 1981.

7. Statement of Specific Objectives for 1981/82

- A. Complete analysis of first year Small Farm Survey data, construct analytical models of representative small farms.
- B. Carry out preliminary economic feasibility analysis of the introduction of dual purpose goats onto these farms.
- C. Complete analysis of joint animal health-economics survey and make recommendations for improvement in animal health delivery systems.
- D. Complete analysis of supplementary questionnaire on farmer goals, attitudes and perceptions.

8. Description of Work Undertaken

A. International Travel

- Mr. Morgan Job and family return to Purdue University to complete PhD thesis.
- Mr. Richard Matthewman and family to Kenya for long-term assignment.
- John DeBoer to Kenya for 2 weeks, March 1982.

B. Data analysis from first year small farm systems survey completed.

C. Model construction partially completed. A linear programming model of representative farms has been constructed with six different dairy goat technologies being considered. Model validation is proceeding.

D. Analysis completed of Animal Health-Economics Survey, a draft MS thesis has been submitted to Department of Agricultural Economics, Washington State University.

E. Assistance with III International Conference on Goat Production and Disease, Tucson, Arizona, January 1982.

F. Personnel:

Morgan Job, Research Associate  
Danna Mortimer, Research Associate (contract completed 1/15/82)  
George Maundu, MLD and UNDP/FAO SGDP  
Alfred Mwangi, MLD, Naivasha  
James Njuki, Trainee, Texas A&M (contract completed 6/1/81)

## 9. Technical Accomplishments

### A. Farm System Characterization

Some adjustments were made to overcome certain fundamental problems with the bi-monthly periodical survey procedure. Intensive survey modules were designed and administered for labor inputs by task, time, and sex-age group; crop yields; cattle prices; food prices; and household expenditures.

Women comprise over 60 percent of the active labor force in all areas. The proportion of labor contributed by children under 15 years was consistently less than 10 percent (Table 1).

The time sequence of farming tasks is different because of differences in (a) time of onset of rains, and (b) total precipitation which controls the prevalence of short rains cropping. In the Kakamega District sample, most agricultural operations are 3 weeks to one month ahead of those in the Siaya District sample.

Off-farm income was less important than anticipated with over 90 percent of the survey producers engaged solely in subsistence agriculture. Most family members working off the farm are husbands or children who are long-term migrants to the urban areas and who no longer make a labor input into the farms. Cash transactions for farm output or for hiring out as casual labor are minor.

The marketing survey module was administered twice between October 1980 - September 1981. Maize was the main item in volume and value but quantities were relatively minor compared to farm output. Over 80 percent of maize sales were non-cash, whereas purchases of cooking fat, salt, meat, and fish were generally by cash.

Details of farm size, cropping patterns, crop yields, animal inventories, and animal feed requirements are detailed in the Dual Purpose Goat Production Systems Report for 1981/82.

### B. Small Farmer Goals and Attitudes Survey

This survey is distinct from survey work conducted by the Rural Sociology Project. Our focus was to identify rankings of economic objectives which needed consideration in modelling potential adoption of dual purpose goat technologies. The Shoneman-Wang approach was used. This model assumes that a set of attributes and a set of groups (or individuals) can be represented jointly in an m-dimensional space. Sets of plausible objectives were solicited from a wide range of respondents, including local farmers. A series of four objectives were found to be stated fairly consistently. These were food security, land acquisition, increasing crop yields, and acquiring more animals. These choices were presented to the farmers, and it was found that the farmers had well defined priorities. Generally, they chose food security or land acquisition as the first priority followed by increased yields. Acquiring more animals was least important. Among the Luo farmers, increasing yields was ranked about equally with food security as the most important objective followed closely by land acquisition. These results will be incorporated into the formal farm planning models where appropriate.

### C. Animal Health-Economics Collaborative Survey

An MS thesis draft was submitted in April 1982. Following the incorporation of suggested revisions by the PI, the thesis draft will be submitted to the Project Leader in Kenya for comments. This summary is from the original draft. The survey attempted to relate ecological and socio-economic characteristics of small farms in Western Kenya to selected indices of animal disease incidence and animal characteristics. A total of 62 farm interviews were carried out in Siaya and Kakamega Districts. These farmers, although they are in the same districts, are some distance from the Small Farm Survey sample clusters of farmers. Ownership of goats was required for inclusion in the sample; consequently, livestock numbers were greater than on the Small Farm Production System Survey farms. Siaya District farmers had an average of 8.2 cattle, 6.2 goats, and 3.6 sheep. Comparable figures for Kakamega District are 6.8 cattle, 4.2 goats, and 3.1 sheep. Management practices are shown in Table 2. Detailed data on animal health practices are also collected and related to distance from tick dips, farmers' previous contact with veterinarian and farmer's knowledge of local animal diseases.

A series of regression equations were then estimated where dependent variables included fecal egg counts collected from the second and third visits by the animal health team, average weight change of animals between the first and second visits, and several alternative measures of animal tick infestations. Independent variables included a large number of farmer socio-economic variables, animal management practices, location of farms, and number of animals held on the farms. The results will be reported in several subsequent publications.

Table 1. Labor Input Profiles Siaya (%)

Operation	Age Group and Sex						Adult Female %	Adult Male %	Female All Ages %
	A		B		C				
	M	F	M	F	M	F			
Digging	7.9	0.7	20.0	24.4	14.3	32.3	56.7	34.3	57.4
Planting	7.4	3.7	12.1	35.5	14.0	27.0	62.5	26.1	66.2
Weeding	7.9	3.6	7.3	32.3	15.4	32.3	64.6	23.7	68.2
Harvest Maize	10.6	4.2	3.1	42.5	12.7	26.5	69.0	15.8	71.2
Harvest Beans	0	0	3.2	41.9	12.9	14.9	83.8	16.1	83.8

Labor Input Profiles, Kakamega (%)

Operation	Age Group and Sex						Adult Female %	Adult Male %	Female All Ages %
	A		B		C				
	M	F	M	F	M	F			
Digging	2	4	27	25	7	33	58	34	62
Planting	6	6	23	27	8	27	54	31	60
Weeding	6.7	5.5	27	28.3	6	25.9	54.2	33	59.7
Harvest Maize	8.9	6.7	24.7	25.2	5.6	28.6	53.8	30.3	60.5
Harvest Beans	3.5	8.3	15.4	38	3.5	30.9	68.9	18.9	77.2

Table 2. Overall Sample Group Information on Breeding, Young Animal Treatment, Animal Shelter, and Other Common Farm Management Practices

	Cattle		Goats		Sheep	
	Zebu		Grade/Crossbred		#	#
	#	%	#	%		
Farms Owning	59		4		59	45
Farms Vaccinating	32	54	1	25	12	18
Farms Not Vaccinating	27	46	3	75	47	82
Use Artificial Insemination	1	1.7	2		0	0
Own Breeding Males	26	44	0		--	--
Use Other Farmer's Males	31	53	--		--	--
Length of Time Young Animals Kept Before Slaughter						
1 - under 4 months	1	1.7	0		1	--
4 - 11 months	0	--	0		10	18
Over 1 year	58	98	4	100	49	82
Animals kept in Boma at Night						32
Bucket Feed Unweaned Young	1	1.7	2	50	4	8
Suckle Unweaned Young	58	98	2	50	56	89
Zero Grazing Practiced	1	1.7	1	25	2	2
Farmers Keeping Animals (% calculated on Total Sample Group Basis)						
For Someone else on Their Farm	31	50			16	3
Keeping Own Animals Elsewhere	18	29			3	4.8

Source: Survey Questionnaire

## Annual Report for 1981/82

1. Project Title: Systems Analysis and Synthesis of Small Ruminant Production
2. Institution: Texas A&M University
3. Principal Investigator: T. C. Cartwright
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$66,666

### 5. Statement of Project Goals

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

- A. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.
- B. To obtain parameters needed to model production systems in the Nyanza and Western provinces and other appropriate ecozones of Kenya; to validate the model and input parameters for each of these specific zones; and to use these validated simulations as baseline simulations.
- C. 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 Kenya.
- D. To supply input-output data of dairy and dual-purpose goat production systems for use in economic analysis and sociological assessment.
- E. To evaluate, through simulations, the response of dairy and dual-purpose goat production systems to alterations or interventions requested or agreed upon by the Kenya Ministry of Livestock Development.

### 6. Summary of Accomplishments in Previous Years

An initial visit was made to Kenya during which (1) a Co-PI was tentatively identified, (2) arrangements for Z. Gathuka to come to graduate school at Texas A&M were initiated, (3) arrangements were made to utilize UNESCO data to verify the sheep and goat models for extensive production systems and (4) increased understanding of small ruminant production in Kenya was gained.

During the first year, the sheep and goat models were conceptually outlined and communicated to collaborators. Their inputs were incorporated into model design. Development of structural and biological components of the models was begun.

During a June 1980 visit to Kenya, T.C. Cartwright (1) finalized arrangements for Z. Gathuka to come to Texas A&M, (2) initiated discussion of graduate training with P. Kiriro and B. Mwandotto, (3) agreed upon the role of the Co-PI, (4) visited research sites at Ol Magogo and Maseno, and (5) gained additional information about small ruminant production in Kenya.

Dr. Chema visited Texas A&M in July 1980 to become more familiar with the graduate training program and to discuss the Systems Analysis Project.

Gerald Smith, Co-Investigator, traveled to Kenya in September 1980 to participate in a CRSP workshop. In addition, he (1) reached agreement on an MOU involving UNESCO, (2) gained final agreement for Dr. Carles to serve as Co-PI, (3) identified P. Semenyé (ILCA) as a collaborator, and (4) discussed graduate training with P. Kiriro.

Dr. Carles visited Texas A&M in October 1980 to (1) become more familiar with systems concepts and with the sheep model, that was being developed, (2) make input into the health and other components of the model, and (3) discuss arrangements for collaboration in Kenya.

J. Mathenge began a graduate program at Texas A&M in June 1980. Z. Gathuka began a graduate program in September 1980.

Development of a sheep production systems model was the major activity during previous years. This required a review of the literature, development of functional biological relationships, and programming for computer application. This research involved the intensive effort of a research team at Texas A&M.

Dr. Norman Graham, CSIRO, Australia, spent April and May 1981 at Texas A&M assisting in the development of the nutrition component of the sheep model.

## 7. Statement of Specific Objectives for 1981/82

- A. To field test sheep production systems model.
- B. To evaluate alternative sheep management strategies for the arid and semi-arid regions of Northern Kenya.
- C. To complete development of a goat production systems model.
- D. To initiate graduate programs for P. Kiriro and B. Mwandotto.
- D. To complete thesis research by Z. Gathuka.

## 8. Description of the Work Undertaken

Single-animal versions of both the sheep and goat models were completed and are currently being used for initial simulations. Flock models which incorporate the biological components of the single-animal versions with more comprehensive accounting procedures are nearing completion.

Dr. Francis Ruvuna joined the Texas A&M staff in November 1981 and after an intensive six-week training period at Texas A&M was located in Kenya. He has installed the sheep and goat models on the Treasury IBM computer and is working with Dr. Carles to develop health and water components for the models. He is also cooperating closely with the MLD and other CRSP projects to assemble the data necessary for evaluation of production alternatives.

Harvey Blackburn returned to Texas A&M in January 1982 after spending six months in Kenya. He analyzed data from UNESCO's IPAL project and put it in suitable form for use in simulations. He has initiated simulations of sheep and goat production alternative for the North of Kenya. While in Kenya, he and Dr. Carles also began developing the water component for the models.

Dr. Jurgen Schwartz, University of Nairobi, spent two weeks at Texas A&M during February 1982 and helped to convert the sheep model to a goat model and to run simulations with data he had collected over a several year period in Kenya. He, Dr. Carles, and Dr. Ruvuna are working together to simulate and evaluate alternative production systems for the North of Kenya.

James Mathenge completed his MS degree in Animal Breeding in December 1981 and returned to Kenya. Zachariah Gathuka will finish his MS degree in Animal Science and return to Kenya in May 1982. Philip Kiriro is making good progress on completing requirements for a BS degree in Animal Science by December 1982. He hopes to continue for an MS degree. Bonfance Mwandotto began his PhD program in Animal Breeding in September 1981. Steven Tallam has been accepted to begin an MS program in September 1982.

## 9. Technical Accomplishments

Single-animal versions of both sheep and goat models are operational. Flock models are running but still contain some errors in the flock dynamics sections. Verification of flock dynamics is expected to be completed during the summer of 1982.

Analysis of UNESCO animal performance data from the Mt. Kalal area has been completed.

Simulations of goat production alternative for the Ngurunit area were completed and presented at the seminar/workshop held in Kabete in March 1982.

PART IV  
PARTICIPATING INSTITUTION ANNUAL REPORTS  
MOROCCO

16/12/21

Annual Report For 1981/82

1. Project Title: Genetic Improvement of Sheep and Goats for Smallholder Production Systems
2. Institution: University of California, Davis
3. Principal Investigator: G. E. Bradford
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$328,984\*  
Matching Contribution from 1981/82 Subgrant: \$79,063

Two visits to Morocco for planning purposes were made by the Principal Investigator during 1981/82. The first was in connection with the CRSP-sponsored Prolific Sheep Workshop in November 1981. Following discussions of objectives for a breeding project with Hassan II staff and visits to farms and research stations, a preliminary proposal for a CRSP Breeding Project in Morocco was prepared. This was discussed with Mr. Lahlou-Kassi during his visit to the Davis campus following the International Goat Conference. The decision to proceed with the project was made on a return trip to Morocco in April 1982, on the occasion of Mr. Lahlou-Kassi's examination for the Doctor of Science degree.

Mr. Donald Torell, University of California Sheep Specialist, went to Morocco in late April to assist with the design of sheep facilities at Hassan II's Tadla Demonstration Farm. This farm, in an important irrigated-agriculture area of Morocco, is planned as the primary site for the Breeding Project work. There will also be good opportunities for work on the Nutrition/By-Products Project. The farm provides excellent feed potential for livestock, but this will be the first livestock project there, hence the need for facilities.

If all goes according to schedule, the first matings will be made this summer, during the current program year.

\* includes carry forward

Annual Report for 1981/82

1. Project Title: By-Product and Crop Residue Utilization in Intensive Sheep and Goat Production Systems for Limited-Resource Farmers
2. Institution: North Carolina State University
3. Principal Investigator: William L. Johnson
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$269,057  
Matching Contributions from 1981/82 Subgrant: \$85,392

5. Statement of Project Goals

Since the inception of the Small Ruminant CRSP in 1978, the objectives for the nutrition and by-products utilization project have continued unchanged. They can be paraphrased as follows:

- A. Study the nutritive value of feeds available for hand-feeding or supplementary feeding to small ruminants in tropical environments.
- B. Develop guidelines for inclusion of such feeds in the diets of small ruminants, and to determine the expected productivity of animals which consume them.
- C. Study storage and treatment methods for crop residues and byproducts.
- D. Test the reliability of simple feedstuff evaluation procedures for predicting animal productivity.
- E. Generate information on nutritional requirements and comparative efficiencies of tropical small ruminant types and breeds, in the environment of their exploitation.

6. Summary of Accomplishments in Previous Years

In 1979 and 1980, workplans were agreed upon with collaborators in Brazil and Indonesia. Village survey activities were initiated in West Java; animal feeding trials were designed and implemented on the experiment stations at Sobral and Bogor. Complementary research activities continued in Raleigh.

In Raleigh, animal studies were conducted with various crop residues and other byproducts. Methodology was tested for storing maize stover with broiler litter. Wheat straw, ground and mixed with maize grain and soybean meal, was evaluated as the roughage source for growing kids and lambs. In another experiment, urea was used as a partial replacement for soybean meal in wheat straw based rations. These results have been documented in the 1980/81 Annual Report and other publications.

A separate line of research in Raleigh compared forage utilization by Dorset, Barbados Blackbelly, and the F<sub>1</sub> cross of these two breeds, with interesting indications of a heterosis effect for voluntary intake and digestibility.

Also in Raleigh, work with tropical and temperate forage species grown in controlled environments documented the negative effect of high environmental temperature on the dry matter and fiber digestibilities of the species studied. The inherent higher lignification and lower digestibility of tropical forage species was also quantified. These data support field observations in both Brazil and Indonesia that small ruminants do not perform well on a diet made up primarily of tropical forage grasses, especially when animals are not given the opportunity to select plant parts of higher relative digestibility.

## 7. Technical Accomplishments

The research work carried out in Raleigh is supportive of the objectives for all overseas locations, and also supports the training function of the SR-CRSP. The relatively small budgetary commitment from the subgrant to support on-campus research pays large dividends when added to the matching commitment from NCSU.

In fact, the NCSU subgrant budget for the program year in progress (October 1981 - September 1982) shows nearly identical budget totals for the AID contribution to be spent in the US and the NCSU match. In view of this de facto one to one match, it is important that the on-campus activities financed by matching funds be given due recognition.

In general terms, the on-campus component of the project contributes in the following ways:

- A. Facilitates research of a more basic orientation than would be appropriate in the overseas setting, where applied problems demand immediate attention. We are thus allowed to ask "Why?" the biological systems that we deal with behave as they do.
- B. Provides for the development and testing of new techniques and procedures.
- C. Provides training opportunities for students from participating countries, as well as US domestic students who are attracted to international programs.
- D. Provides for a two-way flow of knowledge which can help ruminant production in North Carolina as well as in target ecosystems around the world.
- E. Helps the project become fully integrated into the fabric of the department, with obvious two-way strengths: our faculty and students gain in their understanding of animal production systems in our collaborating countries, and the project gains from an expanded pool of expertise.

Against this philosophical backdrop, the following specific accomplishments were attained during this report period.

