THE SMALL RUMINANT CRSP (SR-CRSP)

ANNUAL REPORT
PROGRAM YEAR TWO
1980/81

Prepared by the Management Entity Office

ANNUAL REPORT

SECOND PROGRAM YEAR 1980/81

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I. STATEMENT OF GOALS

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

To accomplish these broad objectives, the SR-CRSP is providing leadership for interdisciplinary research programs and furnishing opportunities for advanced training of scientists interested in small ruminants. This will result in increased numbers of professionals with the necessary analytical skills and motivation to engage in an organized effort to alleviate the problems confronting small ruminant producers. Publishing and disseminating SR-CRSP project results will contribute to an enhanced data base for directing future research, designing sound management recommendations and formulating policy guidelines which mitigate the constraints on small ruminant productivity. The various projects involved in research in the overseas sites each play a vital role in the fulfillment of these goals.

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

PROBLEM AREA	RESEARCH AREA
Inadequate year-round feed supply	Nutrition and Feeding
Improper grazing practices	Range Management
Poor reproductive performance	Research on reproduction in the male and female
Non-selective breeding	Genetic improvement of local breeds and crossbreds
Disease-Parasitism	Animal Health
Sub-optimum utilization of available resources	Management
Cultural constraints and lack of capital	Socio-economic Research
Lack of coordination and integration in improvement efforts	Systems Research

PART II
SUMMARY OF ACCOMPLISHMENTS

TITLE XII
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

II. SUMMARY OF ACCOMPLISHMENTS

The Small Ruminant CRSP (SR-CRSP) is now approaching the end of the third fiscal year. This CRSP was the first, and therefore undertook much of the pioneering work associated with development and implementation of this new idea. At the time we took the CRSP over, there was an incredible amount of groundwork to be done in establishing foreign worksites and educating our many constituencies about Title XII in general, and CRSPs in particular.

Everyone associated with the CRSP both in the USA and overseas should take pride in the fact that in less than three years the CRSP has accomplished so much. In summary:

- The five powerful units of the CRSP have all settled down to an excellent working relationship:

  -- The Management Entity
  -- The Technical Committee
  -- The Board of Institutional Representatives
  -- The External Evaluation Panel
  -- The Overseas Counterparts

  Their work has been thoroughly documented and distributed to all our constituencies.

- We have established Memoranda of Understanding or Initial Agreements with all five of our original target countries where work is now underway: Indonesia, Kenya, Morocco, Brazil, and Peru. Excellent working relationships have been established with senior administrators and scientists in each country.

- More than half of the approximately $15,000,000 of USAID funds have been distributed to participating institutions via subgrants and contracts issued from the University of California at Davis acting as the Management Entity.

- US institutions have matched USAID funds at a rate over 60% according to a recently completed independent audit of all the participating institutions.

- Overseas governments have matched USAID funds at a rate of approximately 20% in total - a very significant contribution to the CRSP.

- We currently have an excellent training program underway. There are 45 overseas students under training as follows:

  -- 20 MS students in the USA.

  -- 20 MS students in home-country.

  -- 5 PhD students in the USA.

There are also 15 US, MS, and PhD students residing long term overseas who are doing their thesis research in the overseas sites.

- Three US technicians have travelled overseas to provide specialized training in analytical procedures and facility development. Four overseas counterpart researchers have studied in the US in short term, intensive instruction in advanced techniques.

- We have been used, primarily, as a scientific resource for our overseas colleagues. In spite of the many comments made about numerous short term trips by US scientists (many of which were inevitable to set up programs), it is true to say that probably the greatest single need, identified by overseas colleagues, has been that of high level technical input from US Principal Investigators to help design long range plans for scientific research.

- We have sponsored over 50 trips to the USA of foreign counterparts for training. These have varied from travel to undertake degree work, for short term training, and for technical and administrative purposes.

- We have completed the first comprehensive audit of the entire SR-CRSP by an independent auditor and the result was excellent. There were absolutely no problems resulting from the audit.

- The CRSP has been publicized through a fold-out flyer, a comprehensive paper, four newsletters, a six volume Integrated Program Plan, a five volume Annual Report with complete budget reporting, and a descriptive brochure, all available from the Management Entity Office.

- One of the most rewarding accomplishments of the CRSP has been the linkages we have been able to provide among institutions, projects and departments overseas. These have included joint work with institutions that have had little contact with each other for decades, until the CRSP came along.

- Teaching and research at US institutions has materially changed as a result of the SR-CRSP. New courses, improved facilities, short courses and campus wide interest have all been generated to a substantial degree.

- The Management Entity Office has been an extremely busy place and functioned with a small staff and a relatively very small budget. It has been a clearing house for literally hundreds of inquiries, and the administrative costs of the ME Office itself have been less than 7% of the CRSP budget.

- The Management Entity has attempted to be not only fiscally accountable, but to be realistic in equating dollars awarded with performance. Five of the thirteen institutions have been targeted for budget cuts or termination by the ME based upon either EEP recommendations or those of foreign counterparts. This has naturally led to conflict and stress at times --but also perhaps to a better SR-CRSP program in the long run because all have survived the resulting intense scrutiny of their modified programs.

- Site development overseas has been very significant. CRSP resources have been used as seed money--the catalyst that has inspired substantial investment from local governments. Many lasting facilities are in place that would not have been there had the SR-CRSP not collaborated with particular counterparts.

- Several seminars, workshops, and short courses have been undertaken overseas including two in Peru, one in Kenya, one in Indonesia and two in Brazil. CRSP scientists will also be much in evidence at the upcoming III International Goat Conference in Tucson, Arizona.