Intake and digestibility of a warm and a cool season forage grass by goats, sheep and steers. Coastal bermudagrass (*Cynodon dactylon* (L) Pers.) harvested at 7 and 12 weeks of age (C7 and C12) and tall fescue (*Festuca arundinacea* Schreb.) harvested at 6 and 9 weeks (F6 and F9) were fed as hays, ad libitum, to young goat (Toggenburg) and sheep (1/2 Suffolk, 1/4 Dorset, 1/4 Barbados Blackbelly) wethers in a latin square design. F6 and F9 were also fed to Holstein steers in a single-reversal design. Total 6-day orts and fecal collections were used for digestibility calculations. For each hay, 8 individual observations were obtained within each animal species. Initial weights (W) of the goats, sheep and steers were 17.9±.5, 30.0±.9 and 182±6 kg. Within animal species, the plant maturity effect was negative for dry matter intake and for apparent dry matter digestibility. Comparing goats with sheep, overall treatment means were higher for dry matter intake (P< .05) and lower for DM digestibility (P<.01), as shown in the table:

	<u>Goats</u>	<u>Sheep</u>
DM intake (g/W <sup>.75</sup> )	75	57
DM digestibility (%)	54	60

However, the intake of digestible dry matter was higher for the goats.

These results are consistent with data presented in the 1980/81 Annual Report, which showed a lower digestibility of dry matter by goats, compared with sheep, for a high fiber diet based on wheat straw. It is evident that an important species difference may exist with regard to rumen function. Future research should examine these differences and their underlying controlling mechanisms in more detail, to be able to design sound feeding strategies for both species in a wide variety of dietary conditions.

Products of digestion and metabolism in goats and sheep. Blood and rumen fluid samples were obtained from nine growing Toggenburg X Saanen wethers and nine Suffolk X Barbados wethers averaging 27 ± 3 and 45 ± 4 kg, respectively. Rations consisting of 35, 50, or 65 percent wheat straw were fed over three periods. Sheep had higher (P<.05) blood potassium, rumen fluid pH, packed cell volume, and blood calcium (P<.01) than did goats. Goats had higher (P<.01) ruminal osmotic pressure, molar percent proprionic acid and serum urea nitrogen than did sheep. There were no statistically significant differences in levels of serum sodium, chlorine, CO<sub>2</sub>, total protein, albumin or glutamo oxalo-transaminase. The molar percent acetic increased and the molar percent butyric acid decreased (P<.01) in the rumen fluid of both species as concentration of wheat straw increased in the rations. There was a significant (P<.01) species by treatment interaction on osmotic pressure of the plasma, serum alkaline phosphatase, and total concentration of volatile fatty acids in rumen fluid.

In vitro digestibility of alfalfa and coastal bermudagrass with rumen inoculum from sheep or goats. Two Suffolk sheep and two Toggenburg goat wethers (rumen cannulated) were fed limited (22% of BW) or ad libitum alfalfa (*Medicago sativa*) in trial 1 and coastal bermudagrass (*Cynodon dactylon*) in trial 2, as hays. Ad libitum DM intake was 3.6 ± .6% of BW for alfalfa (both

animal species) and  $2.0 \pm .5$  (sheep) and  $3.6 \pm .8\%$  of BW (goats) for coastal. During each trial, samples of the forage were incubated in vitro (2 runs per trial) with inoculum from each animal, for 6 time intervals (table), followed by neutral detergent extraction of solubles from in vitro residue. Neither in vitro dry matter disappearance (IVDMD) nor in vitro cell wall disappearance (IVCWD) were influenced by animal species or intake level of the inoculum donor, with either forage. IVDMD and IVCWD both increased with time ( $P < .01$ ) as shown in the table. These results indicate that differences which have been reported between sheep and goats in their rumen function are probably not caused by rumen microbial population differences.

Parameter	Forage	Duration of incubation, hr.					
		3	6	12	24	48	96
IVDMD, %	Alfalfa	56 <sup>a</sup>	58 <sup>a</sup>	64	72	77 <sup>b</sup>	78 <sup>b</sup>
	Coastal	28 <sup>a</sup>	28 <sup>a</sup>	31	39	55	65
IVCWD, %	Alfalfa	8 <sup>a</sup>	10 <sup>a</sup>	24	40	53 <sup>b</sup>	54 <sup>b</sup>
	Coastal	7 <sup>a</sup>	7 <sup>a</sup>	11	21	42	54

a,b Means in the same row followed by the same superscript are not significantly different (Duncan's test,  $P < .05$ ).

Digestibility of alfalfa and brome grass hays by sheep (thesis project conducted by Sorta Silitonga at the University of Minnesota). Twelve wether lambs were allotted to one of three groups and were offered either alfalfa hay, brome hay, or alfalfa and brome mixed in equal proportions. Intake of dry matter was 1.01, .85, and .78 kg per animal per day, respectively, for the three diets. Digestibility of DM was 59, 65, and 62%, while digestibility of the total cell-wall fraction was 51, 74, and 64%. Further analysis is underway to determine the digestibility of crude protein, lignin, and other cell wall fractions.

Reproductive performance of Barbados Blackbelly straight bred and cross-bred ewes. For the humid conditions of the Southeastern United States, the Barbados hair sheep have some advantages in comparison with the wool breeds of European origin, particularly for parasite resistance and heat tolerance. In the 1980/81 Annual Report, it was reported that Barbados Blackbelly X Dorset ewes also showed a heterotic advantage for forage intake and digestibility.

In the present series of studies, reproductive performance was studied in a total of 402 ewes of Barbados Blackbelly (B), Dorset (D), Suffolk (S), BXD, Finnish Landrace (L) XD, and LX Rambouillet (R) breeding. In experiment I, D and BXD ewes came into estrus and were bred earlier ( $P < .05$ ) than LXD or LXR ewes. In experiment II, B ewes exceeded D ewes in percent ewes lambing and lamb survival to 30 days ( $P < .05$ ). Percent ewes lambing was also higher in BXD than S ewes. Twinning rate was higher in B and BXD groups than in D or S. Rectal temperatures of B and BXD ewes were lower during heat stress than rectal temperatures of D and S ewes.

In an accelerated lambing study (Experiment III) percent ewes lambing was higher ( $P < .10$ ) in BXD ewes than in LXD, LXR or S groups. BXD ewes rebred during lactation and lambed at 6.5 month intervals during a 26-month period.

Kg of Lamb marketed per kg of ewe metabolic weight was significantly higher in the BXD ewe group (12.3 kg) than for LXD (8.5 kg), LXR (8.7 kg) or S (6.1 kg) ewes.

Physiological response and fetal development in Barbados Blackbelly (B), Dorset (D) and DXB sheep exposed to high environmental temperature. Data were obtained from 8B, 7D and 6 DXB ewes, which were maintained in two environmental chambers (cool, 22.2°C vs hot, 33.8°C). Ewes entered chambers on day 125 of gestation and remained until day 140 to 144 when lambs were surgically removed. Mean rectal temperature (RT) and respiration rates (RR), respectively, for ewes in the cool chamber were: B, 38.7, 41.4; D, 38.8, 75.2; DB, 39.0, 63.1, and in the hot chamber: B, 38.7, 96.9; D, 39.3, 134.4; DB, 39.1, 106.8. RT varied significantly among breed means in the hot but not in the cool chamber. D ewes in the hot chamber had higher ( $P < .05$ ) RT than cool D ewes. Breed differences in RR were significant in both chambers. Mean serum corticosteroid (CC) concentrations did not differ ( $P > .05$ ) for breeds or chambers. Serum thyroxine ( $T_4$ ) concentrations for ewes in the cool and hot chambers, respectively, were: B, 73.1, 57.6; D, 126.1, 76.4; DB, 106.3, 117.8 ng/ml. Differences among breeds were significant in both chambers.  $T_4$  concentrations were lower ( $P < .05$ ) in hot D ewes compared to cool D ewes. Mean  $T_4$  concentrations were 102.1, 99.6, and 139.4 ng/ml ( $P < .05$ ) in lambs from B, D, and DB ewes, respectively. Lambs from hot D ewes had a lower ( $P < .05$ ) response to 2.0 mg of TRH than lambs from cool ewes. Mean CC concentrations in lambs did not vary significantly and only cool D lambs responded ( $P < .05$ ) to 200 I.U. of ACTH. Birth weights and size of lambs were not affected by environment. In conclusion, B and DB ewes appear to be more heat tolerant than D ewes; DB ewes and lambs have higher  $T_4$  concentrations than D and B groups; and the hot chamber did not depress lamb birth weight.

Pre-pubertal diet and body condition effects on performance of ewes lambing at 13 months. A total of 46 ewe lambs of Dorset (D), Suffolk (S) and Barbados Blackbelly (B) breeding were weaned at a mean weight of 13 kg and subjected to either a finishing (F) or growing (G) ration until onset of puberty. Cumulative daily gain (g), fat score (1 v. thin; 9 v. fat), weight/height ratio (kg/cm) for F lambs were: B, 120, 3.6, .43; D, 217, 7.8, .79; S, 230, 6.7, .73, and for T lambs B, 86, 2.4, .37; D, 153, 5.6, .67; S, 168, 5.4, .65. Differences among diet and breed means were significant for these variables. Mean age at puberty and breeding were 197 and 238 days, respectively, and differences among breeds and diets were not significant. Ewes were machine milked at 25±5 days of lactation. Unadjusted milk yield was slightly lower in F than G lambs. Mean milk yields for B, D, and S, respectively, were 164, 321, and 378 g ( $P < .01$ ). Milk yield within breeds was negatively correlated with both fat score and wt/ht ratio. B ewes had significantly less milk fat than D and S ewes. Lambing rate for B, D and S ewes, respectively, were 1.0, 1.2 and 1.5, ( $P < .05$ ), but the difference between diets was not significant.

Calculation of expected genetic gain for milk production in US dairy goats. An improved method of computing potential genetic gain per year from selection was developed and applied to selection for milk yield in goats. Genetic progress was defined as the change in the mean breeding value of the milking population, and included changes due to culling among lactating animals for yield. Current US population estimates for the age distribution of does, phenotypic means, and heritabilities were used along with assumptions of

moderate selection for milk yield. Two phenotypic standard deviations were used: 300 kg to represent the current US population and 200 kg to represent the amount of variation typical of biological traits after several cycles of selection. The proportion of genetic gain expected from female selection is substantially higher for goats than for cows due to reproductive rates which allow for more selection among females. Various levels of usage of progeny tested bucks and young pedigree-selected bucks were examined for their influences on the expected genetic progress. Maximum gain occurred from the use of progeny tested bucks to sire young bucks, but selected young bucks to sire most replacement does. This system has the additional advantage of minimizing the losses due to inbreeding.

Expected genetic gains in milk ranged from 3.0 to 3.8% per year using a standard deviation of 300 kg. Even with a reduced standard deviation of 200 kg, 2.4% progress per year seems possible. These results show that genetic improvement for milk yield in American goats could be quite rapid if effective selection schemes were implemented.

#### Plans for Collaborative Research in Morocco

The Principal Investigator visited Morocco for ten days in October-November 1981, at the invitation of the Management Entity and the Hassan II Agronomic and Veterinary Institute. As a result of successful discussions with potential collaborators in Morocco (led by Dr. Fouad Guessous), a decision was made by the Department of Animal Science, NCSU, to formally apply for a grant augmentation of \$39,000 to begin work in Morocco during the current program year. This application was made in December 1981.

Plans were finalized for the following preliminary support to collaborative research in Morocco during 1982:

1. Purchase of several items of laboratory equipment and reagents.
2. Purchase of an automobile for the use of the nutrition group.
3. Material support to three on-going research projects in forage and crop residue utilization by sheep, under Dr. Guessous.
4. Travel of Mr. Jean-Marie Luginbuhl, citizen of Switzerland, PhD candidate at NCSU, and a native French speaker, to Morocco for the month of June 1982, to participate in research planning with Dr. Guessous and his staff.
5. Travel of the Principal Investigator to Morocco in September or October 1982 to finalize planning for the 1982-1985 period.

## Annual Report For 1981/82

1. Project Title: Rangeland Research for Increasing Small Ruminant Production
2. Institution: Utah State University
3. Principal Investigator: John C. Malechek/James T. O'Rourke
4. Funds allocated from:  

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$258,818
Matching Contributions from 1981/82 Subgrant:	\$66,982
5. Statement of the Project Goals
  - A. Ecological assessment of range forage resource
    1. Determine successional status and productivity
    2. Determine ecological potential for important range sites
    3. Monitor plant community change in relation to climate and grazing
  - B. Plant-Animal Relationships
    1. Determine animal diets and feeding behavior
    2. Describe the annual forage cycle
    3. Ascertain forage intake in relation to nutritive requirements
  - C. Range Improvement
    1. Determine effect of grazing rates on plant species composition in the field and on diets of sheep
  - D. Sociological aspects of range management
    1. Determine rationale behind decisions made by pastoral people as it affects range management
6. Description of Work Undertaken
  - A. Administrative/Logistical
    1. Although no secretarial time has been billed, and only two months of Dr. O'Rourke's time has been charged to the SR-CRSP, considerable support has been provided by the Logan office. In addition to handling all bookkeeping for all fields of SR-CRSP activity in Morocco, purchase and shipment of all equipment ordered by all SR-CRSP scientists in Morocco has been accomplished by the Logan office. Four Renault-4 cars and one set of household furniture were purchased in Morocco, and one large shipment of laboratory equipment left the US on January 23, 1982, arriving in Morocco on February 10. Orders for equipment from Moroccan scientists under

1981/82 funding are being processed in the Logan office at the present time.

2. Neal Artz arrived in Morocco in July 1981, and following a five-week orientation to Moroccan range management by Dr. O'Rourke, established residence in Azrou. He continues to improve his French and Arabic language capability.

#### B. Site Visits - Project Personnel

Dr. O'Rourke has consulted with Mr. Artz, Dr. Narjisse, Mr. El-Aich, and Mr. Berkat during visits to Morocco in July through September 1981, and in March/April 1982. Dr. Ben Norton made a site visit for one week in March 1982.

#### C. Technical

##### 1. Range Nutrition Research

Dr. Hamid Narjisse returned to Morocco in September 1981, having completed a PhD in Range Science at Utah State University under the direction of Dr. John Malechek. Dr. Narjisse's PhD research was partially funded by the SR-CRSP Brazil Range Project. Upon returning to his position as the Head of the Animal Science Department at the National School of Agriculture in Meknes, Dr. Narjisse has been involved in two major activities. Included in his teaching responsibilities, Dr. Narjisse has proposed a new Range Science Option be offered at the Meknes School. This would initially result in ten graduates at a BS level in Range Science annually from a program entirely in Morocco. Dr. Narjisse's second major activity has been the supervision of research conducted by 4th year (Senior) students. These are studies done during the last six months of their fourth year. From January through July 1982, Dr. Narjisse has had seven students to supervise, all on studies basically concerning range nutrition. Two students are working in the Oujda area on nutritional aspects of alfa grass (Stipa tenacissima), two students on the Plaine de l'Aarid near Midelt analyzing forage quality and balance on seeded ranges (primarily Agropyron intermedium and A. elongatum), two students surveying forage availability and quality of oak woodland resources (primarily Quercus ilex and Q. faginea), and one student assessing nutrient content of forage species on six range sites in the Timahdite area (primarily perennial grasses, forbs and low growing shrubs: Dactylis glomerata, Phleum phleoides, Poa bulbosa, Festuca rubra, Stipa lagascae, Ranunculus orientalis, Bellis silvestris, Alyssum spp, Thymelea tartonraira, Thymus spp, Genista pseudopilosa, and Helianthemum croceum). Results of these studies will be available in late August.

Mr. Walter Schacht has joined the Department of Range Science at Utah State University, where he will annually conduct a six-month shortcourse for Moroccan Adjoint Techniques in applied Range Management under funding from the Morocco Range Extension Project. He is also completing course work for a PhD in Range Science. He will conduct his PhD research in Morocco under SR-CRSP funding beginning in

January 1984 on the topic of goat diets in the oak woodland type as influenced by levels of tree thinning. He will travel to Morocco for two weeks in September 1982 to ensure the initiation of treatments and collect preliminary data.

## 2. Range Ecophysiology Research

Mr. Omar Berkat returned to Morocco in December 1981 from Texas A&M University, where he completed coursework toward a Moroccan Doctorate in Range Science. He resumed his faculty position in the Department of Range Management and Ecology at the Institute of Agronomy and Veterinary Medicine, Hassan II in Rabat. In addition to teaching one course in Principles of Range Management and conducting one week-long field trip concerned with Range Management, Mr. Berkat is initiating research at the INRA (National Institute of Agronomic Research) Talsinit Station at the northern end of the High Atlas mountains. His research deals with the ecology and research of native plant species. Results will be available in late August.

## 3. Grazing Research

Mr. Ahmed El-Aich has been on the Faculty of Animal Science, specializing in Range Livestock Management, at the Institute of Agronomy and Veterinary Medicine, Hassan II, since September 1979. He has received SR-CRSP support since June 1981. His accomplishments center around three activities: (1) personal research; (2) research of one Third Cycle (MS) student from June 1981 through March 1982; and (3) research of four Third Cycle students from September 1981 through July 1982.

Personal research of Mr. El Aich has centered around the continued study of sheep diets on mountain grassland ranges of the Timahdite area. Since his own Third Cycle research on this topic was completed in July 1979, Mr. El Aich has supervised the Third Cycle research of three additional students. In the absence of students in the summer and fall of each year, he has done the data collection. Mr. El Aich is in the final stages of preparing a publication summarizing these studies, which should be available in August. Portions of this data will be used in his Doctoral research, the coursework portion of which he will begin in September at Colorado State University.

The Third Cycle research of Abdelaziz Chergaoui, which received SR-CRSP support, was completed in March 1982. This is one of the three Third Cycle studies supervised from September 1979 to September 1981 as mentioned above.

Since September 1981, SR-CRSP funds have supported research conducted by six students supervised by Mr. El Aich. These students and their topics include:

a. Third Cycle students

- 1) Mohamed Chami - Dietary systems of herds (sheep and goats of the Rharaya Valley.
- 2) Mastapha Derfaoui - Characteristics of ranges and movements of herds (sheep and goats) in the Rharaya Valley.
- 3) Abdelouahid Chriyaa - Dietary preferences of sheep under various grazing rates at the Timahdite Station.
- 4) Mohamed Harkousse - Nutritive value of sheep diets under various levels of utilization (at the Timahdite Station).

b. Fourth Year Meknes Students

Names unknown - Contribution to the study of animal production systems of small ruminants at Tazarwalt.

In March 1983, Mr. Val Jo Anderson will move to Morocco, where he will conduct his MS research at the Timahdite Station for approximately nine months. His research will deal with vegetational changes after four years, as a result of various grazing rates at the Timahdite Station. He will also assist Dr. Narjisse in establishing various treatments on the Oak Woodland Station, part of which will prepare for the arrival of Walt Schacht in January 1984, as discussed previously.

4. Range Sociology Research

Mr. Neal Artz moved to Morocco in July 1981, having almost completed his MS coursework in Range Science at Utah State University under non-CRSP funding. His study deals with the rationale behind decisions made by pastoral people in Morocco. His efforts have been on the Timahdite Perimeter. Mr. Artz spent July and part of August in French language training in Rabat, followed by seven weeks joining the Range Extension Project Team in a tour of range management activity in Morocco. He moved to Azrou in mid-October, but due to time involved in vehicle acquisition, and due to the study location change, work began in December. Much of the time since December has been spent in literature review, administrative level discussions, and in attempting to obtain Ministry of Interior approval to interview pastoralists and to utilize existing governmental records.

7. Technical Accomplishments

- A. El Aich, Ahmed. 1979. Etude des preference alimentaires et de la valeur nutritive de la ration des ovins sur la Station Pastorale de Timahdit. Memoire de 3eme Cycle Agronomie. Institut Agronomique et Veterinaire Hassan II. 154 pp.

Three sheep fitted with esophageal fistulae were used to study the botanical and chemical composition of the rangeland diet during October and November of 1978 and in April 1979. The frequency and contribution to the biomass of individual forage species were studied during the same months. For the three months, the contribution to the biomass of the grasses was 52.87%, 61.56%, and 53.14%; that of forbs was 10.86%, 11.73%, and 13.35%, and for shrubs was 35.62%, 26.48%, and

33.81% in October, November and April, respectively. The grasses and shrubs were more sought out by the animals in the fall. In spring, the grasses and forbs were preferred. Of the grasses, Festuca spp., Stipa lagascae, Phleum phloides, and Dactylis glomerata were more acceptable. For forbs, Bellis silvestris, Ranunculus orientalis, Thymelea tartonraira were the species most preferred. Genista pseudo-pilosa was the shrub chosen by the animals. Stems were consumed more in the fall, while in the spring leaves were taken. Flowers were not available during the study period. Crude protein and mineral elements increased from fall to spring while membranous constituents (crude fiber, ADF, ADL, and NDF) decreased. This was true for both the forage available, as well as in the diet selected. The nutritive value of the diet of the animals was therefore higher in the spring.

- B. El Aich, W., J. O'Rourke, and A. Bourbouze. 1980. Etude des preferences alimentaires et de la valeur nutritive de la ration des ovins sur la Station Pastorale de Timahdite. *Homes Terre et Eaux* 10(36):59-67.

De nombreux parcours sont delaissees, se degradent et doivent etre remis en valeur pour maintenir la vie rurale en place, et produire de la viande en quantite suffisante pour le pays; L'etude presente s'est deroulee dans le cadre d'un projet d'amenagement des parcours, sur la station de recherche pastorale de Timahdit situee dans le Moyen Atlas a 1000 m d'altitude. La station beneficie d'une moyenne annuelle de precipitations de l'ordre de 800 mm.

L'etude consiste a analyser selon la saison l'evolution des preferences alimentaires des ovins et de la valeur nutritive de la ration; Elle vise a contribuer a l'elaboration d'un schema d'amenagement et de mise en valeur de ces paturages.

- C. Chergaoui, A. 1982. Etude des preferences alimentaires des ovins et la vegetation sous differents niveaux de charge, a la Station Pastorale de Timahdite. *Memoire de 3eme Cycle Agronomie. Institut Agronomique et Veterinaire Hassan II.* 127 pp. (Plus a separate literature review of 71 pages).

During the spring of 1980 (March through June), a study was conducted in order to investigate the effects of three stocking rates on vegetation dynamics and sheep diets. The study area is located in the middle Atlas mountains at the Timahdite Range Experiment station.

Three stocking rates were used: light (3.8 animals/hectare), moderate (6 animals/hectare), and heavy (9 animals/hectare).

Plant species frequency, aerial biomass, and diets of esophageal fistulated animals were determined at monthly intervals.

No changes in the species frequency were observed at least over the study period. However, aerial biomass varied from March to June and under three stocking rates: 819.9 kg DM/ha (heavy stocking), 950.5 kg DM/ha (moderate stocking) and 1,300.2 kg DM/ha (light stocking). The utilization levels were 49%, 30% and 26% respectively under

the heavy, moderate and light stocking rates, respectively. Averaged over all collections, diets selected on the three grazing treatments did not differ greatly in their respective proportion of grass, sedge, forbs, and browse. Grass and sedge were an especially important food item on different pastures from March through June. However, forbs were slightly more abundant in the diet under the light stocking rate.

In general, plant parts presence was influenced to a certain extent by plant phenology. However, leaves were the major plant part constituent in diets throughout the study period for the different stocking treatments.

- D. Oumekloul, A. 1980. Etude des effets de la charge animale sur les performances zootechniques des ovins et l'évolution la végétation naturelle sur la Station Pastorale de Timahdite; Memoire de 3eme Cycle Agronomie. Institut Agronomique et Veterinaire Hassan II. 140 pp.

In order to show the effects of stocking rates on animal weight and vegetation trends, we employed three stocking pressures. They were heavy (4 sheep/ha), moderate (2.5 sheep/ha) and light (1.6 sheep/ha). This study was carried out in the Timahdite Range Station which is situated in the Middle Atlas. This research took place in March, April and May, 1980. Statistical analysis on species frequency did not show any significant differences due to stocking rates from April to May. Forage production on the lighter pressure was greater than that in the heavier, and they were respectively 796, 922, and 1123 kg of dry matter per hectare for the heavier, moderate, and lighter stocking rates.

Forage utilization was low for all stocking rates, which was 36, 23, and 25 percent respectively for the heavier, the moderate and the lighter stocking rates.

The average daily gains by yearling sheep were greater on the lighter than the others. They were 90.6, 107, and 119 g, respectively. On the contrary, the mean daily gain per hectare were greater on the heavier stocking rate than on the lighter. They were 387, 267.8, and 198.3 g respectively for the heavier, the moderate, and the lighter stocking rates.

A large difference in stocking pressure must be imposed before the significant difference in stocking in either sheep gains, hectare gains, frequency, or herbage dry matter and forage utilization is shown.

- E. BaMamadou, Abdoul. 1980. Etude des preferences alimentaires et de la valeur nutritive des rations des ovins sous l'influence du taux de charge. (Station Pastorale de Timahdite dans le Moyen Atlas). Memoire de 3eme Cycle Agronomie. Institut Agronomique et Veterinaire Hassan II. 186 pp.

Les plantes sont de organismes vivants qui ne sont pas fondamentalement differentes des animaux, croissants, respirants, digerants et mourants. Elles exigent des conditions bien definies pour leur devel-

oppement appropriée. Un système de pâturage qui empêche ce développement, constitue un mauvais usage des parcours; Et il en résulte, un déclin de la production fourragère avec pour conséquence une réduction de la production animale.

- Dans la lutte contre la sous-alimentation et la mal nutrition, le choix pour une utilisation rationnelle des parcours, doit être l'une des principales options d'une politique de développement.

- Il est donc important d'étudier le comportement alimentaire des animaux sur les parcours et ses conséquences sur l'écosystème pastoral afin de mettre en relief les principaux problèmes liés au système de pâturage.

C'est dans cette optique que nous avons étudié le comportement alimentaire des ovins à la station pastorale de Timahdit dans la région du moyen Atlas.

- Notre thème de recherche s'intègre dans un programme d'aménagement des parcours au moyen Atlas où une série de recherches ont été déjà effectuées.

- Laraisse (1978) a étudié les préférences alimentaires des ovins par la méthode de fistule œsophagienne sur un site à Genet durant les mois de mars, avril et mai.

- EL MAGHRAOUI Abdelaziz (1979) a conduit une étude se rapportant aux effets de la mise en défens sur les préférences alimentaires.

- EL AICH (1979) a mené une étude relative aux effets de la saison sur les préférences alimentaires des ovins et de la valeur nutritive des espèces pastorales en automne et au printemps, sur un site de pelouse mis en défens.

- OUMEKLOUL (1979) a étudié les effets de la charge sur les performances zootechniques des ovins et l'évolution de la végétation;

- La présente étude a pour but d'étudier les effets du taux de charge sur les préférences alimentaires et la valeur nutritive des rations d'animaux et la valeur nutritive des rations d'animaux au parcours.

Les objectifs visés sont les suivants:

- Maîtriser la technique de la fistule œsophagienne et encourager son utilisation.

- Analyser la végétation dans 6 parcelles soumises à différents taux de charge durant trois mois (mai, juin, juillet).

- Analyser les échantillons de bol alimentaire en vue de déterminer les contributions spécifiques des espèces ou catégories d'espèces à la composition botanique des rations.

- F. Artz, Neal E. 1982. The perception of range management options among pastoralists of the Timahdite Perimeter (Mimeo). Range Science Department. Utah State University, Logan, Utah.
- G. Oumekloul, A. 1980. Etudes des Effets de la Charge Animale sur les Performances Zootechniques des Ovins et l'Evolution la Vegetation Naturelle sur la Station Pastorale de Timahdite. Memoire, Institut Agronomique et Veterinaire Hassan II. Rabat, Morocco.

PART IV  
PARTICIPATING INSTITUTION ANNUAL REPORTS  
PERU

## Annual Report for 1981/1982

1. Project Title: Evaluation and Genetic Improvement of Sheep and Goats in Extensive Management Systems
2. Institution: Montana State University
3. Principal Investigator: Robert L. Blackwell
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$149,999  
Matching Contributions from 1981/82 Subgrant: \$54,759

5. Statement of Project Goals

Provide the genetic and animal breeding component of the Small Ruminant CRSP in the extensive management systems in Peru through the following:

- A. Identify breeds of sheep with high genetic potential for increasing food and fiber production under extensive management systems.
- B. Develop superior breeding stocks of sheep by (a) selecting within breeds that exhibit superior merit, and (b) combining desired characteristics of several breeds into synthetic stock(s) utilizing the combined forces of different mating systems and selection.
- C. Investigate genetic and environmental factors affecting growth, reproduction, and fiber production of alpacas.
- D. Develop methodology for utilizing superior breeding stocks to improve the productivity of indigenous herds and flocks.
- E. Provide training in animal breeding and livestock husbandry for both foreign and domestic students and for producers, managers, and Ministry of Agriculture personnel in Peru.

6. Summary of Accomplishments in Previous Years

Extensive breeding research projects have been developed with UNA. Limited research effort has been initiated at IVITA. UNA has excellent cooperative working relationships with several SAIS and cooperatives in the Central Sierra. These organizations provide abundant resources for research in the form of animals, land, facilities, and labor. Breeding research at SAIS Tupac Amaru involves evaluation of three different breeding groups within the Junin breed, comparisons of two groups of imported rams (Targhee and Finn x Targhee) and two local stocks (Junin and Criollo), and a study of the existing breeding program at the SAIS. Similar comparisons of the Targhee and the Finn x Targhee are being made in Montana.

At a second work location in the Central Sierra, the Central de Cooperativas, additional matings were made to evaluate the merit of the Junin and

Corriedale breeds. Two lamb crops have been produced in this project. A breed of sire comparison is being made at this location in which the Targhee, Finn x Targhee, Junin, Corriedale and Criollo rams are being compared in breeding tests.

The research effort at IVITA is confined to analysis of production data on alpaca from the La Raya station. Heritability and genetic correlation regarding fiber production and growth rate have been estimated from one data set and some color inheritance studies have been made.

The training component has been directed primarily to the graduate students at UNA. One student has completed all requirements for the Master's degree. Two others have proceeded to the point where they are involved in thesis research and two more have started graduate programs. All graduate students have been heavily involved in the management of the research projects, data collection, and in analysis. In addition, several other students who are doing research for the professional title, having completed the BS degree, have been involved in our program. The Breeding Project has provided assistance for them in several ways, either through direct employment or through advice and assistance on research projects and data analysis.

#### 7. Statement of Specific Objectives for 1981/82

- A. Continue to analyze production data as it becomes available, either from active SR-CRSP projects or from the files of cooperators.
- B. Continue breed comparisons of local breeds and the introduced sire breeds to determine merit of these different breeding groups.
- C. Initiate selection experiments with alpaca to determine direct and correlated responses to selection for staple length and growth rate.
- D. Continue the analysis of alpaca production and color data from the La Raya station.
- E. Provide financial support for graduate students at UNA and provide counsel and guidance in research procedures, experimental design, and data analysis relative to their thesis research.
- F. Initiate a large scale ram performance/progeny test project at SAIS Tupac Amaru to determine the efficacy of selecting for maternal ability and to compare that program of breed improvements with the existing breeding programs at the SAIS.
- G. Initiate collaborative research with Universidad Nacional Tecnica del Altiplano at Puno.

#### 8. Description of Work Undertaken

The breeding program at SAIS Tupac Amaru has made extensive use of a stratification system in the Junin breed similar to the nucleus breeding schemes that have been used with success in some areas of the US and in Australia and New Zealand. Breeding comparisons are being made in an attempt to evaluate the differences in genetic merit of two of the upper strata (Super

and "A" classes) and of a separate group of Junin sheep that have been selected for twin producing ability. The test matings involved approximately 20 rams each from the three groups during the first two years. Mass matings were made using ewes taken at random from the "B" (middle) class. Sufficient numbers of ewes are being used to ensure that the difference between mates of these rams are negligible (assumed to be zero). Thus, progeny performance will provide estimates of half the genetic difference between the sire groups. Two lamb crops have been produced and the performance of these offspring are being systematically recorded. Lamb and wool production of the females will be measured until they are four or five years old. The results will provide an objective basis on which to determine the differences in genetic merit between these groups. If substantial differences are found, it will indicate that the system is working. If only trivial differences are found, it will suggest the accuracy of identifying merit of individual animals and/or the system of classification used has some deficiencies and requires greater objectivity than currently prevails. These studies will not necessarily be an evaluation of the nucleus breeding scheme concept, but rather of the operational results of its application in this situation. Emphasis has been given to this work because the nucleus breeding scheme is popular in Peru. One objective, therefore, is to assist in developing an understanding of the systems and to provide objective information with which to reinforce or modify the way in which the breeding scheme is being operated.

Junin and Corriedale sheep are the most numerous of the improved breeds in Peru. Comparison between these two breeds in top cross matings have been made at the Central de Cooperativas where two lamb crops have been produced. Additional breed comparisons are underway. The first lamb crop from the imported rams, Targhee and Finn x Targhee, was born in October/November 1981 at two locations (SAIS Tupac Amaru and Central de Cooperativas). At the Central de Cooperativas, the Junin, Corriedale, and Criollo comparisons are included with the two imported breeding groups in the sire breed evaluation. At the SAIS Tupac Amaru, the Junin and Criollo are being compared with the imported rams. At both locations, the tests have included improved ewes, either Corriedale or Junin, and Criollo ewes. For reasons largely unknown, the matings to Criollo ewes at SAIS Tupac Amaru the first year were unsuccessful. Some death loss has occurred in the Targhee rams at SAIS Tupac Amaru and some of the imported rams located at the Central de Cooperativas have been lost to the project due to epididymitis.

A wide sampling of the Junin breed at SAIS Tupac Amaru has been made to establish a randomly mated, unselected control flock. The research effort at SAIS Tupac will be conducted primarily at one location, the Consac Production Unit, which has good facilities and ample resources to accommodate the project activities. Uniform sheep management will permit experimentally sound comparisons between the various breeding groups involved. Ten breeding pastures are being constructed at this location to facilitate research.

The work at the Central de Cooperativas has continued despite uncertainty regarding land availability. The long term availability of this location as a worksite for UNA has to date not been approved. Therefore, work plans are being made only to the extent that the animals produced in the project up to this time will be continued. No expansion is anticipated at this location unless firm commitments are made by the Cooperative to establish the area now being used as a worksite for UNA.

Considerable progress in analysis of alpaca production data from La Raya has been accomplished by Dr. Velasco at IVITA. These data have also been utilized in teaching a course in animal breeding. Further development of a research program in alpaca breeding at La Raya is uncertain. The difficulty in this matter apparently is, in part, a result of the recent division of resources at the La Raya station between IVITA and UNTA at Puno. The uncertainties that prevail have dictated that we maintain a relatively small program with IVITA and primarily confine the effort to data analysis and publication of results.

To date, the data collected and analyzed on all projects have provided good information on levels of wool production, growth rates, and reproductive rates. Information on lamb mortality to weaning has also been obtained. The data confirmed the fact that reproductive rates are low. Rarely are twins produced in the general populations of Corriedale or Junin ewes. The data from the twin flock of Junin sheep at SAIS Tupac Amaru suggests that reproductive rates are higher in this group of sheep, but not by a substantial amount. Our research should determine if this observed difference is genetic or due to management practices. Some data summaries are tabulated at the end of this report.