- CRSP scientists have already begun to publish their research findings. There have been over 20 papers presented at symposia, seminars and short courses, six papers at major scientific meetings and four papers are submitted for publication in scientific journals. In addition, some 26 internal publications have been developed.

- Finally, and perhaps most significantly, it has been particularly exciting to see that the SR-CRSP has focused on the needs of the smallholder or limited resource farmer. In Indonesia and Kenya, almost all the effort has been conducted in baseline survey work at the village level in every discipline, backed up by relevant research programs at regional research centers. In Peru almost all the work has concentrated in the Central and Southern High Sierra working with cooperatives formed after land reform or with ethnic groups in isolated villages; and in Brazil the new CRSP has dove-tailed well into EMBRAPA's newly established Sheep and Goat Research Center.

In summary, it is my view that the SR-CRSP has worked well in promoting one of the most exciting mechanisms ever to come about for institution building and collaborative support between the US and overseas countries in the area of research.

And yet, the best is still to come! The Annual Reports from participating institutions for Program Year Two already have begun to reflect the collection of very interesting new information from research programs underway, and it is anticipated that in its next meeting, the Technical Committee will be able to focus wholly on the discussion of technical information.

There is also good news from the administrative side in the Dr. Bill Weir will join the Management Entity Office. Dr. Weir has been at UC Davis for 33 years, is an internationally known sheep and rangeland researcher, a former Department Chairman and Dean at the University of California. In this appointment, few should doubt the commitment of the University of California to ensuring the success of the SR-CRSP.

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Program Year Two

1. Annual Report - Program Year One.

   Part I: Administrative Activities
   Part II: Individual Annual Reports
   Part III: Budget

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3. Review of the SR-CRSP by the External Evaluation Panel. July 1980
4. SR-CRSP Informational Pamphlet
5. Minutes of the Board (BIR) Meeting. October 1980
6. Newsletter of the SR-CRSP - Issue II. October 1980
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9. External Evaluation Panel Review of Subprojects. January 1981
10. Minutes of the Kenya Regional Group Meeting. January 1981
11. Minutes of Special Board (BIR) Meeting. February 1981.
12. Minutes of the Brazil Regional Group Meeting. February 1981
13. Minutes of the Kenya PAC Meeting. April 1981
14. Newsletter of the SR-CRSP. Issue IV. April 1981
15. Interim Agreement with Morocco. April 1981
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17. Informational Pamphlet ("Glossy") on the SR-CRSP. June 1981
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19. Report on the SR-CRSP - Presented at AUSUDIAP Meeting. June 1981

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PART III
SUMMARY OF COUNTRY ACTIVITIES

TITLE XII
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

III. SUMMARY OF COUNTRY ACTIVITIES

Peru

The Breeding Project is identifying sheep and goat breeds with high genetic potential for meat and fiber production. These are being used to develop superior stock for use in selection programs geared toward improving the productivity of indigenous herds and flocks. In order to improve the condition of the Puno grazing areas and provide these upgraded animals with an adequate diet, the relationship between the physical and biological characteristics of the native rangelands and the nutritional status of the grazing stock are being investigated by the Range Management and Nutrition Project. Also working in this area, in close cooperation with the range scientists, is the Forages Project, which is concentrating on integrating improved forage production with improved range management practices. The Reproduction Project is studying the genetic, environmental, and management factors which influence reproductive capacity in order to increase the reproductive efficiency of the sheep, goats and alpacas in Peru. Identifying the causes of productive loss due to poor animal health, performing studies on the etiology, serology and immunology of such diseaes as chronic respiratory disease and clostridial enterotoxemia and devising improved means of diagnosing and controlling major disease problems are the primary concerns of the Animal Health Project. Using data from all the projects, the Economics Project is characterizing the present small ruminant production and marketing systems in order to undertake studies on farm management/production economics and consumer demand/marketing mechanisms. The present emphasis in Peru is focused on continuing field surveys on production economics of cooperative sector sheep and alpaca producing units, initiating marketing studies of sheep and alpaca fiber and conducting economic analysis on previously collected data sets for range, pasture and animal health research projects. The Sociology Project is describing the social organization of sheep and alpaca production systems, documenting agro-pastoral interactions in Andean communities, comparing traditional and government cooperative agricultural production strategies, and documenting the manner in which such external factors such as access to credit restrict the options of small ruminant producers.

Kenya

The Breeding Project is comparing the meat and milk production and adaptability to different environments of indigenous and indigenous/dairy crossbreds in Kenya. This information is being used to develop breeding plans for genetic improvement of dual purpose goats for smallholder production systems in the high potential agricultural areas. In order to improve the feed base for dairy/dual purpose goats in these regions, the Forages Project is identifying and characterizing the forages available in the humid tropics so more efficient forage/animal production systems can be developed and plant/animal responses can be evaluated. The Health Project is assessing the prevalence and economic significance of major small ruminant diseases, adapting known prevention programs and developing new approaches to disease control in order to devise and implement a comprehensive Herd Health Program. Using baseline

and monitoring surveys, the Production Systems Project is characterizing small farm systems in Kenya including an analysis of available resources, major constraints and potential competition between livestock and cropping activities. These survey activities are providing data for assessment of biological, economic and sociological interventions in the smallholder systems under study. The Economics Project is engaged in collaborative research on animal health economics with the Health Project and is also working closely with the Central Bureau of Statistics in Nairobi. Research on goat milk product markets and demand with a particular emphasis on methodological aspects of applicability to other developing countries, has been initiated. In order to understand the potential role for goats in the intensive crop production areas of western Kenya, the Sociology Project is studying the social organization of agriculture in this region with a particular emphasis on examining the role of women in crop and small ruminant production. In addition to participating in the interdisciplinary production system baseline survey, an in-depth farm survey on decision making/risk taking has been initiated as well.