In November 1981, a one-week shortcourse in animal breeding was conducted in Lima. A broad coverage of animal breeding topics was included, from basic principles to application as they apply to sheep and alpaca breeding. We also included material from range management, physiology of reproduction, and economics. We drew heavily on the faculty of UNA and IVITA in addition to Ben Quijandria, Kress and Blackwell, Gary Sides and Ed Lotterman. Manuel Carpio, Jorge Velasco and Ben Quijandria made outstanding contributions to the program, both in terms of material presented and in planning and executing the shortcourse. The 65 registered participants included faculty from several universities in Peru, professionals working throughout Peru, SAIS and cooperative managers, Ministry of Agriculture employees, students that had completed the BS degree, and graduate students. Interest was high and well maintained throughout the course.

Two additional research projects have been initiated during the current program year. The first is a selection project with alpaca at SAIS Pachacutec. Extensive baseline production data were collected on the herd of approximately 1500 alpaca females and the available males prior to the breeding season in December and January. Two separate selection projects were initiated, each with replicated sub-populations. A control population has also been included. The two selection criteria are staple length and yearling body weight. In addition to the direct selection effects, data will be collected to permit estimations of correlated response in other important production traits in alpaca.

The second new project, at SAIS Tupac Amaru, will be initiated during the 1982 breeding season. It will incorporate a progeny test for daughter's maternal ability with performance testing and mass selection procedures. Initial ram selection will be directed primarily at growth and wool production prior to 16-months of age. The number of rams' progeny tested will be no less than 40 each year. Approximately 4000 ewes will be utilized in these test matings, and it is estimated that approximately 25 producing daughters per ram will be produced. Data on growth and wool production will be collected on all

progeny up to about 16-months of age and reproduction and lamb production data will be collected on all female progeny. This project will generate data to thoroughly investigate certain animal breeding principles and practices. In addition, direct comparisons can be made with the SAIS breeding program. The control population will provide comparisons to determine change in experimental populations.

Analysis of one set of data from the project provided the basis for an abstract which has been accepted by the American Society of Animal Science, to be presented at the 1982 Annual Meeting. The abstract is included below.

Data on 1634 birth weights (BW) 1381 weaning weights (WW) and 628 8-month weights (8-MW) of range lambs from three locations in the central Andes of Peru were analyzed. Estimates of means (kg) and error mean squares ( $\text{kg}^2$ ), respectively, ranged from 3.57 to 3.99 and .278 to .425 for BW; 17.88 to 24.56 and 10.07 to 15.55 for WW; and 22.22 to 29.20 and 8.66 to 11.60 for 8-MW. Least squares analysis of variance models (which included variables such as breed, breeding group or management group, age of dam, sex of lamb, date of birth or age of lamb and weight of dam) accounted for 3.3 to 20.9; 10.5 to 25.6; 8.7 to 40.7% of the variation in BW, WW and 8-MW, respectively. Lambs sired by Corriedale and Junin (a medium wool breed recently developed in Peru) rams, and out of Corriedale ewes, did not differ in BW or WW ( $P < .01$ ) while Junin-sired lambs were 1.35 kg heavier at 8 months ( $P < .01$ ) than lambs sired by Corriedale rams. Junin lambs sired by rams from three different "merit" classes differed in BW ( $P < .01$ ) but not in WW or 8-MW. Age of dam (2-, 3-, 4-, and 5-year old ewes) significantly affected BW, WW and 8-MW ( $P < .01$ ). In all data sets, males were consistently heavier than females. Comparisons were made with published data on age-of-dam and sex effects on BW and WW. Age-of-dam effects were similar to published data, with lambs from 2-year old ewes being significantly lighter at birth and weaning than from older ewes. There were little weight differences observed for lambs from 3 to 5 years of age. On the average, the sex effects were smaller than most published results, ranging from .2 to .3 kg at birth and .5 to 2.8 kg at weaning. Age of lambs (in days) had a significant linear effect on WW and 8-MW ( $P < .05$ ).

In November/December 1981, preliminary contacts were made with faculty of the Universidad Nacional Tecnica del Altiplano at Puno, and their station at Chuquibambilla was visited by Quijandria and Blackwell. Tentative working relationships were discussed and the decision to establish collaborative projects with this University was made. The extent of the effort at this location and the nature of the research will be defined in May/June 1982. The resources at Chuquibambilla will be incorporated in the overall breeding project and possibly cooperation between UNTA and producers in the southern region of Peru will be supported.

Dr. Jorge Velasco travelled to Montana, Texas, and North Carolina. He presented a paper on his research with alpacas at the 1981 ASAS meetings. Dr. Burfening also presented a paper at these same meetings that resulted from research done in collaboration with UNA. Manuel Carpio attended the meeting of the Latin American Association of Animal Production. Two trips to Peru will have been made during the year by Blackwell (the second in late May/June) and one each by Burfening and Kress.

During the year, Benjamin Quijandria completed requirements for the PhD at North Carolina State University. This is considered a contribution to the animal breeding effort in Peru and was supported in part by the Animal Breeding Project of the SR-CRSP.

Table 1. Average values (kg) for production characteristics of Junin ewes and lambs (foundation for control flock) at SAIS Tupac Amaru tabulated by age of ewe.

Ewe Age	Ewe Weight June	Lamb Birth Weight	Lamb Weaning Weight <sup>1</sup>	Ewe Weight March	Ewe Fleece Weight	Lamb Weight <sup>2</sup>	Lamb Fleece Weight <sup>2</sup>
2	43.2	3.35	20.8	41.3	2.80	26.8	1.58
3	47.6	3.68	21.8	44.0	3.09	29.2	1.70
4	49.6	3.82	22.8	45.2	3.13	31.0	1.56
5	51.6	3.79	22.4	46.2	2.92	31.3	1.68

Total No.

Records	427	434	341	383	283 <sup>3</sup>	127 <sup>3</sup>	145 <sup>3</sup>
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<sup>1</sup> Weaning age approximately 4.5 months

<sup>2</sup> Age of lambs approximately 7.5 months

<sup>3</sup> Data from three of four production units

Table 2. Average values (kg) and numbers of records for production characteristics of mates and progeny of sires from Super, A and Twin flocks, SAIS Tupac Amaru.

Characteristic	Ram Source					
	Super		A		Twin	
	No.	Average	No.	Average	No.	Average
Ewe Weight	226	43.3	267	43.2	267	43.3
Ewe Fleece Weight	212	2.76	258	2.81	254	2.80
Lamb Birth Weight	308	3.64	318	3.51	312	3.60
Lamb Weaning Weight						
4.5 months	265	24.0	279	23.9	274	24.2
Lamb Weights,						
7.5 months	102	28.6	93	28.3	107	28.5
Lamb Fleece Weights,						
7.5 months	125	1.36	143	1.38	132	1.36

Table 3. Comparison of mates (Corriedale ewes) and progeny of Corriedale and Junin rams at Central de Cooperativas, Cerro de Pasco. Number of records and average values of production characteristic.

Characteristic	Breed of Sire			
	Corriedale		Junin	
	No.	Average	No.	Average
Ewe weight at breeding (May), kg.	154	47.9	150	47.3
Ewe weight at shearing (February), kg.	148	36.4	147	35.6
Ewe fleece weight (February), kg	148	3.70	147	3.79
Ewe staple length (February), cm	148	8.78	147	9.13
Progeny birth weight, kg	138	4.02	126	3.97
Progeny weaning weight (5 months), kg	126	18.0	109	17.8
Progeny weight (8 months), kg	110	20.4	95	21.8
Progeny fleece weight (8 months), kg.	111	1.25	96	1.17
Progeny staple length (8 months), cm	111	9.08	96	9.34

## Annual Report for 1981/1982

1. Project Title: Improving Small Ruminant Nutrition, Management and Production
2. Institution: Texas Tech University
3. Principal Investigator: Fred C. Bryant
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$66,667

5. Statement of Project Goals

The goal of the SR-CRSP is to improve production and management of small ruminant livestock. The objectives of the Texas Tech University (TTU) range project in Peru have been to initiate collaborative field and laboratory work to help accomplish this main goal. The objectives of the initial year of the program included:

- A. To work collaboratively with the other US institutions involved in the SR-CRSP research in Peru.
- B. Identify counterparts from Peruvian institutions.
- C. Employ long-term US personnel for the program in Peru.
- D. To initiate development of small ruminant Experimental Research Centers (ERC) in Peru.
- E. To inventory the range resources at the research sites.
- F. To determine the seasonal variation in the range forage quality.
- G. To determine the diets and forage preferences of sheep and alpaca grazing the rangelands.
- H. To evaluation long-term grazing studies in terms of animal performance and the impact on the native vegetation.
- I. To evaluate the advantages of improved, cultivated pasture on animal performance.
- J. To initiate a long-term graduate training program.

6. Summary of Accomplishments in Previous Years

Program Year 1979-80. The first active year of the program consisted of 1) identifying experienced counterparts from Peruvian institutions, 2) identifying and hiring qualified TTU faculty and students to coordinate and

carry out specific research projects in Peru and 3) locating representative worksites to initiate the range research projects. This was done collaboratively with the Principal Investigators from the Ohio State University CRSP subproject.

Program Year 1980-81. The specific objectives of the second year were rapidly advanced upon the arrival of TTU MS candidate, Brad Wilcox, first, and especially of the long-term Range faculty member residing in Peru, Dr. Al Schlundt. Wilcox spent the entire year qualifying and quantifying the productivity and variability of the major range sites in the vicinity of the Corpacancha ERC. Corpacancha, headquarters of the SAIS Pachacutec, is our primary ERC for collaborative research in the Central Sierra with Dr. Arturo Flores of the National Agrarian University (UNA) forages program (PF). Permanent exclosures and a large multi-level sheep grazing study were initiated at the site. Two grazing treatments included collaborative studies with the Ohio component in nearby Conocancha. Several thesis projects for UNA agronomy and animal science students were also incorporated into this larger project.

In the southern Sierra at La Raya, both laboratory and field studies were initiated by Dr. Schlundt and the IVITA (Instituto Veterinario de Investigacion Tropical y Altura) Nutrition Department staff at La Raya, Ing. Diomedes Holgado and DVM Arturo Rosales. The primary project initiated there was a long-term alpaca stocking rate study. This was complemented by small pasture studies of camelid and sheep grazing preferences. In addition, the behavior of free-ranging alpaca was studied. Finally, Ing. Ramiro Farfan, head of IVITA Pasture and Forages at La Raya, returned to Peru after his course work at TTU to collect data for his MS thesis on alpaca diets during the dry season.

During the summer of 1981, contingency funds became available for a goat production project to be initiated in the coastal region in northern Peru. Texas Tech was one of six US institutions involved. A series of small range goat studies were supported within the framework of this project. By the end of Program Year 1980-81, several specific subprojects had been outlined with students of Pedro Ruiz Gallo University (UPRG), Lambayeque, to be directed by Ing. Francis Villena, head of UPRG animal science, and Dr. Schlundt. Additional projects were proposed by and for the University of Piura and CIPA-Norte (Vista Florida) the investigative branch of INIPA in Lambayeque.

#### 7. Statement of Specific Objectives for 1981/82

- A. To continue development of the Experimental Research Centers at La Raya and Corpacancha (SAIS Pachacutec).
- B. To summarize and analyze data from the inventory and classification of rangeland vegetation and soils at Corpacancha (SAIS Pachacutec).
- C. To analyze data for development of production curves of major plant species at Corpacancha.
- D. To evaluate the impacts of long-term grazing on floristic structure and composition at Corpacancha.

- E. To continue data collection from long-term grazing treatments at Corpacancha.
  - F. To continue data collection from long-term grazing treatments at La Raya.
  - G. To initiate, summarize, and analyze research on the dry season forage preferences of alpaca at La Raya.
  - H. To initiate range nutrition research at Corpacancha and La Raya.
  - I. To evaluate the influence of stocking rate for grazing short duration grazing with sheep at Texas Tech University.
  - J. To produce corollary research projects with our Co-Investigators in Peru.
  - K. To continue the emphasis on LDC student training.
8. Description of Work Undertaken

Objective A

TTU Range Science faculty member on permanent assignment in Peru, Al Schlundt, continued to coordinate the development of the ERC's of the Southern (La Raya) and Central (Corpacancha) Sierra. Research was also initiated in the Department of Puno (Chuquibambilla) and the northern coast (Lambayeque and Piura). Research at the latter two sites were initiated after last year's proposal was submitted and detailed objectives were not included. [Work undertaken and accomplishments will subsequently be discussed only under Objective A.]

La Raya. Collaborative research with IVITA on alpaca nutrition and grazing has continued at La Raya. Sr. Harry Correa was supported by the Texas Tech SR-CRSP and trained in Lima (IVITA) as a forages analyst by Dr. Ricardo Valdivia. He was then stationed at La Raya to provide the nutrition staff with a qualified technician to begin on-site forages analysis research. Unfortunately, the lab has not been completed even though the equipment has been there since August 1980.

The ten room structure supported by CRSP site development funds and identified as critical for use by visiting scientists was not completed as planned and will hopefully be available by September, 1982. The lack of the "hotel" negatively affected the rate of the development of the TTU forages laboratory and of CRSP involvement in general because of the difficulty in commuting from Siquani. The availability of a CRSP Suburban at La Raya, however, greatly facilitated the movement of personnel and of supplies.

The long-term grazing studies were established on an area of the station called "el Tambo". Electric fences were constructed for four large pastures to conduct continuous alpaca grazing studies under continuous grazing, adjacent, smaller pastures were fenced for grazing studies to evaluate the forage preferences of llamas, alpacas and sheep.

A stoutly constructed holding corral was constructed near the nutrition laboratory near the center of the station where ten experimental alpaca with esophageal fistulas could be observed and carefully maintained. These animals were fistulated March 1982, by Drs. Bryant, Valdivia, and San Martin, and may provide the most useful tool for determining free-ranging alpaca diets. An additional stable was constructed to contain llamas and alpacas with rumen fistulas. These animals will provide the critical source of camelid rumen fluid for in vitro digestibility studies in the laboratory. A small electric fence-training corral was also installed, not only to determine the correct heights for working with alpacas and llamas, but also to train additional livestock to avoid problems with subsequent replacements to the larger field studies.

Corpacancha. Fence construction for the long-term grazing studies at Corpacancha ERC was completed in Program Year 1980-81. Additional contributions to the Central Sierra facility has been the fencing off of a large holding area for 80 replacement lambs produced from the ewes of the grazing treatments of the studies in progress. The improvement of the housing of the TTU shepherd, Zenon Rojas, has included new windows, paint, and additional lighting. A field technician, Jose Laurente, was hired to replace the previous man, Victor Beraun, who moved up the ranks in the SAIS "Pachacutec" administration. A project "house" at Conocancha was furnished using site development funds.

Chuquibambilla. Small long-term grazing experiments were initiated with Ing. Juan Astorga at Chuquibambilla, the main livestock research facility of the National Technical University of the Altiplana (UNTA). Treatments included four seasons of grazing by alpaca and sheep on two important range sites. The management of these experiments will continue during the years to come to provide information about the range trend under these grazing regimes. Four grazing exclosures were also constructed at Chuquibambilla. These were placed in conjunction with the long-term grazing studies mentioned above.

Lambayeque and Piura. The only long-term range studies established in conjunction with the goat project on the north coast were two grazing exclosures in Olmos near permanent weather stations. These will provide permanent locations for repeated observations of ungrazed sites. This will be especially important in wet years to determine the variability in annual herbage production of the sites. Other research objectives were included in the "Goat Project" report submitted for contingency funds.

#### Objective B

MS candidate, Brad Wilcox, completed his field work in August 1981, and returned to the Texas Tech campus. Ongoing activities include coursework and data analysis. Partial findings were presented at the International Society for Range Management Annual Meeting at Calgary, Alberta, Canada in February 1982.

#### Objective C

Brad Wilcox currently is summarizing data on standing crop biomass he collected from grazing exclosures at Corpacancha.

#### Objective D

Brad Wilcox is currently analyzing and summarizing these data from Corpacancha.

The work at La Raya along these lines has not advanced satisfactorily because of the lack of trained personnel. Ing. Juan Astorga of UNTA in Puno proposed range work as part of a larger proposal to study the rangelands of the Puno altiplano. Because the grazing lands of the La Raya station were recently divided between IVITA and UNTA, Astorga's proposal was supported albeit not with the amount of funds merited. With minimal support, Astorga and seven students initiated studies on four distinct sites near the Chuquibambilla sheep ranch, a facility of UNTA, and at La Raya on the Puno side. The studies included vegetation surveys, plant production and utilization (by both alpaca and sheep) studies as well as forage quality and soil descriptions.

#### Objective E

Data were collected from all of the following grazing treatments: continuous stocking of sheep at 3 sheep/ha; rotational grazing of sheep at 2,3,4 and 6 sheep/ha; complimentary grazing of sheep with cattle where sheep were stocked at 3 sheep/ha; complimentary grazing of sheep with cattle on fertilized range where sheep were stocked at 5 sheep/ha.

The first complete year of data collection ended March 15, 1982. Animal production included: lamb birth weights, lamb growth rates from birth through weaning; lamb crop (percent); monthly ewe weights; and fleece weights. Vegetation data included measurement of standing crop biomass every 3 months. These data have not been summarized to date.

#### Objective F

Data from the research project implemented on alpaca stocking rates under continuous grazing included liveweights of female alpaca on a monthly basis and standing crop biomass of vegetation, quarterly. To date, data have not been summarized.

Research on the utilization of forage species by llama, alpaca, and sheep is still underway. Partial findings were presented by Dr. Al Schlundt at the Annual Meeting of the International Society for Range Management in Calgary, Alberta, Canada, February 1982.

#### Objective G

Ramiro Farfan returned to the Texas Tech campus in January 1982 after 7 months of data collection on forage preferences of alpaca during the dry season. Data are currently being prepared for analysis.