Indonesia

Characterizing the performance of the major types of Indonesian sheep and goats under experiment station and village conditions so genetic improvement plans and selection programs can be developed, is the primary objective of the Breeding Project in Indonesia. An important aspect of this effort is comparing sheep and goat performance on different rations. This is being done in cooperation with the Nutrition Project which has, as its major goals, characterizing the nutritional value of by-product and crop residue feedstuffs so guidelines for the formulation of balanced maximum profit rations can be developed. As part of this effort, the intake and relative preference for crop by-products by native sheep and goats is being evaluated and the effects of different planes of dietary energy and protein on small ruminant productivity is being studied. The Economics Project is concentrating on establishing a farm survey program including procedures for village and farmer selection, frequency of enumeration and data checking, processing, storage and analysis. In addition, the possibilities for incorporating small ruminant research into outer island transmigration areas is being explored. The Sociology Project is focusing on describing the social organization of small ruminant production on Java, an island where intensive crop production systems predominate. The role sheep and goats play in the socio-religious-cultural milieu of this region is being examined to understand the place small ruminants occupy with relation to the economic calculus of the small producer.

Brazil

The main focus of the Breeding Project work in Brazil is to identify and characterize indigenous sheep and goat genotypes for further study. Genetic parameters of desired traits and their compatibility are being estimated so selection programs for growth rate, fertility and disease resistance can be initiated. The Range Project, in an effort to upgrade the native feed base, is conducting an ecological assessment of the range forage resources, defining and quantifying plant/animal relationships and investigating methods for

improving the range. In conjunction with the Range Project's activities, the Nutrition Project is investigating the nutritional value of agricultural by-products and crop residues and conducting feeding trials to ascertain how these feedstuffs can be most optimally incorporated within the overall feeding regime. The Reproduction Project is concentrating on assessing the reproductive capabilities of the predominant indigenous small ruminants in Northeast Brazil and measuring the influence of environment, nutrition and management on reproductive efficiency in the native flocks and herds. The Health Project is identifying major animal health problems in order to develop cost effective herd health programs utilizing both known diagnostic, control and prevention techniques in conjunction with procedures developed as the result of SR-CRSP research efforts. The effects of management regimes on the milk production, growth and reproductive rate of various breeds of native goats is being examined by the Management Project with particular attention being paid to lactating does and young kids raised for meat production. The Economics Project is initiating regular farm survey and in-depth monitoring work with sheep and goat producers and inter-institutional research programs with other Brazilian institutes. They are, in addition, preparing long term plans for agricultural economics research focusing on small ruminant production with an emphasis on assessing the impact of technological programs on sheep and goat producers. The Sociology Project is working towards understanding the role sheep and goats play in the overall system of agricultural production and learning what non-economic importance small ruminants have for the people of the Northeast region.

The means by which research priorites can be more effectively established and the practical application of research results be evaluated is being provided by the Systems Analysis Project, which, like the Economics and Sociology Projects, is working at all the overseas sites. They are developing sheep and goat models which, when used with host country production parameters, will supply input/output data for economic analyses and sociological assessments and evaluate, through simulations, recommended alterations of the current production system.

Morocco

Morocco is currently receiving high priority as a primary overseas site and events are moving rapidly toward its establishment as the CRSP Near East worksite. An initial interim agreement for work in two disciplines, Range Management and Sociology has been signed and the early involvement of these projects will likely be followed by the participation of two additional CRSP projects in Animal Breeding and Forages.

Neil Artz has already arrived in Morocco as a long term scientist working with Range and Sociology. Also, the return of Moroccan scientists who have been studying in the USA under various auspices is imminently expected which will strengthen the program. In November, an international team of experts will arrive at Hassan II University under sponsorship of the SR-CRSP to study the prospects for a Prolific Sheep Project. Scientists from Morocco, Egypt, the US, the United Kingdom, Australia and FAO are expected to attend for further planning and project development activities.

PART IV
PARTICIPATING INSTITUTION ANNUAL REPORTS

PERU

TITLE XII

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

Annual Report Form for 1980/81

(Peru)

1. Institution: Montana State University

2. Principal Investigator: Robert L. Blackwell

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant - $200,000.
   Matching Contributions from 1980/81 subgrant - $70,323.

4. Project Title: Evaluation and Genetic Improvement of Sheep and Goats in Extensive Management Systems.

5. Project Goals:

   Objectives: Provide the genetic and animal breeding component of the Small Ruminant CRSP in the extensive management systems in Peru and Morocco through the following:

   a. Identify breeds of sheep and goats with high genetic potential for increasing food and fiber production under extensive management systems.

   b. Develop superior breeding stocks by (a) selection 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. Develop methodology for utilizing superior breeding stocks to improve the productivity of indigenous herds and flocks.

   d. Provide training (including graduate study at the Master's level) in animal breeding and livestock husbandry for both foreign and domestic students.

6. Summary of previous accomplishments.

Two trips to Peru were made by scientists from Montana State University to develop a close working relationship and design breeding project to start in Peru. Project for sheep breeding were designed in cooperation with Manuel Carpio (UNA) and were initiated at SAIS Tupac Amaru and the Central de Cooperativas in the central highland of Peru. A breed comparison project was designed and part of the matings comparing Junin and Corriedale breeds of sheep were made. At SAIS Tupac Amaru a breed comparison project was designed to start in 1981 and 2 projects involving 1667 ewes to evaluate selection procedures and collect basic data on sheep production were initiated. Three graduate students are working at the two locations. Support was provided for Dr. Velasco (IVITA) to begin to tabulate and analyze alpaca breeding data.

7. Statement of specific 1980/81 objectives.

1. Analysis of as much existing data from Peru and Montana as possible. Study of selection effects on reproduction, growth and fiber production will be included.

2. Conduct sheep breed comparisons in Peru to determine merits of the local improved stocks and some introduced stocks.

3. Develop improved selection procedures and initiate selection programs in breeding flocks of cooperators to evaluate these procedures.

4. Initiate studies to identify the major factors responsible for low reproductive rate among sheep at these high elevations and to determine the nature and relative importance of heredity in reproductive failures.

5. Conduct breeding tests to compare various breeding groups of sheep at SAIS Tupac Amaru, and investigate means of increasing the flow of improved genetic material to the native sheep production.

6. Continue the analyses of alpaca production data from a genetic point of view and strengthen the current breeding program with alpacas at La Raya.

8. Description of work undertaken.

Burfening traveled to Peru in June to develop detailed plans for the collection and processing of data and in the absence of a Site Coordinator, worked on all necessary administrative details. Breeding has started at the Central de Cooperativa and SAIS Tupac Amaru. Data already collected had been tabulated and transported back to US for analysis. Carpio traveled to the US in August to attend the American Society of Animal Science Meeting and then on to Bozeman and Dubois, Idaho to view and select Targhee and $\frac{1}{2}$ Finn x $\frac{1}{2}$ Targhee rams for export to Peru to use in the breeding project. Lambing is in October and November. Graduate students, Cabrera at the Central, and Rodriquez at SAIS Tupac Amaru, oversee the collection of all lambing data at these locations and Huapaya is charged with data tabulation at UNA. Blackwell and Kress traveled to Peru in December for the PI Meeting, to work on design and data collection details with Carpio and to assist in writing an abstract for presentation by Velasco at the ASAS Meeting in 1981. The Targhee (20) and $\frac{1}{2}$ Finn x $\frac{1}{2}$ Targhee (20) rams were imported to Peru while Blackwell and Kress were in Peru, and they inspected the rams and assisted with importation procedures. Burfening traveled to Peru in February. After arrival in Peru, Carpio and Burfening spent 1 week in the Central Highlands while sheep were being sheared and to supervise graduate student collection of data. Details of project management were discussed with the managers of SAIS Tupac Amaru and the decision was made to move the portion of the breeding project from the Central to SAIS Cahuide. Data were analyzed by Burfening and Carpio on reproductive performance in the Highlands and an abstract was written for the paper to be presented at the 1981 ASAS Meetings. A former Peace Corp member, Anne

Alderson, worked jointly with MSU and UC Davis to analyze a large set of sheep data from the highlands of Columbia and a scientific paper was prepared for publication.

9. Technical Accomplishments.

Although the initiation of the breeding project commenced only 1 year ago, some results and technical accomplishments have been recorded to date. Data on reproductive performance and lambing rates of ewes at SAIS Tupac Amaru have been recorded for two different experimental groups. The first of these groups is a random bred control population which is being established to help evaluate the effects of selection at SAIS Tupac Amaru. There were approximately 140 ewes at each production unit. Each group of ewes were bred to ten randomly selected class A rams. The data on reproductive performance are summarized in Table 1. After a 60-day breeding season, an average of 77.4% of the ewes lambed. Of the 432 ewes that lambed at the four locations, 0.6% gave birth to twins. Lamb mortality within 24 hours averaged 4.8% and lamb birth weight averaged approximately 3.6 kg. In the other experiment at SAIS Tupac Amaru, Table 2, rams from the super, class A and twin line were bred to approximately 370 ewes per each line 20 rams for each line used. The objective of this experiment are to compare the reproductive rate and maternal performance of the ewes produced from these matings. The matings will be made one more year with new rams from each line to the same type of ewes. The percent ewes lambing was 83% and 1.4% of the ewes lambing gave birth to twins. The average birth weight was 3.5 kg and the average ewe body weight was 47.4 kg.

At the Central de Cooperativa, 300 Corriedale ewes were bred to six Corriedale or six Junin rams (150 each) as part of a cross-breeding study. Ninety-four percent of the Corriedale by Corriedale ewes lambed compared to 84.6% of the Junin by Corriedale ewes. All ewes were 2 and 3-year-old ewes and no twins (0%) were born. The average lamb mortality at 24 hour after birth was 8.2% and the average birth weight of the lambs was 4 kg.

Data were analyzed that had been collected at SAIS Ramon Castilla on body weight and fleece weight of ewes and their first and second offspring. The general ranges, means and standard deviation for ewe body weight at first through fourth shearing, ewe fleece weight at first through fourth shearing and first offspring's birth weight and body weight at first and second shearing and the second offspring's birth weight and body weight and fleece weight at first shearing are shown in Table 4. Body weights tended to increase with increase in age from 28 kg to 36 kg. Fleece weight tended to decrease from first through fourth shearing.

Dr. Velasco, working at the La Raya Research Station, found in a study of alpaca color inheritance and breed characteristics that uniform color was dominant over spotted color and that black color was dominant over brown color. Crosses between Huacaya breed with crimped fiber and Suri breed with straight fiber indicated that the straight fiber of the Suri was dominant over the crimped fiber of the Huacaya. Further, in studying the inheritance of body weight and fleece weight by using the

daughter-dam regression technique, the heritability of body weight was estimated to be .69±.2 and the heritability of fleece weight was estimated to be .35±.2 with a genetic correlation between the two traits of -.03.