#### Objective H

PhD candidate, Carlos Fierro, of Chihuahua, Mexico, arrived at the Texas Tech campus in January 1982, to begin coursework and develop a research proposal for his dissertation. Preliminary plans include the use of esophageally

fistulated sheep to estimate nutrient quality of their diets and dry matter intake as influenced by various grazing treatments. Mr. Fierro's research should be conducted at Corpacancha. Ongoing research at Corpacancha also evaluates sheep nutrition in terms of animal production (see E).

For La Raya, Peruvian Horacio Acuna of IVITA, declined the PhD assistantship offered him to study alpaca nutrition on native range. Richard Reiner (BS, Humboldt State; MS, Utah State) has been selected to conduct this or another aspect of alpaca research.

#### Objective I

This research was initiated on the Texas Tech campus in May 1981. For reference, preliminary findings may be obtained from the Management Entity Office.

#### Objective J

No new corollary projects were proposed this year by Peruvian counterparts to the TTU Range Project. The range plant autecological studies continued. Ivan Lares, Luis Bueno, Nelly Rodriguez, and Jorge Gamarra continued their research projects initiated by Dr. Arturo Florez at UNA. Projects initiated by Dr. Al Schlundt included thesis research of Carlos Guitierrez and Marina Rios of IVITA.

#### Objective K

Students supported in full or in part by Texas Tech included:

##### US Training:

Ramiro Farfan, Peruvian National  
Carlos Fierro, Mexican National  
Brad Wilcox, American

##### LDC Training:

Luis Bueno, UNA  
Jorge Gamarra, UNA  
Ivan Lares, UNA  
Nelly Rodriguez, UNA  
Marina Rio, IVITA  
Carlos Guitierrez, IVITA

## Annual Report for 1981/1982

1. Project Title: Intensive Forage Production Systems for Smallholder Sheep and Goat Producers
2. Institution: Ohio State University
3. Principal Investigator: Robert Van Keuren
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$150,000  
Matching Contributions from 1981/82 Subgrant: \$91,221

5. Statement of Project Goals
  - A. To identify and characterize the forages available or of potential usefulness for areas under study.
  - B. To develop forage/animal production systems and evaluate plant/animal response.
  - C. To evaluate the nutritional and microbiological factors of these forage production systems for small ruminants.
  - D. To determine the importance of animal genetic variation for resistance to gastrointestinal parasites under intensive grazing systems.
6. Summary of Accomplishments in Previous Years

During the period of the 1980-81 report, two trips were made to Peru by Drs. Van Keuren and Parker (May 1980 and December 1980). The Ohio research associate was established in Peru during July 1980. Initiation of the Ohio workplan was begun at Ayaracra, but was abruptly terminated due to a land invasion by local campesinos (August 1980). In late September, the Peruvian professionals from Ayaracra recommended that Ohio and Texas Tech not initiate projects there at that time; hence efforts were concentrated on selecting a new site. A working arrangement was negotiated with SAIS Pachacutec in October 1980, and cultivation efforts were begun shortly after. However, a heavy rainy season plus equipment shortages prohibited completion of cultivation for the major project until the following dry season. Some of the land preparation was completed and utilized in the establishment of several smaller forage studies in collaboration with UNA. Plans were developed during this period to bring Enrique Nolte to Ohio for graduate study. While his application was being processed, Efrain Malpartida was furnished with SR-CRSP funds for English tutoring in anticipation of traveling to Ohio for graduate study the following year. Excellent working relations with our Peruvian counterparts at UNA were developed during this period. Detailed plans for additional cultivated forage studies were also developed at this time, and literature available on forage production in the Peruvian high Sierra was reviewed.

## 7. Statement of Specific Objectives for 1981/1982

### A. Central Sierra

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 of 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.

### B. Northern Coast

1. Initiation of digestion trials involving various forages and by-products commonly available to goat producers on the Northern Coast.
2. Initiation of growth trials utilizing forage materials commonly consumed by goats on the Northern Coast.
3. Initiation of various agronomic trials involving Leucaena leucocephala in order to evaluate its feasibility for use in goat production systems on the Northern Coast.
4. Support of the overall goat research effort on the Northern Coast in terms of assisting in surveys, training, and provision of physical facilities.

## 8. Description of Work Undertaken

Since January 1981, the Ohio State University component of the SR-CRSP has collaboratively established a large number of studies aimed at shedding light on the use of small ruminants in intensive forage systems. The following is an overall listing of studies initiated:

### A. Central Sierra (All projects centered upon sheep production)

1. Cultivated forages as a supplement to the nutrition of range ewes (pasture-established August 1981) - SAIS Pachacutec.
2. Comparison of 11 grass-legume mixtures both with and without irrigation (irrigated pasture - established August 1981; dryland pasture - established November 1981) - SAIS Pachacutec.
3. Dryland variety trial (15 species - established November 1981) - SAIS Pachacutec.

4. Legume inoculation effectiveness trial (8 mixtures, 2 sub-treatments - established January 1981) - SAIS Pachacutec.
5. Forage variety trial (25 species - established January 1981) - SAIS Pachacutec.
6. Forage variety trial (22 species - established December 1980 - collaborative with UNA/IDRC project - OSU contributed 8 species for evaluation) - SAIS Ramon Castilla.

B. Northern Coast

1. Voluntary consumption and digestibility of by-products common to the Northern Coast of Peru - Lambayeque.
2. Voluntary consumption and digestibility of native forage materials common to the Northern Coast of Peru (to be initiated immediately following the termination of B.1 - research facilities and framework are already established) - Lambayeque.
3. Livestock growth trial - 4 levels of Acacia macrocantha and corn stalks - Lambayeque.
4. Livestock growth trial - 4 levels of Prosopis chilensis and corn stalks - Lambayeque.
5. Livestock growth trial - 4 levels of Leucaena leucocephala and corn stalks - Lambayeque.
6. Response of Leucaena leucocephala to fertilization with various levels of Nitrogen and Phosphorus - Lambayeque.
7. Effect of density of plant stand on overall production and regrowth characteristics of Leucaena leucocephala - Lambayeque.
8. Regrowth characteristics of Leucaena leucocephala under various harvesting schemes - Lambayeque.
9. Regrowth characteristics of Acacia macrocantha and Prosopis chilensis under a harvesting system - Lambayeque.

The Central Sierra work designed by Drs. Van Keuren, Parker, and Florez has all been initiated with Ohio's collaborators at UNA. Dr. Arturo Florez, Efrain Malpartida, and Robert Cochran accomplished the actual establishment of projects A-1 through A-6 with the help of day laborers from SAIS Pachacutec. For the large pasture trials, tractors were contracted to cultivate the land area due to shortage of SAIS equipment plus the SAIS's inability to complete agreed-upon responsibilities. The soils in the smaller trials were cultivated by SAIS machinery. All seeding and fertilization was accomplished by hand. Irrigation canals were dug by hand by Ohio's shepherd (Saturnino Silvestre) and other SAIS laborers for all of the pasture trials except for the dryland trials. The large cultivated pasture in Conocancha (SAIS Pachacutec) was fenced with electric fencing. Gallagher Electric Fence Company's technician oversaw the installation of the electric fence and its accompanying solar

panel. All other trials are equipped with standard woven wire fencing. Frequency of travel by Dr. Florez, Ing. Malpartida and Robert Cochran averaged out to one working trip every 2-4 weeks.

The projects on the Northern Coast have been initiated with quite a number of collaborators from the INIPA Goat Station and from Universidad Pedro Ruiz Gallo. A listing of collaborators follows:

Helido Vidal, Professor of Animal Nutrition, Universidad Pedro Ruiz Gallo

Francis Villena, Professor of Animal Production, Universidad Pedro Ruiz Gallo

Carolina Aguilar, Professor of Animal Nutrition, Universidad Pedro Ruiz Gallo

Antonio del Carpio, Professor of Animal Nutrition, Universidad Pedro Ruiz Gallo

Teofilo Cordero, Director of Goat Research, INIPA Goat Station

Rose Higaonna, Pasture Researcher, INIPA Goat Station

Jaime Pincon, Technician, INIPA Goat Station

Trials B-1 and B-2 were primarily initiated by Ing. Vidal, Ing. Cordero, and Robert Cochran. Digestion stalls were constructed by a local carpenter and two goats were rumen fistulated to provide a source of rumen fluid for doing the in vitro portion of the analyses. The harnesses for collecting feces were also made in the area by a local leather worker. Sylvia Calderon, an Ingeniero student of Ing. Vidal's at Pedro Ruiz Gallo, has been working with this project and plans on writing her portion up for her thesis. Trials B-3, B-4 and B-5 were principally initiated by Robert Cochran and Antonio del Carpio. Two sets of corrals for use in these trials (16 individual pens per set) were constructed from woven wire by goat station personnel. Laura Baquedono, also an Ingeniero student of Ing. Vidal's, worked on trial B-3 for her thesis. Trials B-6 through B-9 were initiated by Ing. Villena, Ing. Higaonna, and Robert Cochran. The goat station accomplished the cultivation and provided personnel to seed the trials by hand. Irrigation is accomplished with existing canals. Frequency of travel by Robert Cochran to the Chiclayo area averaged out to approximately one working trip per month.

#### Travel Activities

March 10-13, 1981

Dr. Ricardo Valdivia (Animal Nutritionist with IVITA, San Marcos University) visited Wooster to discuss research possibilities.

May 27-June 1981

R.W. Van Keuren and C.F. Parker visited Peru including visits to Pucallpa, to view potential research in the jungle, and to Chiclayo/Piura to view potential goat research in northwest Peru.

July 3-August 2, 1981

Robert Cochran visited Wooster to discuss research design, current status and development, future research plans and to receive training in several specific items pertaining to Ohio's research (e.g., rumen fistulation, etc.).

## 9. Technical Accomplishments

### A. Central Sierra

Data on three separate clippings has been collected on the "Legume inoculation effectiveness trial" and on the "Variety garden" at Corpacancha. Data from four clippings on the SAIS Ramon Castilla "Variety garden" has also been collected. Data from these trials generally includes yield, height, botanical composition (where applicable), legume inoculation, vigor, quality analyses (percent DM, percent CP, ADF, NDF, IVDMD) and mineral analyses. The trial using cultivated forages to supplement range ewes is presently underway with ewes from the Texas Tech Range treatments being flushed on the pastures. Production data will begin coming off of that study in September-October 1982, when ewes are put back on for lambing. The "Dryland variety garden" and the "Comparison of 11 grass/legume mixtures both with and without irrigation" involve dryland plots that were not seeded until November 1981. These plots need at least one year for proper establishment in the High Sierra. Hence, data will be collected from these trials in November 1982.

### B. Northwest Coast

Data collection on the digestion trial with by-products is approximately 75 percent complete. This trial involves four 28 day periods, of which only the final period remains to be completed before the trial is terminated. The digestion trial involving local forage material will be initiated immediately following the termination of the trial using by-products. The growth trial with Acacia macrocantha has been completed and data is available on consumption, weights and their implied gains, body measurements and the quality analyses of the diets involved. Two more growth trials involving Leucaena leucocephala and Prosopis chilensis are presently underway and will be completed in July 1982. All agronomic trials on the northwest coast have only recently been established, hence data will not begin to be collected from these trials for several months yet.

Annual Report for 1981/82

1. Project Title: Improving Female Reproduction Performance of Small Ruminants in Least Developed Countries

2. Institution: Utah State University

3. Principal Investigator: Warren C. Foote

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$134,000  
Matching Contribution from 1981/82 Subgrant: \$61,875

5. Statement of Project Goals

A. To measure reproduction capabilities of the major genotypes of small ruminants and mechanisms of control of selected reproduction processes.

B. To determine the influence of environment, including climatic factors, and nutrition and other management factors on reproduction in selected genotypes of small ruminants and to develop alternative management programs to increase production.

C. To cooperate with other SR-CRSP components in reproduction related programs.

D. To provide graduate and non-degree training programs to selected foreign collaborators and other program related personnel.

6. Summary of Accomplishments in Previous Years

Refer to 1980/81 Annual Report

7. Description of Work Undertaken

A. Research Results

Reproductive performance of two breeds of ewes in Southern Altiplano (Puno). This research was conducted at the La Raya Experiment Station. (Thesis research for Walter Bravo's MS program)

Two experimental flocks of Criollo and Corriedale ewes at different ages are involved in this research. The first flock is maintained non-pregnant and used to observe the occurrence of estrus and the occurrence and rate of ovulation. The second flock is mated during the traditional period and reproductive performance in terms of fertility, date of lambing, type of birth (lambing rate), and birth weight of lambs are obtained.

Some information on estrus and ovulation obtained from the first flock of experimental ewes have been gathered. Information on body weights have not yet been summarized.

Although estrus occurred each month in each breed and age group for which data are currently available, the incidence was much higher in the Corriedale breed during May-August than April and September-December (data are not included for January-March). The occurrence of estrus was distributed more evenly throughout the year for the Criollo breed. This indicates that the Corriedale experience a period of reduced estrus activity during the year which must be considered in establishing programs to improve reproductive performance.

The percentage of ewes ovulating followed the same general pattern as shown for estrus for both breeds. Except for two incidences when two ovulations occurred, the ewes in both breeds and in all ages produced only single ovulations.

This indicates a very serious limitation to improved reproductive performance. The cause of the low ovulation rate is an important question to be answered. Ovulation rate in the Corriedale breed is approximately 1.5 in many parts of the world. Elevation and possibly feed are prime contributing causes.

Information obtained from the second flock of sheep on fertility and birth weights and mortality of lambs indicate the following. The fertility (percent of ewes lambing) was higher (97.7 vs. 84.3%) and lamb mortality (8.4 vs. 37.1%) in the Criollo than the Corriedale breeds. This difference was particularly obvious in the younger aged ewes. Birth weights of lambs were slightly higher in the Corriedale ewes (2.5 vs. 2.4 kg).

Reproductive physiology and endocrinology in the female Alpaca. (This research is being conducted at the La Raya Experiment Station in the Southern Altiplano)

Several separate experiments are being conducted with alpaca in an effort to learn more about their basic physiology and endocrinology of reproduction.

In one of these studies, two age groups of alpaca are being used; one year old females that have not been exposed to males and 3-5 year old females that are 20 or more days post-partum. The females are exposed to active males for three minutes and their receptivity scored from 0-5 as intensity of estrus. A score of 0 indicates no receptivity or estrous intensity. A score of 1 indicates lowest and 5 highest degree of estrous intensity. The females are classified as low (1-2 score) and high (4-5 score) for inclusion in this study. The females are checked for estrous intensity and those with appropriate scores are bred with fertile males (physical examination). Immediately after breeding, each female is examined with a laparoscope (within 45 minutes) and ovarian follicular activity recorded. This time is recorded as time 0 to represent time of mating. Each female is similarly observed 32 and 72 hours post-mating to determine if ovulation has occurred and classified according to their response.

Females ovulating by 32 hours are classified as normal time ovulators, those ovulating between 32 and 72 hours are classified as late time ovulators, those not ovulating by 72 hours are classified as failing to ovulate. The females are checked for pregnancy at 45 days to determine pregnancy to measure embryo survival.

In another study, twenty alpacas 3-5 years of age that lambd the previous year were assigned to this study. The females are checked twice weekly for estrus using two sterile males per 10 females. Estrus is scored from 0-5 during a 3 minute exposure period. The occurrence of ovulation will be determined by level of serum progesterone taken at weekly intervals. The study will continue for 2-3 years. Data being collected: (1) incidence and intensity of estrus measured at twice a week intervals; (2) weekly blood samples (via jugular) for RIA for progesterone to indicate occurrence of ovulation. Data are being obtained, but have not yet been summarized.

Reproductive performance of three breeds of ewes in the Central Sierra.  
This research was conducted at SAIS Tupac Amaru (Dissertation research for Cesar Novoa's PhD program)

The same experimental design was used in this research as described for the research in the Southern Altiplano. The breeds of ewes were expanded to include the Junin. Information on body weight, estrus and ovulation have been gathered. Body weights were lowest for the Criollo and highest for the Corriedale and Junin. The occurrence of ovulation by month and the distribution of estrus by 17 day (estrous cycle length) intervals throughout the year was generally similar to that obtained for the Southern Altiplano; the greatest incidence occurred from April-August. Also similar to the results obtained in the Southern Altiplano, more than one (two) ovulation points occurred in only six instances.

The estrous cycle lengths were divided into five categories. This classification indicates a relatively high incidence of short cycles in all breeds. Approximately 50% of the cycle lengths observed were in the normal category. Others may have been due to failure to observe estrus, the occurrence of ovulation without estrus or periods of anestrus as occurred in the category of greater than 57 days. These results indicate that failure to show estrus may contribute substantially to reduced reproduction.

The second flock of ewes consisted of Criollo and Junin breeds. They were bred at the traditional Spring breeding period. Data on breeding and lambing were collected. The Junin breed is much heavier than the Criollo which was already well known. Body weight changes very little between weigh periods. The slight increase primarily indicates changes due to pregnancy and possibly wool growth. Birth weights of lambs generally reflect the difference in mature body weights. All of the lambs, with only two exceptions, are singles. The mean gestation lengths for the Junin were 150.7, 151.4, and 150.0 for 1.5, 2.5 and 3.5 years of age, respectively. Breeding dates were not obtained for Criollo ewes; length of gestation could not be determined.

## B. Shortcourses

A shortcourse on management for reproduction was presented in the spring of 1981 to nearly 30 scientists and instructors.

## C. Equipment and Technology

Laparotomy and laparoscopic techniques were taught to cooperating personnel. Laparoscopes have replaced laparotomy and greatly increased the efficiency and number of observations possible. Photographic equipment has also been purchased for use at La Raya.

## D. Radioimmunoassay Laboratory

Arrangements have been made with the International Atomic Energy Agency for financial support to provide required equipment, reagents and related materials to establish the lab. It is expected to be operable during this year.

## E. Graduate Training Programs

1. Dr. Cesar Novoa has begun his formal program at Utah State University for the PhD degree. His research will be conducted in Peru.
- b. Dr. Walter Bravo will begin his MS program at Utah State University in approximately two years. He is conducting research for his degree in Peru and studying English at the present time.