Performance of four breeds imported into the Columbian highlands (Rambouillet, Corriedale, American Romney Marsh, British Romney Marsh) and the native Criolla were studied in cooperation with MSU and UC Davis. Records on 6,653 ewes and survivability and production of meat and wool were investigated. The effects of breed and year were found significant in all traits tested. Males were significantly heavier than females and females, on the average, had a higher survival rate. The year by breed interaction was significant in a majority of the traits. The overall production of the Criolla compared favorably with the imported breeds. Ranking the breeds on composite traits, the British Romney Marsh weaned significantly more kilograms/ewe bred followed in order by Criolla, Corriedale, Rambouillet and American Romney Marsh. The American Romney Marsh and Corriedale produced significantly more wool per ewe than the other breeds while the Criolla produced the least (Table 5).

The data from sheep experiments, which is preliminary in nature, and from the highlands of Columbia, indicates that the reproductive rate in the central highlands of Peru and Columbia is low and that a very small percentage of the ewes give birth to twins. The data collected from alpacas indicates that careful selective mating and understanding of genetic principles of color inheritance could result in matings to produce the colored offspring that are desireable. The inheritance of body weight and fleece weight indicates that selection for increased growth rate or body weight and increased fleece weight could effectively increase either the meat or fiber production of the alpaca with no apparent antagonistic effect between fiber and meat production.

TABLE 1. REPRODUCTIVE PERFORMANCE OF CONTROL LINE EWES AT 4 LOCATIONS OF SAIS TUPAC AMARU

	Location			
	Atocsaico	Casaracra	Consac	Pachacayo
No. Ewes	140	138	140	139
No. Rams	10	9	9	9
No. Ewes Lambing (%)	96 (68.5)	117 (84.5)	107 (76.4)	112 (80.5)
No. Lambs Born	96	118	109	112
Lamb Mortality (24 hr) (%)	4 (4.1)	3 (2.5)	6 (5.5)	8 (7.1)
Birth Wt (kg)	3.5	3.8	3.7	3.6
Ewe Body Wt (kg)	46.8	48.7	48.0	48.0

TABLE 2. REPRODUCTIVE PERFORMANCE OF EWES MATED TO 3 LINES OF RAMS AT SAIS TUPAC AMARU.

	Type of Ram		
	Super	Class A	Twin
No. Ewes	368	370	372
No. Rams	19	24	19
No. Ewes Lambing (%)	302 (82.0)	310 (83.8)	311 (83.6)
No. Lambs Born	307	317	312
Lamb Mortality 24 hr (%)	3 (0.9)	0 (0.0)	1 (0.3)
Birth Wt (kg)	3.5	3.5	3.6
Ewe Body Wt (kg)	47.5	47.4	47.2

TABLE 3. REPRODUCTIVE PERFORMANCE OF CORRIEDALE EWES MATED TO CORRIEDALE OR JUNIN RAMS AT CENTRAL DE COOPERATIVAS

Breed of Ram Breed of Ewe	Corriedale x Corriedale	Junin x Corriedale
No. Ewes	150	150
No. Rams	6	6
No. Ewes Lambing (%)	141 (94.0)	127 (84.6)
No. Lambs Born	141	127
Lamb Mortality	12 (8.5)	10 (7.9)
Birth Wt (kg)	4.0	4.0

TABLE 4. OVERALL MEANS (KG), NUMBERS, STANDARD DEVIATION AND RANGE FROM SAIS RAMON CASTILLO

Trait	Number of observations	Mean	Standard deviation	Range
Ewe				
Body wt. 1st shearing[a]	2710	28.5	3.0	20.6 - 39.4
2nd shearing	2412	34.2	4.0	21.3 - 47.9
3rd shearing	2039	33.4	3.2	21.7 - 43.8
4th shearing	1468	36.6	3.4	23.0 - 75.3
Fleece wt.				
1st shearing[a]	2710	2.7	.46	1.2 - 5.1
2nd shearing	2412	2.7	.49	.8 - 4.4
3rd shearing	2039	2.3	.40	1.1 - 4.2
4th shearing	1467	2.2	.40	1.2 - 4.7
First Offspring				
Body wt. birth	1383	4.1	1.26	1.0 - 9.0
1st shearing[a]	576	29.5	3.4	10.0 - 40.6
2nd shearing	345	33.0	5.7	24.0 - 99.0
Fleece wt.				
1st shearing[a]	576	2.6	.61	1.3 - 4.3
2nd shearing	345	2.3	.36	1.2 - 3.5
Second Offspring				
Body wt. birth	1903	3.4	.64	1.5 - 7.0
1st shearing	684	31.6	3.4	22.0 - 42.0
Fleece wt.				
1st shearing	684	2.0	.48	1.0 - 3.2

[a]Approximately 18 months of age.

TABLE 5. LEAST SQUARES ESTIMATES FOR BREED AVERAGES OF SHEEP FROM THE HIGHLANDS OF COLUMBIA

Trait	Rambouillet	Corriedale	American Romney	British Romney	Criolla	Overall breed average
Ewes lambing/ewes bred	.70[d]	.78[c]	.70[d]	.83[b]	.94[a]	.79
Lambs born/ewe bred	.77[d]	.83[c]	.71[e]	.88[b]	1.03[a]	.84
Lambs born/ewe lambing	1.10[a]	1.06[b]	1.03[c]	1.05[bc]	1.09[a]	1.07
Liveability (lambs born alive/number born)	.92[b]	.94[b]	.89[c]	.97[a]	.97[a]	.94
Birth weight	4.12[a]	3.89[b]	3.44[c]	4.13[a]	3.44[c]	3.80
Lambs weaned/lamb born alive	.78[c]	.85[b]	.82[b]	.93[a]	.93[a]	.86
Lambs weaned/ewe lambing	.79[c]	.85[b]	.76[c]	.95[a]	.98[a]	.87
Lambs weaned/ewe bred	.56[d]	.66[c]	.53[d]	.79[b]	.94[a]	.70
Weaning weight	18.68[b]	17.10[c]	16.69[c]	20.04[a]	15.87[d]	17.68
Average daily gain	.121[b]	.110[c]	.110[c]	.132[a]	.103[d]	.115
Kg weaned/ewe bred	10.56[c]	11.37[c]	8.88[d]	15.83[a]	14.72[b]	12.17
Kg weaned/ewe lambing	14.97[bc]	14.53[c]	12.70[d]	18.92[a]	15.57[b]	15.34
Annual wool production	3.16[b]	3.64[a]	3.71[a]	3.17[b]	1.84[c]	3.10
Spinning counts	64s[a]	54s[b]	48s[d]	50s[c]	44s[e]	

[a,b,c,d,e] Means with different superscript within a row were significantly different $P<.05$.

ANNUAL REPORT FORM FOR 1980/81

1. Institution: Texas Tech University

2. Principal Investigator: Fred C. Bryant

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
   Matching Contributions from 1980/81 subgrant. $66,674

4. Project Title: Improving Small Ruminant Nutrition, Management and Production

5. Project Goals:

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

1. To collaborate with US institutions conducting research in Peru and other locations under the Small Ruminant CRSP.

2. To identify and establish contact with counterparts at collaborating institutions in Peru.

3. Identify US personnel for the Small Ruminants program in Peru.

4. To initiate development of Small Ruminant Research Centers in Peru.

5. To inventory the rangeland resources available as small ruminant research sites.

6. To determine seasonal variation in the nutritive value of forages from rangelands.

7. To determine seasonal diets and diet preferences of sheep and alpaca that are grazing rangelands.

8. To evaluate long-term grazing studies[1] in terms of animal performance and the impact on native vegetation.

9. To evaluate the advantages of improved, cultivated pasture on animal performance.[1]

10. To initiate a long term graduate training component in range management or animal science. The program will be for limited numbers of students from Peru or other countries with similar rangeland and livestock resources.

[1]Amended from the original subgrant.

6. Summary of previous accomplishments.

In Program Year One, accomplishments focused largely on (1) identifying collaborators (co-Principal Investigators) and work sites in Peru, (2) initiating collaborative ties with US institutions in the Small Ruminant CRSP, (3) employing a Texas Tech scientist and graduate student to initiate and oversee the preliminary phases of project implementation, and (4) securing fencing materials, laboratory, and field equipment to be shipped to Peru.

7. Statement of specific 1980/81 objectives.

1. To continue development of the Experimental Research Center (ERC) at La Raya and Corpacancha.[2]
2. To inventory and classify rangeland vegetation and soils at the Corpacancha ERC.
3. To develop production curves of major plant species at the Corpacancha ERC.
4. To evaluate the impacts of long-term grazing on floristic structure and composition at selected sites in the Central and Southern Sierra.
5. To initiate long-term grazing treatments at the La Raya and Corpacancha ERC's.
6. To establish grazing exclosures at La Raya and Corpacancha ERC's.
7. To initiate research on the nutritional requirements of alpaca at La Raya.
8. To initiate range nutrition research at Corpacancha.
9. To initiate a research project on grazing management at Texas Tech.
10. To initiate corollary research projects of the Range Management counterparts in Peru.
11. To continue the emphasis on host country training.

[2]Because of the campesino invasions of the lands of the Central de Cooperativas (Cerro de Pasco, Ayaracra) in August of 1980, the Central Sierra grazing study was transferred to Corpacancha of the SAIS (Sociedad Agricola de Interes Social) "Pachacutec".

8. Description of work undertaken.

Objective 1

The arrival of Texas Tech Range faculty on permanent assignment to Peru, Al Schlundt, has accelerated the development of both ERC's. The subsequent distribution of lab materials to La Raya and fencing materials for Corpacancha allowed rapid progress in both the Southern and Central Sierra, respectively.

La Raya

A complete forages analysis laboratory (Proximate Analysis, Van Soest and more) was funded by Texas Tech and will go into operation by May of 1981. The main responsibilities for its operation will be those of a full time technician identified by Drs. Valdivia and Acuna of IVITA. The construction of additional rooms required to house the entire forages laboratory was provided by IVITA. Site development funds for the entire CRSP will cover the completion of a 10 room structure which will be available for all visiting scientists. This critical facility should be completed by September of 1981.

Two 20 hectare areas on the two major range sites of the area will be fenced and stocked with alpaca by the end of April 1981. These areas will be studied intensively to provide data for range experiments that emphasize alpaca nutrition and forage preferences.

Corpacancha

The main thrust of the Texas Tech Small Ruminant research effort is centered at Corpacancha, the headquarters of the SAIS "Pachucutec". A large scale and long-term grazing study has been initiated to gain knowledge in managing these sites for sheep production. Developments here included:

1. Installation of 5 permanent exclosures.

2. Construction of sufficient electric fence to control over 100 hectares of fair/good condition range in eight treatment combinations.