## Annual Report for 1981/82

1. Project Title: Improving Female Reproduction Performance of Small Ruminants in Least Developed Countries
2. Institution: Utah State University
3. Principal Investigator: Warren C. Foote
4. Funds allocated from:  

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$134,000
Matching Contribution from 1981/82 Subgrant:	\$61,875
5. Statement of Project Goals
  - A. To measure reproduction capabilities of the major genotypes of small ruminants and mechanisms of control of selected reproduction processes.
  - B. To determine the influence of environment, including climatic factors, and nutrition and other management factors on reproduction in selected genotypes of small ruminants and to develop alternative management programs to increase production.
  - C. To cooperate with other SR-CRSP components in reproduction related programs.
  - D. To provide graduate and non-degree training programs to selected foreign collaborators and other program related personnel.
6. Summary of Accomplishments in Previous Years  

Refer to 1980/81 Annual Report
7. Description of Work Undertaken
  - A. Research Results Most Directly Related to the SR-CRSP  
Reproduction and lamb production performance among St. Croix, Rambouillet and their cross.

Research has continued on these genotypes. Because of their wide variation in some reproductive traits such as prolificacy and postpartum interval, they are being used as models for further study of these traits. Under conditions of controlled twice a year exposure for breeding under confinement, a high percent of the St. Croix lamb at 6 month intervals consecutively for three or more times and then fail to breed at the following breeding period. They lamb first at one year of age. Lambing rates average 2.0 or greater at each lambing for ewes two years of age and older. The Rambouillet fail to lamb more than once a year because of their relatively long postpartum/lactation anestrus. Their lambing rates

ror ewes 2 years and older are from 1.50 - 1.60. Data on the crossbred ewes are just being generated, but it appears that they will demonstrate increased reproductive performance more similar to the St. Croix (prolificacy and twice a year lambing). The St. Croix are smaller than the Rambouillet and have higher lamb mortality. Annual patterns of the occurrence of estrus and ovulation and of ovulation rate are being determined for the St. Croix and Rambouillet.

#### Endocrine parameters during different reproductive phases in goats.

Endocrine profiles and anterior pituitary response to GnRH is being measured during the estrous cycle and seasonal and postpartum anestrus in goats. The definitive measurements in this experiment are LH and progesterone levels of peripheral (jugular) blood and of the anterior pituitary. These measurements will help identify and define phenomena that are peculiar to each of these three reproductive phases (estrous cycle, seasonal anestrus, postpartum anestrus) for the goat. Such data are not complete, particularly for anestrus periods.

#### The evaluation of various ultrasound devices that have the capability to determine multiple fetuses in sheep.

Three ultrasound devices were evaluated in this study. A Real-time sonograph that has the capability to project real images on a cathode ray tube was provided by ADR Ultrasound Company, Tempe, Arizona. A second type was a developmental sonograph provided by Dr. John Hanton, Department of Engineering, at Montana State University. The purpose of this prototype was to provide the sheep industry with a low-cost sonograph that would discriminate between single and multiple pregnancies. Uterine images were produced as a series of blips on a cathode ray tube. The third device was a scanogram provided by Animark, Aurora, Colorado. The scanogram projects uterine content as a series of blips along a gradient scale on a cathode ray tube.

The ADR Real-time sonograph was tested on 44 Finn-cross ewes whose gestation ranged from 40-100 days and 29 St. Croix ewes ranging in gestation from 36-57 days. Sheep were prepared for scanning by shearing the wool from the abdomen from flank to flank and 6-8 inches in front of the udder. The sheep were then placed on their backs in a laparotomy cradle. The transducer was placed horizontally in front of the udder and moved forward in a sweeping motion. As a fetus was located, one end of the transducer was maintained at that area, while the other end was pivoted in search of additional fetuses. Identification of a fetal sac, cotyledous, or a fetus was used as criteria for establishing pregnancy. Only when two fetal sacs, or two or more fetuses could be visualized were single versus multiple pregnancies differentiated. During 80-100 days gestation, heads and/or hearts were used to differentiate multiple pregnancies.

Pregnancy diagnosis with Real-time ultrasound was 97% accurate and the detection of multiple fetuses was 84% accurate for the Finn-cross ewes and 86% accurate for the St. Croix ewes. Accuracy was related more to the experience of the sonographer rather than time of gestation. However, the gestational sac must be present during early gestation to verify pregnancy. Differentiation of multiple pregnancies becomes more difficult beyond 100 days gestation because of the large size of the fetuses.

Hanton's sonograph was tested on 10 St. Croix ewes at gestational intervals of 36-56, 66-86, 80-100, and 94-114 days and two open ewes. Nine positions on the ewe's abdomen were scanned at each examination. This was necessary since the transducer was only 18 mm in diameter.

At the first scanning interval (36-56 days), signals were observed at Position 1-6 of 10 ewes. Depth of signals ranged from 4-6 inches. At Position 3, signals were observed in 4 of the 10 ewes. Signals were observed in 7 of the 10 ewes at Position 7. Signal depth ranged from 2-6.5 inches. At Position 8, two ewes displayed signals ranging from 4-5.5 inches. Five ewes did not display any signals, two of which were not pregnant. At the second scanning interval (66-86 days), signals were observed at more position points: Position 1, 6 of 10 ewes ranging from 2.5-7.0 inches; Position 2, 5 of 10 ewes ranging in depth of 2-7.5 inches; Position 3, 5 of 10 ewes ranging in depth of 2-7 inches; Position 5, 7 of 10 ewes ranging in depth of 2-7 inches; Position 6, 6 of 10 ewes ranging in depth of 2-7 inches; Position 7, 6 of 10 ewes ranging in depth of 2-7 inches; Position 8, 4 of 10 ewes ranging in depth of 2.5-8 inches; and Position 9, 4 of 10 ewes ranging in depth of 2.5-9 inches. Three ewes did not display any signals, two of which were open ewes. At the third scanning interval (80-100 days) the signal display was similar to the second scanning: Position 1, 9 of 10 ewes had signals ranging in depth from 1-4 inches; Position 2, 7 of 10 ewes ranging from 1-4.5 inches; Position 3, 7 of 10 ewes ranging from 1-3.5 inches; Position 4, 6 of 10 ewes ranging from 1-5 inches; Position 5, 6 of 10 ewes ranging from 1-4 inches; Position 6, 5 of 10 ewes ranging from 1-3 inches; Position 7, 6 of 10 ewes ranging from 1-6 inches; Position 8, 6 of 10 ewes ranging in position from 1-6 inches; and Position 9, 5 of 10 ewes ranging in position of 1-2 inches. One non-pregnant ewe displayed signals at Position 1 at depths of 2-2.5 inches.

The number of signals decreased considerably during the fourth scanning interval (94-114 days). Position 1, 5 of 10 ewes displayed signals at depths of 1-6 inches; Position 2, 4 of 10 ewes at 1-4.5 inches; Position 3, 7 of 10 ewes at 1-4 inches; Position 4, 6 of 10 ewes at 1-5 inches; Position 5, 6 of 10 ewes at 1-3 inches; Position 6, 2 of 10 ewes at 1-3.5 inches; Position 7, 3 of 10 ewes at 2-3 inches; Position 8, no signals; and Position 9, 3 of 10 ewes at 1-2 inches. One open ewe displayed signals at Position 3 and 4 and at depths of 1-2 inches.

The signal display at each scanning interval was adequate to determine whether the ewe was pregnant, but there was no consistency in patterns for determining single versus multiple pregnancies.

Research on the Animark scanograph is in progress and will be summarized later.

#### Cytogenic analysis of Camelidae.

Cytogenetic analysis of New and Old World camels is underway. This includes standard karyotype development and also differential chromosome staining techniques.

B. Equipment and Technology.

1. RIA laboratory
2. Cytogenetics laboratory
3. Laparotomy/laparoscopy and related procedures
4. Embryo transfer
5. Pregnancy diagnosis

C. Reproduction Data Collection Forms.

The USU/CSPU Reproduction Project has developed data forms for collection of reproduction related data. The Reproduction Project is willing to cooperate using these forms or in any other way possible within available resources to optimize the collection and use of reproduction information.

## Annual Report for 1981/82

1. Project Title: Improving Reproductive Capability of Small Ruminants in LDCs with Emphasis on Male Reproductive Physiology

2. Institution: California State Polytechnic University, Pomona

3. Principal Investigator: Edward A. Nelson

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 Subgrant: \$97,761  
Matching Contributions from 1981/82 Subgrant: \$65,365

5. Statement of Project Goals

- A. To develop methods to improve the capability of collecting, processing, storing, and transporting viable sheep and goat semen to selected Developing Country locations.
- B. To measure the reproductive potential of selected small ruminant male genotypes in the United States and Peru. To coordinate the relative problems in developing countries.
- C. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.
- D. To provide the opportunity for qualified scientists and technicians to continue formal education and obtain special training in reproductive physiology and management of small ruminants.

6. Summary of Accomplishments in Previous Years

Summary of accomplishments to March 1981 are reported in previous annual reports.

7. Statement of Specific Objectives for 1981/82

- A. To study the reproductive characteristics of rams and alpaca males maintained at high elevations.
- B. To cooperate with other components of the SR-CRSP in measuring the reproductive characteristics of males used in their studies.
- C. To provide H. William Vivanco the opportunity to enroll in a graduate program leading to the MS degree at the California State Polytechnic University.
- D. To provide technical assistance in the establishment of a male goat reproductive project in Peru.

## 8. Description of Work Undertaken:

### Objective A

Male puberty studies. Animals were purchased and measured (preliminary results have been reported in Peru). Criollo males appear to show puberty at an earlier age and lighter weight than Corriedale and Junin ram.

Mature male studies were conducted. Preliminary results are now available from data collected in Peru. Criollo and Junin rams performed well throughout the collection period with Corriedale rams developing a high incidence of epididymitis. The male physiology work on sheep and alpaca at the La Raya station has been delayed due to political problems present at that station. There is a project with sheep using two breeds and following the same basic experimental design that is being followed in the Central Sierra. The male alpaca research includes an effort to establish measurement parameters on males that can be correlated to their ability to cause conception in the female. Aggressive behavior and time of copulation are criteria included in the present study.

### Objective B

Males imported by the breeding project were all tested for fertility at least once during the year.

### Objective C

H. William Vivanco enrolled at Cal Poly September 1981 and has developed a complement of courses to be completed as part of his MS degree program. He is progressing satisfactorily in his course work. He initiated research before leaving Peru as a part of the reproduction research being presently conducted. That research will be continued when he returns to Peru in September 1982. Mr. Vivanco also participated in the Third International Conference on Goat Production and Disease presenting one paper (Comparison between insemination with frozen semen and natural mating in Criollo goats in the North Coast of Peru under range conditions), and serving as chairman of one of the contributed paper sessions.

### Objective D

The goat project in Northern Peru has been supplied with equipment and supplies requested for male reproductive work. Technical assistance has also been provided for this project.

## 9. Technical Accomplishments

Preliminary results of work done in the Central Sierra have been presented in Peru and are available for distribution. These data were collected by our cooperators in Peru with assistance from Gary Sides, our country representative.

Procedures for collecting processing semen have been established.

Equipment and supplies in support of the goat project have been purchased and transported to Peru.

Male goats at Cal Poly have been tested and certified free of disease and semen has been processed for shipment overseas.

Support Personnel

Gary Sides, Lima, Peru  
Maximo Gamarra, Tupac Amaru  
Julio Sumar, IVITA, La Raya  
H. William Vivanco, UNA  
Cesar Novoa, IVITA  
Walter Bravo, La Raya  
Victor Leyva, La Raya  
Jose Gamacho, IVITA

Technicians are supporting this project at each location.

Annual Report for 1981/82  
(Cal Poly Campus)

1. Project Title: Improving Reproductive Capability of Small Ruminants in LDCs with Emphasis on Male Reproductive Physiology

2. Institution: California State Polytechnic University, Pomona

3. Principal Investigator: Edward A. Nelson

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$97,761

Matching Contributions from 1981/82 Subgrant: \$65,365

5. Statement of Project Goals

A. To develop methods to improve the capability of collecting, processing, storing and transporting viable sheep and goat semen to selected Developing Country locations.

B. To measure the reproductive potential of selected small ruminant male genotypes in the United States and Brazil. To coordinate the relative problems in developing countries.

C. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.

D. To provide the opportunity for qualified scientists and technicians to continue formal education and obtain special training in reproductive physiology and management of small ruminants.

6. Summary of Accomplishments in Previous Years

Summary of accomplishments to March 1981 are reported in previous annual reports.

7. Statement of Specific Objectives for 1981/82

A. To measure the characteristics relating to sexual development and aging of three breeds of sheep and three breeds of goats.

B. To continue to develop techniques and procedures for extended time storage of goat and sheep semen.

C. To process semen as a cooperative research effort in identifying superior dairy goat males by the University of California, Davis, Breeding Project.

## 8. Description of Work Undertaken

Objective A is being satisfied by ongoing research projects at California State Polytechnic University. These statistics include:

- a. Male puberty studies on both sheep and goats.
  1. Sheep--Rambouillet, Suffolk, St. Croix, Hampshire, and Finnsheep.
  2. Goats--Nubian, Alpine, Saanen, Toggenburg, and La Mancha.
- b. Age, season, and breed effect on semen characteristics.

Objective B is being satisfied by ongoing research at California State Polytechnic University relating to techniques for processing, extending and storage of both sheep and goat semen. Preliminary data are available for distribution.

Objective C is being satisfied by the cooperative effort to collect, process, freeze, transport, and inseminate goats in Kenya with semen from selected Nubian, Toggenburg, and Alpine bucks. In addition, semen from bucks of two breeds of goats (East African and Galla) was collected, processed, frozen and inseminated in a cooperative breeding study conducted in Kenya. Definitive results from this study are not yet available. However, pregnancy tests conducted in January 1982 indicated approximately 50% conception rate. These does kidded in April with a very low kidding rate.

## 9. Technical Accomplishments.

Over twenty articles involving small ruminants in scientific journals, conference proceedings and livestock journals have been published by members of the Cal Poly research team. Other papers are now being prepared on research that has been conducted both in Brazil, Peru, and at California State Polytechnic University.

### Research Facilities

The graduate program at the Master's level in Animal Science was approved in 1976. To support the graduate program, a graduate laboratory (Building 2, Rooms 109, 110, 111) was established and equipped to facilitate graduate level research shortly thereafter. In addition, each animal production unit serves as a laboratory where Cal Poly Foundation-owned animals can be used through a special project system to conduct research.

For small ruminant research, two additional laboratory areas have been developed from private funds to support the Title XII SR-CRSP project. A well-equipped, air-conditioned semen research laboratory has been constructed as a part of the small ruminant program. In addition, a goat buck barn was constructed.

The projected plan includes two more phases, one is the extension on the buck barn to provide a semen collection and an equipment and supply storage area. The second is the construction of a grade "A" milking parlor. The goats are now under a PHIR production testing program, but the new milking facility will enable more efficient testing and utilization of the dairy goat products.

In addition to these facilities, other laboratories are available and used in support of the SR-CRSP. These include the Veterinary Clinic (for clinical support), the Equine Research Center (for Hormone analysis), the Meats laboratory (for carcass data), the computer center (for statistical assistance), and the Biological Science laboratories (particularly those dealing with electron microscopy and radiation biology).

## Annual Report for 1981/82

1. Project Title: An Investigation of Small Ruminant Health Problems
2. Institution: Colorado State University
3. Principal Investigator: James C. DeMartini
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$175,000  
Matching Contributions from 1981/82 Subgrant: \$58,333

5. Statement of Project Goals

The overall objective for the SR-CRSP Animal Health Project in Peru is to decrease disease-related losses of food and fiber products of sheep, goats, and alpaca by:

- A. Determining the causes and prevalence of infectious and non-infectious diseases of these species in smallholder production units as well as large cooperatives in Peru.
- B. Conducting research on the etiology, pathology, immunology, epizootiology, and diagnosis of chronic respiratory disease of sheep and neonatal enteritis of alpaca, two disease syndromes of particular importance.
- C. Developing new methods for the diagnosis and control of these conditions based on the findings in Objective B.
- D. Performing studies on the etiology, serology, or vaccines necessary to control such diseases as ram epididymitis, leptospirosis, toxoplasmosis, fascioliasis, or alpaca fever.
- E. Providing advanced training for a limited number of veterinarians interested in disease investigation.
- F. Promoting the exchange of ideas between US and Peruvian scientists.

6. Summary of Accomplishments in Previous Years

In May 1980, a collaborative research program on sheep and alpaca diseases was established between scientists from CSU and IVITA, a veterinary research institute of the Peruvian government also affiliated with San Marcos University. Following reviews of local disease prevalence reports and discussions with Peruvian officials, chronic respiratory diseases of sheep, neonatal enteritis of alpaca and certain aspects of other disease problems of small producers were targeted for further research. Much effort and large sums of money were expended in equipment repair and replacement, facilities renovation, and purchase of new equipment for the diagnostic and research laboratories in Lima, La Raya, and Huancayo. Research personnel and graduate student

trainees have been identified in conjunction with mutually agreed-upon research goals. Work at CSU has been oriented toward advanced training in certain research techniques, development of virologic and serologic assays, processing and analyzing data originating from research in Peru, and detailed pathogenesis studies of relevant disease entities.