3. Development of lodging for CRSP personnel at Corpacancha.

4. Identification of two permanent range field hands, Victor Beraun and Senor Rojas.

5. Organization of the veterinary laboratory at the SAIS with an inventory and minor repairs.

6. A joint project with Ohio State University involving cultivation of 8 hectares of irrigated land. Sheep from the Texas Tech range studies will be transferred to the Ohio ryegrass/white clover pastures during critical times in the production cycle, once these pastures are well established (1982).

Objectives 2 through 4

MS candidate, Brad Wilcox, has been in Peru since July 1980, and has been collecting data on the classification soils and the description of plant communities found on these soils. In addition, he has been clipping vegetation at regular intervals to identify production curves of major grass species. Plans for summer 1981 include an eval-uation of long-term grazing on floristic composition.

With respect to studying range trend and plant succession in the Southern Sierra, the La Raya station has sufficient site variety and grazing impact to allow an interesting study along these lines. The lack of range expertise in IVITA may slow such a study, however, the preliminaries will be initiated during the rainy season of 1980-81.

Objective 5

By the end of September 1981 a full set of wet and dry season data will have been collected along with background and baseline information for both major research sites.

La Raya

The optimum stocking rates for alpaca will be studied on two sites using the same experimental design for both sites. These sites are (1) moderate slopes near the valley bottoms which receive most use during the dry season and, (2) the steep, upper slopes which are most often grazed during the wet season.

Briefly, each site was fenced in April 1981 (electric), to provide four different sized pastures (2, 4, 6, and 8 ha) and permanently stocked with young female alpaca. Adjacent to these pastures are smaller study pastures (about ½ ha) in which the grazing preferences of the local small ruminants will be studied. The impact of grazing alpaca in 48 day/8 pasture rotations will be simulated both in single species treatments and in combination with sheep. Permanent exclosures will also be constructed.

Corpacancha

Over two hundred Corriedale ewe lambs (boreguillas) were selected from a class "B" herd at the SAIS "Pachacutec". These were weighed and distributed among treatments according to the natural stratification which was determined from the weights. Treatments (systems of management) include:

1. Continuous year long grazing at 3 ewes per hectare (control).

2. Rotation: 48 day/8 pasture at 2, 3, 4 and 6 ewes per hectare.

3. Rotation in common use: 48 day/8 pasture at ewes per hectare followed by 0.75 AU of cattle per hectare.

4. Fertilized rotation in common use: 48/day/8 pasture at 5 ewes per hectare followed by 1.0 AU of cattle per hectare.

Baseline data were collected which will allow range trend to be determined at some future time. Utilization of pastures and animal production will be determined bi-monthly. Fertilizer will be applied according to the following schedule:

1. Phosphorus 100 kg/ha/yr (about 500 kg simple super phosphate).

2. Nitrogen 50 kg/ha/4 mo. (108 kg urea).

Objective 6

Permanent exclosures (1 ha) were established at La Raya (3) and Corpacancha (4) using 1 m tall net wire and a single strand of barbed wire.

Objective 7

Research on the nutritional requirements of alpaca depends upon the initiative of Dr. Ricardo Valdivia. Once the forages lab is operating, detailed analyses of forage quality can be made. Horacia Acuna, PhD candidate, was selected to initiate and conduct his research project on the nutrition of free-ranging alpaca.

Objective 8

The range nutrition studies at Corpacancha are headed by Dr. Arturo Flores. He has selected two students to study two aspects of range forage nutritive quality related to clipping height. First, in the field, Luis Bueno will determine the effects of three levels of clipping height during five different phenological stages on five key grasses. Second, in the lab, Nelly Vasquez will measure the quality (proximate analysis, Van Soest) of the regrowth during the five phenostages. She will also determine carbohydrate levels of root samples corresponding to the plants clipped at different heights (simulated levels of use).

Because animal performance is a direct indicator of nutrition, sheep production under the various treatment combinations was monitored. UNA student, Ivan Lares, will determine stocking optima within the rotational grazing system which constitutes the main range management research at the SAIS. Carlos Fierro, PhD candidate was selected to initiate and conduct his research on the nutrition of free-ranging sheep.

Objective 9

Fenced paddocks were established at Texas Tech University during the fall of 1980 and 50 ewes were purchased. Data collection on the impact of stocking rate on diets and vegetation began in April 1981. Mark Gannaway was hired to oversee this research project.

Objective 10

La Raya

Along with studies of alpaca nutrition and range forage utilization at La Raya, studies regarding animal distribution and activity patterns (behavior) are currently being initiated. These studies will serve as the thesis project of Srta. Marina, a veterinary student at IVITA. She began a three month field study in April of 1981. Her studies will include diet simulations of alpaca grazing on two sites at different stocking rates. Her alpaca behavior studies will likely dovetail into the Utah State/Cal Poly studies of male reproductive behavior, headed by Dr. Julio Sumar at the La Raya station.

Corpacancha

A small study was initiated by Dr. Flores which takes advantage of the existent research facilities at Corpacancha. The SAIS has a relatively large (9,000) alpaca herd grazing the highest ranges available there, too high for the production of sheep. Because the poor condition of these ranges reduce alpaca production, an experiment was designed to study alpaca production on the lower "sheep" ranges. The goal in mind was to keep the fiber producing flock on the high ranges while increasing the reproductive capacity of the reproductive females on lower, more nutritive range. Additional research opportunities along these lines include studies on increasing nutritive forage available to these alpaca through strategic use of fertilized range and cultivated forages.

Objective 11

1. Ing. Farfan of IVITA was accepted to work toward his MS in Range Science at Texas Tech University. He will return to Peru to do research at the La Raya station.