#### 7. Statement of Specific Objectives for 1981/82

- A. Complete the morphologic and serologic study of 100 adult sheep with chronic respiratory disease from the Central Sierra of Peru.
- B. Culture tumor cells from several cases of pulmonary adenomatosis and determine the presence of viral agents by isolation.
- C. Study the pathology, virology, and immunology of chronic progressive pneumonia in experimentally infected lambs and in cell culture.
- D. Conduct a field and laboratory study of enterotoxemia of alpaca involving pathology, culture and identification of disease agents, and toxin detection.
- E. Obtain field isolates of Strept. zooepidemicus from cases of alpaca fever and compare them serologically.
- F. Conduct field studies on three vaccines for ram epididymitis in Peru and in Colorado.
- G. Determine the usefulness of an ELISA assay for early diagnosis of ovine fascioliasis in Peru.
- H. Conduct a serologic evaluation of 1,500 sheep sera from different parts of Peru for leptospirosis and toxoplasmosis.
- I. Establish a data base for ovine mortality in smallholder flocks.

#### 8. Description of Work Undertaken

##### A. Chronic respiratory disease (objectives A-C)

A detailed pathology and serology study of 80 sheep with clinical evidence of chronic respiratory disease from the Central Sierra of Peru has been completed. Following initial visits in early 1981, Dr. Snyder traveled to Peru in May 1981 and Dr. DeMartini in January 1982 to collect the data which were analyzed at CSU (histopathology, electron microscopy) and in Peru (serology, bacteriology). Dr. John Ellis spent three months in Peru (June, July, and August 1981) conducting a disease prevalence survey in smallholder flocks of the Central and Southern Sierra. Preliminary tissue culture and virus isolation attempts were made from several cases of pulmonary adenomatosis at San Marcos University. Continuing efforts to propagate, identify, and characterize strains of progressive pneumonia virus were conducted at CSU and a study was initiated to determine whether the virus can be transmitted vertically (in utero) from ewe to lamb.

B. Bacterial diseases of alpaca and sheep (objectives D-G)

Studies of causative agents for neonatal enteritis of alpaca were continued at La Raya, despite a relatively low mortality in 1981. All bacterial isolates were characterized as Clostridium perfringens type A. Dr. Ellis worked at La Raya in November 1981, and in April 1982. Two veterinarians from San Marcos University, Marina Rios and Alberto Soto, were engaged in research on alpaca fever and alpaca enteritis, respectively. A study of bacterial causes of perinatal mortality in range lambs was completed at CSU and will be useful for comparative and technical purposes. Studies on causes and immunoprophylaxis of ram epididymitis were conducted in Colorado and an investigation of control of the disease with REV-1 vaccine was completed in Peru by Dr. E. Ameghino.

No progress was made on application of a ELISA test for diagnosis of ovine fascioliasis as appropriate serum samples were not collected.

C. Epizootiologic studies (objectives H-I)

Under the direction of Drs. John Reif and H. Samame, large numbers of sheep sera from three geographic areas of Peru have been collected. Over 1,200 sera have been analyzed for antibodies to toxoplasma and over 100 for antibodies to 14 types of leptospira.

Analysis of causes of mortality in newborn lambs at a large cooperative production unit during a 10 year period have been completed.

d. Cooperation/Collaboration with other SR-CRSP projects:

Research Area

Ram epididymitis	Montana State	Breeding
Ovine mortality	Winrock	Economics
Goat disease	Missouri	Sociology
Reproductive disease	Utah State	Reproduction
Caprine arthritis- encephalitis	Washington State	Health

9. Technical Accomplishments

Summary of significant findings

Chronic respiratory diseases of sheep

- A. Pulmonary adenomatosis (PA) is responsible for 20-25 percent of all adults sheep disease losses in smallholder flocks, as well as large cooperative units and kills about 2 percent of adult sheep in the Central Sierra of Peru annually.
- B. Progressive pneumonia virus infection occurs in sheep in Peru (first report) and may be responsible for losses due to pneumonia, arthritis, and weak lambs. Further studies are warranted.

- C. A virus related to progressive pneumonia of sheep, caprine arthritis-encephalitis, does not appear to occur in native criollo goats in Peru, but causes arthritis in goats imported from the US, in one herd at least.
- D. Viral particles morphologically compatible with a retrovirus have been seen ultrastructurally in lungs of sheep with PA. This offers hope for development of a serologic diagnostic test and possibly a vaccine for PA.

#### Bacterial diseases of alpaca and sheep

- A. All clostridial isolates from cases of neonatal enteritis of alpaca were Type A. Alpha and enterotoxins from these bacteria and rabbit antibodies against them have been produced.
- B. E. coli isolates have been obtained from 77 neonatal alpaca at necropsy (14), after signs of diarrhea (28), after recovery from diarrhea (20), and from healthy cria (15). Twelve of 20 of these isolates were positive in assays for enteropathogenicity.
- C. REV-1 vaccine and manual palpation can be used to control ram epididymitis in large flocks.
- D. Ram epididymitis can be caused by bacteria such as Actinobacillus sp. as well as Brucella ovis.
- E. Enteritis may be responsible for up to 40 percent of neonatal lamb losses and K-99 pilus antigen is present in more than half of the E. coli isolates, suggesting that K-99 vaccine may be of value in preventing neonatal lamb mortality.

#### Epizootiologic studies

- A. Leptospirosis, a disease associated with reproductive failure and liver and kidney damage, occurs in Peruvian sheep. The highest rates of seropositivity were associated with L. ballum (12 percent), L. bratislava (9 percent), L. autumnalis (7 percent), and L. pomona (1 percent).
- B. An important cause of abortion, toxoplasmosis, occurs in sheep in Peru as indicated in serologic studies of over 1,200 sera from ewes. The overall seroprevalence rate is 16 to 25 percent with factors such as altitude, rainfall, and time of year important variables requiring further study.
- C. In a 10-year study of neonatal lamb mortality in a large, well managed cooperative unit, about 3.6 percent mortality occurred from 0-3 days of age and additional 0.6 percent from 3-30 days of age.

Training

1. Graduate Students:

<u>Name</u>	<u>Degree Objective</u>	<u>Location</u>
J.A. Ellis	PhD	CSU
A. Ramirez	MS	CSU (beginning July 1982)
M. Rios	DVM	Lima/La Raya
A. Soto	DVM	Lima/La Raya

2. Technicians

<u>Name</u>	<u>Dates</u>	<u>Subject</u>	<u>Instructor</u>
R. Sam, H. Rivera	2/1-10/82	Cell culture/ virology	J.C. DeMartini

## Annual Report for 1981/82

1. Project Title: Sociological Analysis of Small Ruminant Production Systems
2. Institution: University of Missouri - Columbia
3. Principal Investigator: Michael F. Nolan
4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$76,721

5. Statement of Project Goals

The principal goal of the SR-CRSP Sociology component is to develop an understanding of the social and cultural context in which small ruminant production occurs. This will be necessary in order to evaluate specific technological interventions in relation to their social soundness and their likelihood of acceptance by the population at large.

Among the issues that the project will address are the social organization of livestock production, particularly vis a vis crop production, institutional constraints on production including credit, markets and extension services, and the values and attitudes of the population toward the adoption of new technology.

6. Summary of Accomplishments in Previous Years

In 1979-80, contacts were made with potential collaborators at the National Agrarian University and at the University of Cusco. Baseline studies of sheep and alpaca production in Southern Peru were undertaken by Constance McCorkle and Terry West during the spring and early summer of 1980. George Primov conducted a study of mutton marketing in Cusco during the summer of 1980. Keith Jamtgaard arrived in Peru in the summer of 1980 to undergo language training in Quechua in preparation for his research in the community of Tocra. Research in Tocra began in late August 1980.

7. Statement of Specific Objectives for 1981/82

- A. Analyze and publish the results of studies of animal production in Southern Peru (West and McCorkle) and the study of Cusco meat markets.
- B. Complete field study of pasture management in the community of Tocra and begin analysis of results obtained (Jamtgaard).
- C. Initiate studies undertaken in the Central Sierra by collaborators at the National Agrarian University (NAU). Specifically, the management of collective lands and the effects of land disputes on the acceptance of new technology in Huaychao (Fernandez) and the transfer of technology from collective to individually owned flocks in Junin (Rivera).

D. Begin training of Ms. Lidia Jimenez.

## 8. Description of Work Undertaken

- A. Analysis of results of study of mutton distribution in Cusco, and preparation of technical report (George Primov).
- B. Analysis of results of study on animal management practices in the village of Usi (Cusco Department) and preparation of first of three technical reports (Constance McCorkle).
- C. Compilation of results of a survey of sheep and alpaca production in the Department of Puno and writing of technical report (Terry West).
- D. Visit in December of 1980 of Michael F. Nolan. Attended PI meeting in Lima and visited Tocra research site in southern Peru.
- E. Jere Gilles takes one semester of Spanish instruction at the University of Missouri-Columbia.
- F. Completion of census, formal survey and observations of the village of Tocra. Mr. Jamtgaard moves to Lima in January 1981 to begin analysis of research findings and to assist in the development of the CRSP's sociological research program in Central and Northern Peru.
- G. Visit in February and March 1981 of Jere Gilles. Collaborative research programs with professors Pareja, Rivera, and Fernandez were finalized. Gilles and Jamtgaard attended a workshop on sheep production sponsored by NAU and IDRC. Gilles and Jamtgaard then interviewed 30 range and forage specialists in Peru about the social and institutional barriers to expanded research in this area.
- H. Jamtgaard travels to Piura in late March 1981 as part of a team to develop goat research program in this area.
- I. Jamtgaard returns to Tocra in April to gather additional information on local pasture use. Finalizes program of collaboration with professors Tapia and Flores of the University of Cusco.
- J. Rivera and Fernandez begin research in the Central Sierra.
- K. Tapia and Flores begin compiling data and literature for book on management and uses of Andean pastures.
- L. Lidia Jimenez left Peru for Columbia, Missouri in order to begin her graduate training.
- M. Keith Jamtgaard returns to the US in June 1981 to finish writing his MS thesis.

## 9. Technical Accomplishments

- 1. "Regional Structure of Distribution of Mutton in Cusco, Peru" (Primov and Jimenez, 76 pages, Sociology Technical Report #2. Copies may be

obtained from the Department of Rural Sociology, University of Missouri-Columbia.) A detailed description of the legal Cusco mutton markets and a more general description of illegal markets are contained in this report. In addition to statistics on meat marketing in Cusco, the report contains an excellent description of the informal organization of the wholesale and the retail meat trade in Cusco.

2. "Alpaca Production in Puno, Peru" (West, 109 pages, Sociology Technical Report #3. Copies of this report may be obtained from the Department of Rural Sociology, University of Missouri-Columbia.) This report contains three sections: (1) a general description of animal production in the Puno Department, (2) a description of management practices used by traditional herders and by a successful commercial producer (Mr. Barreda), and (3) a description of the use and commercialization of small ruminant products in Puno.
3. "Management of Animal Health and Disease in an Indigenous Andean Community" (McCorkle and Jimenez, 67 pages, Sociology Technical Report #4). This report provides a description of the approach that members of an isolated Indian community take toward animal diseases. It includes a description of the terms used in Quechua to describe diseases and their causes.
4. "Survey of Pasture Forage Specialists in Peru" (Gilles and Jamtgaard, to be published in 1982). This study reveals a considerable difference between the importance assigned to range management and natural pastures by policy makers and the amount of research on these subjects.
5. "Studies of Pasture Management in the Community of Tocra" (Jamtgaard and Jimenez, to be published in 1982). Most of the findings will be presented in a later report, but two important factors seem to have emerged from this study and that of McCorkle. First, even though households in agro-pastoral communities typically own 20-35 sheep, these communities typically are net importers of wool and export relatively little meat or animals. Secondly, manure is an important economic product of sheep. The annual manure requirement of an average Tocra family is about 1.5 tons.

Annual Report for 1981/82

1. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Peru
2. Institution: Winrock International Livestock Research and Training Center
3. Principal Investigator: A. John DeBoer

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant:	\$200,000
Matching Contribution from 1981/82 Subgrant:	\$78,310

5. Statement of Project Goals

- A. Provide a well trained group of professional agricultural economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multidisciplinary research on small ruminants and their producers.
- B. Provide an improved data base for guiding research and providing policy guidelines for improving small ruminant productivity and farmer incomes.
- C. Strengthen the overall research capacity of selected host country research institutions by providing leadership in conducting interdisciplinary research, conducting training programs, and publishing research results.
- D. Publication and dissemination of research results representing a wide variety of research and which will contribute to a better understanding within the scientific community of small ruminants and their place in selected rural economies of developing countries.

6. Summary of Accomplishments in Previous Years

Project Year 1 (October 1978 - April 1980)

- A. Two trips to Peru by PI to develop workplans and collaborative relationships.
- B. Local project budget and administration put in place through SACI, La Molina, and INIPA.
- C. Research Associate hired.
- D. Project equipment placed in Peru, fieldwork in Central Sierra commences.

Project Year 2 (May 1980 - September 30, 1981)

- A. Mr. Ed Lotterman takes up residence in Peru, initiates two MS thesis programs, begins teaching courses at La Molina, begins development of computer software packages.
  - B. Two MS students begin studies in US.
  - C. Goat research program in Northern Peru initiated, Ms. Terri Capps hired as Research Associate.
  - D. Initiated field studies of mixed farms in Hauncavelica Department.
  - E. Initiated studies of alpaca fiber price formation and supply a response.
  - F. Initiated collaborative research on pasture production economics.
  - G. Installed SAS computer software package and got data analyzed.
7. Statement of Specific Objectives for 1981/82
- A. Assist in the development of research capacity in Department of Agricultural Economics and Planning, La Molina, through teaching, research supervision, and statistical analysis.
  - B. Complete earlier studies of sheep production enterprises in Central Sierra.
  - C. Improve Peruvian understanding of international market forces for alpaca fiber and develop policy oriented models.
  - D. Complete baseline surveys of goat producers in Northern Peru.
8. Description of Work Undertaken
- A. International Travel:  
  
Ed Lotterman to Winrock January 1982  
  
Terri Capps to III International Conference on Goat Production and Disease, January 1982.
  - B. Lotterman assistance with Interamerican Course on Administration of Rural Enterprises, sponsored by the Rural Settlement of the National Agrarian University, and the Organization of American States Regional Project on Training in Rural Development of the Department of Social Development, Nutrition, and Human Resources. Included were 26 hours of lectures, course materials, and per diem for Peru participants in the fieldwork case studies.
  - C. Lotterman participated in Animal Breeding shortcourse and presented paper at Peruvian Association of Animal Production meetings July 5-12.

- D. Partial sponsorship for Ing. Enrique Nolte to attend International Symposium on Nutrition and Systems of Goat Feeding, Tours, France.
- E. Martinez completed major monograph on sheep enterprises based on earlier CRSP-supported work.
- F. First round of goat survey work completed, questionnaire and interview procedures revised, instruction manual written.
- G. Huancavelica survey work coded, preliminary computer analysis carried out.
- H. Personnel:

Edward D. Lotterman, Research Associate  
 Terri Capps, Research Associate  
 Jesus Ruiton, Research Assistant; part-time\*  
 Ruben Velarde, Research Assistant; part-time\*  
 Martha Cruces, Research Assistant; part-time\*  
 Roxana Diaz, Research Assistant; part-time\*

Trainees:

Isabel Luque, Licenciatura candidate, La Molina\*\*  
 Gorki Llerena, Licenciatura candidate, La Molina\*\*\*  
 Domingo Martinez, University of Missouri, Columbia  
 Corinne Valdivia, University of Missouri, Columbia

9. Technical Accomplishments

A. Study of three sheep production units in Central Sierra

This study compared three different types of production organizations that have resulted from Peruvian land reform efforts applied to large grazing enterprises. Although all three enterprises were large scale (3500-9300 ha in grassland) sheep producing units located in the same general ecological zone, some major differences were apparent (Tables 1 and 2). Some of these differences are related to differences in physical characteristics of the units while other differences are a result of socio-historical-legal background under which the units operate. Extensive description of the Cooperative enterprises are provided in the publication by Domingo Martinez-Castilla entitled, A Comparative Study of the Organization, Management, and Husbandry Practices of Three Sheep Production Units in the Central Sierra of Peru.

B. Huancavelica Department Baseline Study

Two indigenous communities, Santa Barbara and Orccobama, were surveyed in late 1980. These areas were of interest because they represented

\* Undergraduate students, La Molina  
 \*\* Left project, August 1981  
 \*\*\* Completed MS thesis, December 1981

mixed crop-livestock production units and also had some alpaca production. A total of 150 interviews were carried out; 75 in each community. Of these, 108 were found to be reasonably complete. A summary of alpaca and llama populations found on these farms is given in Table 3. The relatively low standard deviations indicate that animal numbers did not vary widely between owners. In addition, 92 percent of the farmers had sheep and about 40 percent had cattle. The farmers, on average, sold 125 pounds of alpaca fiber to merchants, sold 67 pounds in the local markets, retained 10 pounds for home use, and 10 pounds for handicraft manufacturing. A much more detailed manuscript is now being prepared from this survey.

Table 1. General Description of Production Units

	Ucrucancha	Gaya	Palcan
<u>Type of Organization</u>	<u>Central of Cooperatives</u>	<u>Communal Cooperative</u>	<u>CAP</u>
Area			
hectares	3636	10307	8464
acres	8165	23146	19007
Average Altitude			
meters	4300	4400	4400
feet	14100	14450	14450
Membership	23*	464	18
People	60	61	114
Workers <sup>†</sup>	14	16	18
Sheep	8511	12053	8682
Grasslands			
hectares	3500	9294	5279
acres	8649	22965	13044

\* Actually other co-ops, not individuals

† Permanent payroll

Table 2. Production Unit Herd Composition  
(Annual Average, Per Class, Quality)

	Ucracancha	Gaya	Palcan
	%	%	%
Total Imported	10.33	1.87	0.11
Rams	0.31	0.52	0.11
Ewes	10.02	1.35	--
Total Improved	80.55	98.13	45.00
Lambs	5.20	18.03	4.70
Y. Ewes	116.64	8.79	7.11
Y. Rams	6.79	1.64	2.37
Y. Wethers	9.13	6.75	3.88
Ewes	35.22	50.00	22.43
Rams	4.21	4.05	4.29
Wethers	3.36	8.87	0.22
Total Others	9.12*	---	54.89 <sup>†</sup>
Lambs	1.92	---	6.72
Y. Ewes	2.35	0	10.37
Y. Rams	1.39	---	---
Y. Wethers	---	---	3.41
Ewes	1.27	---	33.98
Rams	2.19	---	0.41
Wethers	---	---	---
TOTAL	100	100	100

\* Stud

† Criollo

Table 3. Distribution of Alpaca and Llama Numbers, Huancavelica Survey  
(108 farmers)

<u>Type of Animals</u>	<u>Number of Farmers with That Type</u>	<u>Average Herd/Flock for Farmers with That Type</u>	<u>Standard Deviation</u>
Huacayo Alpacas			
<u>Males</u>			
0-2 yrs.	96	11	7
2-6 yrs.	103	13	7
over 6 yrs.	67	9	5
<u>Females</u>			
0-2 yrs.	108	17	12
2-6 yrs.	108	32	17
over 6 yrs.	88	27	13
Suri Alpacas			
<u>Males</u>			
0-2 yrs.	35	2	1
2-6 yrs.	108	12	6
over 6 yrs.	15	2	1
<u>Females</u>			
0-2 yrs.	61	14	8
2-6 yrs.	36	4	1
over 6 yrs.	16	3	1
Llamas			
<u>Males</u>			
0-2 yrs.	65	5	3
2-6 yrs.	70	5	3
over 6 yrs.	13	4	1
<u>Females</u>			
0-2 yrs.	67	6	4
2-6 yrs.	70	5	5
over 6 yrs.	23	8	4

Source: 1980 Survey

## Annual Report for 1981/82

1. Project Title: Systems Analysis and Synthesis of Small Ruminant Production

2. Institution: Texas A&M University

3. Principal Investigator: T. C. Cartwright

4. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1981/82 Subgrant: \$200,000  
Matching Contributions from 1981/82 Subgrant: \$66,667

5. Statement of Project Goals

The broad objective is to increase productivity of small ruminant production systems in Peru, especially those of the smallholder in high altitude areas. The improved methods would then be available for transfer and utilization in other LDCs with similar environmental conditions. A systems analysis approach will be used to evaluate practical application of research results and recommended practices by the smallholder. Specific objectives are:

- A. To develop a dynamic, comprehensive, mathematical model, based on biological functions for sheep production systems.
- B. To obtain parameters needed to model production systems in the Montaro Valley, at SAIS and Cooperatives at higher elevations in Junin Province and other appropriate altiplano areas of Peru; to validate the model and input parameters for each of these specific areas; and to use these validated simulations as baseline simulations.
- C. 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.
- D. To supply input/output data of sheep production systems for use in economic analysis and sociological assessment.
- E. To evaluate, through simulations, the response of sheep production systems to alterations or interventions requested or agreed upon by INIPA, IVITA, and UNA.

6. Summary of Accomplishments in Previous Years

- A. Development of a sheep production system model was the major effort for the previous year. This activity required a major effort on the part of several individuals at Texas A&M University over an extended period of time. It required an extensive and intensive review of literature, development of functional biological relationships and programming for computer application. It is not an activity which can

be done hurriedly and requires continuous adjusting and balancing among components as additional data become available.

- B. Luis Coronado arrived at Texas A&M University in January 1981 to begin studies towards an MS degree in Animal Breeding.
- C. Luis Coronado brought data collected at the IVITA Montaro Valley research station with him to be used in validating the sheep model and for use in projecting the most effective utilization of irrigated pastures at high elevations.

#### 7. Statement of Specific Objectives for 1981/82

- A. To field test sheep production systems model using SAIS and/or cooperative data.
- B. To evaluate the biological efficiency of lamb and wool production at the higher elevations coordinated with finishing weaned wethers and excess ewe lambs on intensively managed cultivated pastures in Montaro Valley for the Lima Market using IVITA and SAIS Tupac Amara data.
- C. To evaluate alternative sheep management strategies for mutton and wool production utilizing native and improved strains of sheep kept by SAIS/Cooperatives and by smallholders.
- D. To supply input/output data of sheep production systems for use by the Range/Nutrition, Forage Nutrition and Breeding Projects and for economic analysis and sociological assessment.
- E. To have Luis Coronado complete formal course work for an MS degree.

#### 8. Description of Work Undertaken

J.W. Bassett, Co-Investigator, was in Peru for three weeks in May-June 1981. A major portion of that time was spent with Alberto Pumayalla of UNA and Jorge Velasco of IVITA identifying sources of data which can be used with the sheep model to analyze production systems and to predict alternative management strategies for mutton and wool production for SAIS cooperatives and smallholders. A portion of the time was spent in outlining with A. Pumayalla the alpaca fiber project for which contingency funds have been requested.

Dr. Jorge Velasco spent four days in west Texas and on campus while en route from Montana State University to the annual meeting of the American Society of Animal Science. He was able to provide input into the development of the sheep model while on campus.

Luis Coronado's work on the MS degree program has not progressed as rapidly as anticipated, but progress is being made. This has also hampered progress in analysis of the IVITA data which Dr. Coronado brought with him.

Work continued at Texas A&M University to complete the sheep production system model and to validate it for use in individual animal simulation. Dr. Norman Graham, Australia, spent two months in College Station assisting in development of the nutrition component of the model.

## 9. Technical Accomplishments

Simulation models for both sheep and goats have been completed and functions validated. These models are operational and verifications of flock dynamics components will be completed during the summer of 1982.

PART V

BUDGET: PAST, PRESENT AND FUTURE

BUDGET: PAST, PRESENT, AND FUTURE

1. AID Funds

Under the terms of Grant No. AID/DSAN/XII-G-0049, Project 931-1328, the sum of \$15,577,043 was budgeted for the period October 1, 1978, to September 30, 1983.

To date, the following awards have been made to the University of California on behalf of the SR-CRSP:

September 1, 1978	\$4,652,000
August 29, 1979	\$2,700,000
August 25, 1980	\$3,200,000
January 23, 1981	\$615,000
March 4, 1982	<u>\$3,200,000</u>
Total	\$14,367,000

The University of California has distributed these funds under the direction of the Board of Institutional Representatives (BIR) in the manner outlined in Table 1.

2. Supplemental Funding from AID

With the particular significance of sheep and goats to the Near East area, the Near East Bureau provided two additional supplements to promote SR-CRSP work in Morocco. These were:

1980 - 1981	\$35,000
1981 - 1982	\$50,000

3. Future Funding by AID

At the time of writing, a written commitment from AID is for an extension to January 1, 1984, by provision of \$900,000 to cover the period October 1, 1983, to December 31, 1983. We have also received, in writing, a commitment for approximately \$12,000,000 for a further three years, through September 30, 1986.

4. US Institution Funds

Table 2 documents the matching contribution of US institutions towards the work of the SR-CRSP. US institutions through the grant period have more than met their obligation to the SR-CRSP.

## 5. Overseas Counterpart Contributions

While still difficult to calculate because much of the contribution is "in kind", host governments continue to surprise participants by their own commitment to SR-CRSP activities.

In Indonesia, BAPPENAS, the National Planning Body, has consistently matched the SR-CRSP dollar for dollar on AID funds committed to the Indonesia program.

In Brazil, the calculated contribution of \$240,000 last year, was exceeded this year.

In Kenya, once again expenditures in excess of \$140,000 were approved for support of SR-CRSP activities.

In Peru, matching contributions were estimated at \$340,000.

In Morocco, matching contributions have been estimated at \$80,000 per annum.

## 6. Site Coordinator Expenses

It was agreed early in the life of the SR-CRSP that each subgrant awarded would be taxed an equal percentage, which would be returned to the ME for the purpose of supporting Site Coordinators in each overseas location. The tax imposed in each program year has been as follows:

Program Year One	10/01/78 - 05/31/80	8%
Program Year Two	06/01/80 - 09/30/81	5%
Program Year Three	10/01/80 - 09/30/82	8%
Program Year Four	10/01/82 - 09/30/82	7%

These funds are distributed among the five sites according to need, and Table 3 documents the status of these funds. The first line shows the value of the actual percentage contributed by PIs in each country. The second line for each year shows the actual amount spent. In 1982/83, the current year, the balance is shown and vividly demonstrates the need to subsidize some countries (e.g., Indonesia) with few PIs from other countries (e.g., Peru) with many PIs.

## 7. Site Development Funds

In the first year of the SR-CRSP, some \$200,000 was added to the grant for site development. Decisions on the expenditure of this money rested with the Technical Committee, subject to approval by the Board. These funds have now been totally disbursed.

## 8. Management Entity Expenditures

The Management Entity has closed its ledgers on the first three fiscal years of operations. Table 4 documents the expenditures for 1980/81 and 1981/82. It should be noted that Management Entity costs for 1981/82 include those of:

- a. The External Evaluation Panel
- b. The Board of Institutional Representatives
- c. The Technical Committee
- d. The AID mandated Audit
- e. The Overseas site visits at SR-CRSP initiation
- f. The Visit of Overseas Administrators to USA
- g. The Costs of the Management Entity Office in Davis

## 9. Contingency Funds

The Management Entity received 18 applications for contingency funds, which were advanced to the Board for funding. \$234,228 (12) were approved in the amounts indicated in Table 5.

Table 1. The SR-CRSP Program Budget

	COLUMN	1	2	3	4
		BOARD	BOARD	BOARD	BOARD
		Approved	Approved	Approved	Approved
		Year One	Year Two	Year Three	Year Four
<u>Institution</u>	<u>Discipline</u>	<u>10/78-5/80</u>	<u>6/80-10/81</u>	<u>10/81-9/82</u>	<u>10/82-9/83</u>
California	Breeding	206,786	266,666	185,104	220,000
California	Health	196,145	233,333	175,000	190,000
Cal Poly	Physiology	60,000	100,000	97,761	--
Colorado	Health	150,000	233,333	175,000	190,000
Missouri	Sociology	174,992	253,333	200,000	275,000
Montana	Breeding	200,000	200,000	149,999	165,000
N. Carolina	Nutrition	109,435	266,666	200,000	295,000
Ohio State	Forages	166,016	233,000	150,000	---
Texas A&M	Breeding	160,000	212,800	150,000	240,000
Texas A&M	Systems	184,000	253,333	200,000	240,000
Texas Tech	Range	200,000	266,666	200,000	295,000
Tuskegee	Management	104,000	153,000	115,000	---
Utah State	Range	196,081	266,666	200,000	295,000
Utah State	Physiology	99,800	160,599	124,000	220,000
Washington	Health	200,000	233,333	175,000	190,000
Winrock	Economics	175,000	265,333	200,000	220,000
<u>Winrock</u>	<u>Management</u>	<u>100,000</u>	<u>153,333</u>	<u>215,000</u>	<u>240,000</u>
<u>Program Subtotals</u>		2,682,255	3,751,394	2,911,864	3,275,000
Management Entity		<u>516,691</u>	<u>468,154</u>	<u>515,429</u>	<u>435,000</u>
Prolific Sheep Proposal					100,000
Morocco Program Development			50,000	100,000	0
Exchanges between LDCs					100,000
General Contingency Funds			200,000	200,000	240,187
Site Development		196,000			
<u>GRAND TOTAL</u>		<u>3,394,946</u>	<u>4,469,548</u>	<u>3,727,293</u>	<u>4,150,187</u>
Additional Near East Bureau Funds			35,000	50,000	

Table 2. Matching Contributions From US Institutions\*

<u>Institution</u>	<u>Discipline</u>	<u>Inception To May 1980</u>	<u>June 1980 To Sept 1981</u>	<u>Oct 1981 To Sept 1982</u>	<u>Oct 1982 To Sept 1983</u>
California	Breeding	40,964	108,827	79,063	85,733
California	Health	87,872	131,168	59,827	63,340
Cal Poly	Physiology	110,765	110,709	65,365	--
Colorado	Health	47,897	101,500	58,333	63,333
Missouri	Sociology	65,183	91,727	73,251	92,112
Montana	Breeding	76,721	70,323	54,759	73,708
N. Carolina	Nutrition	46,353	93,881	85,392	98,764
Ohio State	Forages	96,962	139,236	91,221	--
Texas A&M	Breeding	44,021	70,465	45,711	80,000
Texas A&M	Systems	62,234	110,877	52,957	80,000
Texas Tech	Range	65,827	59,446	66,667	104,395
Tuskegee	Management	32,763	41,143	38,395	--
Utah State	Range	137,740	175,366	115,058	106,828
Utah State	Physiology	106,610	112,551	81,261	182,563
Washington	Health	65,961	73,161	80,923	65,170
Winrock	Economics	40,214	80,147	79,310	73,311
<u>Winrock</u>	<u>Management</u>	<u>31,913</u>	<u>65,502</u>	<u>103,773</u>	<u>106,724</u>
Total		1,160,000	1,636,029	1,231,266	1,275,981

\*As of 11/4/82

Table 3. Site Coordinator Expenses

	<u>KENYA</u>	<u>PERU</u>	<u>BRAZIL</u>	<u>INDONESIA</u>	<u>MOROCCO</u>	<u>TOTAL</u>
1978/79	56,667	56,666	30,000	56,667		200,000
Site Development	56,667	56,666	30,000	56,667		200,000
Current Balance	0	0	0	0		0
1978/80 7%	46,550	59,950	49,150	38,650	0	194,300
Actual Expenditures	5,210	19,735	15,426	33,134	0	73,505
Cumulative Balance	41,340	40,215	33,724	5,516	0	120,795
1980/81 5%	35,536 →*	64,638	70,863 ←*	22,837	6,700	200,574
Actual Expenditures	97,227	84,012	97,550	74,151	6,700	359,640
Cumulative Balance	[20,351]	20,841	7,037	[45,798]	0	[38,271]
1981/82 8%	54,235	69,040	86,862	30,702	4,200	245,039
Actual Expenditures	51,850	59,174	87,848	34,688	4,200	237,760
Cumulative Balance	[17,966]	30,707	6,051	[49,784]	0	[30,992]
1982/83 7%	57,900	64,200	54,458	25,583	27,459	229,600
Actual Available	39,934	94,907	60,509	[24,201]	27,459	198,608

\* Arrows represent shifts of OSU, CPP, and USU to Brazil and Peru.

Table 4. Management Entity Expenses

	October 1980 - September 1981 <u>EXPENDED</u>	October 1981 - September 1982 <u>EXPENDED</u>
Salaries	\$96,717.26	\$118,021.37
Benefits	<u>34,945.69</u>	<u>40,505.09</u>
Subtotal	\$131,662.95	\$158,526.46
Supplies and Expense	35,782.86	42,153.91
Equipment	896.97	0
Travel		
International		
Management Entity	25,110.74	28,725.01
External Evaluation Panel	16,652.21	15,564.57
Board	0	7,427.72
Technical Committee	<u>195.00</u>	<u>0</u>
Subtotal	41,957.95	51,717.30
Domestic		
Management Entity	9,799.39	13,820.29
External Evaluation Panel	5,595.49	12,928.59
Board	18,953.05	13,497.69
Technical Committee	11,358.86	12,235.35
Meeting Rooms	<u>583.82</u>	<u>355.64</u>
Subtotal	46,290.61	52,837.56
Other		9,165.00
EEP Consulting	16,850.00	29,830.00
Audit	<u>38,500.00</u>	<u>0</u>
Subtotal	55,350.00	38,995.00
Indirect	<u>60,836.78</u>	<u>67,813.37</u>
TOTAL	\$372,728.12	\$412,043.60

Table 5. Contingency Fund Requests, 1982/83

<u>No.</u>	<u>Requested by</u>	<u>Objectives</u>	<u>Amount</u>	<u>Board Decision</u>
1	Robinson	Overdraft on 81/82 contingency funds due to passage of further requests by BIR during current year.	32,030	yes
2	Robinson	Contingencies in <u>Kenya</u> jointly agreed by Kenya PIs at March 1982 meetings with Dr. Chema & MLD staff	50,000	yes
3	Cartwright	Initiate grading scheme for alpaca wool fiber & assist in development of criteria for wool industry in <u>Peru</u> .	26,314	yes
4	Bradford	Development of facilities at Tadla Farm of Hassan II <u>Morocco</u> , to serve 3 of the 4 projects based there.	10,000	yes
5	Indonesia PI	Extension of Dr. N. Thomas contract to complete write up of several papers on <u>Indonesia</u> village work survey.	10,000	yes
6	DeMartini	Study of the health consequences of heavy metal pollution in Montaro Valley of <u>Peru</u> where toxicities are a serious problem.	27,684	yes
7	DeMartini	Placement of full time person from S. Dakota University who will match CRSP funds at 200% to place pathologist in <u>Peru</u> .	35,000	yes
8	Thomas	Replacement of vehicle in <u>Indonesia</u> . TC Exec. recommended funds for 1 yr. rental rather than purchase.	5,000	yes
9	Bradford	Funds to support work of Astuti in <u>Indonesia</u> .	5,000	NO
10	Bradford	Provision of 2 vehicles for animal breeders in <u>Morocco</u> .	12,000	NO

<u>No.</u>	<u>Requested by</u>	<u>Objectives</u>	<u>Amount</u>	<u>Board Decision</u>
11	Bradford	Support for Animal Genetics 250 class designed for overseas students.	5,000	NO
12	Nolan	Augmentation for placement of person full time in <u>Brazil</u> .		to be reworked with Brazil Pls; resubmit.
13	DeBoer	Augmentation for placement of person full time in <u>Peru</u> .		to be reworked with Peru Pls; resubmit.
14	Fitzhugh	Augmentation of additional funds for forages work in <u>Kenya</u> over & above current \$25,000.		NO
15	Bradford	Augmentation to support goat facility	15,000	yes
16	Chema	Support for films	400	yes
17	McGuire	Support for CAE work	7,800	yes
18	Lassiter	Ohio State continued support for Nolte	15,000	yes