2. Drs. Valdivia and Sato of IVITA visited the Texas Tech facilities and other CRSP Universities in March of 1981.

3. Dr. Bryant participated in February in the symposium entitled "Produccion de Ovinos y Vacunos en el Sistema Extensivo de Los Altos Andes." His paper was entitled "Grazing Management on Natural Pasture".

4. Dr. Schlundt has been given "visiting professor" status at UNA and will be teaching range courses filling in for Dr. Flores and Ing. Malpartida.

5. Dr. Schlundt will continue to work closely with the four thesis students who have been chosen to work within the framework of the two TTU-CRSP projects.

6. Horacia Acuna (Peruvian national) and Carlos Fierro (Mexican national) were selected as PhD candidates. Total funding for their projects comes from the Texas Tech Grant.

7. Luis Bueno, Nelly Vasquez, Ivan Lares, Carlos Gutierrez and Srta. Marina were selected by Dr. Arturo Florez and Ricardo Valdivia to work on their projects in their respective Universities. All receive financial support from the Texas Tech component.

9. Technical Accomplishments.

Sufficient data has not been collected at this time to constitute presentation of tabular data. However, two papers were presented and published by the Principal Investigator. On November 10, 1980, the paper "Women in Andean Highland Agriculture with special Emphasis on Advancing Range Management Technology" was given at the Symposium: Developing Nations-Challenges Involving Women, at Texas Tech University. In February 1981, "Grazing Management on Natural Pasture" was given at the Symposium on Sheep and Cattle Production in the High Andes in Lima, Peru.

INTERNATIONAL TRAVEL IN FY 1980-81

Date	Investigator	Destination	Justification
July 1980	Fred C. Bryant	Peru	To accompany Brad Wilcox, MS student to Peru. To work with Peruvian collaborators to plan research projects.
July 1980	Brad Wilcox	Peru	To reside long-term in Peru to collect data for his thesis research project.
July - August 1980	Arturo Florez	US	Attend ASAS meetings. Travel to US Institutions to consult with collaborating scientists and discuss overall project goals and objectives.
August 1980	Al Schlundt	Peru	To reside long-term in Peru to oversee research efforts.
August 1980	B. L. Allen	Peru	To assist Brad Wilcox in identification and classification of soils.
October 1980	John Pitts	Peru	To supervise the initial construction of sophisticated electric fences for long term grazing studies.
November 1980	Diana Wilcox	Peru	To join her husband, Brad, who is on long-term assignment in Peru.
December 1980	Fred C. Bryant	Peru	To participate in the conference of Peruvians, US Principal Investigators and Management Entity.
December-January 1980-81	Al Schlundt	US	To come to US and return to Peru. Work accomplished in US includes travel to Winrock for collaboration there; consult with PI on FY 81-82 proposal, budget, and annual report, purchase and ship equipment.
January 1981	Terri Schlundt	Peru	To join her husband, Al, who is on long term assignment in Peru.

Date	Investigator	Destination	Justification
February 1981	Fred C. Bryant	Peru	To participate in the Symposium "Sheep and Cattle Production in the High Andes". The paper "Grazing Management on Natural Pasture" was given.
February 1981	J. Knox Jones	Peru	As Vice President of Research for Texas Tech University, his mission was (1) to better understand our research goals (2) to meet high level Peruvian Administrative Scientists (3) to strengthen our collaborative effort in Peru by demonstrating Texas Tech's commitment to the SR-CRSP and (4) to obtain first-hand knowledge of the overall project to be able to provide better backstop and support at Texas Tech.
March 1980	Ricardo Valdivia	US	To travel to several US Institutions in the SR-CRSP to strengthen collaborative ties and discuss research projects.

Annual Report Form for 1980/81

(Peru)

1. Institution: The Ohio State University

2. Principal Investigator: Robert W. VanKeuren

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,000
   Matching Contributions from 1980/81 subgrant. $133,126

4. Project Title: Intensive Forage Production Systems for Smallholder Sheep and Goat Producers.

5. 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 previous accomplishments.

The US Principal Investigators have made two trips to Peru and I feel that we have developed excellent working relations with our Peruvian counterparts at UNA. Detailed plans for the irrigated cultivated pastures have been developed and are now being implemented at Pachacutec. In addition several cultivated forage studies have been established. Forage seed for these studies has been sent down to Peru from the US. The Ohio research associate in Peru has provided a great deal of assistance to the Peru collaborators in initiating and conducting these studies, under their guidance. He has also worked on literature review of pertinent material available in Peru that relates to the forage/livestock studies. Plans are proceeding to bring one Peruvian researcher to Ohio State University for graduate study the summer of 1981. Another is getting ready to come a year later. He is being furnished with Ohio SR-CRSP funds for English tutoring in Peru in preparation for his graduate studies. Funds for UNA Ingenerio students are being provided for their independent studies on the forage/livestock project. Funds are being used to provide animals for intake and digestion studies on goats by E. Nolte.

7. Statement of specific 1980/81 objectives.

a. To identify and characterize the cultivated forages available or that have potential in the Andean highlands.

b. 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.

c. To evaluate cultivated grasses and legumes under Andean highland environments and determine yield, seasonality of growth, persistence and nutritive value.

d. To develop cultivated forage/animal production systems that complement or supplement the extensive range forages and evaluate plant/animal response.

8. Description of work undertaken.

Documentation of the importance of gastriontestional parasitism as a major disease in grazing sheep.

Consultation with IVITA scientists indicates helminth infestation is a major disease problem for sheep production in Peru,

a. Languages

(1) Attended Spanish language course at Agr. Tech. Inst., Wooster, R. W. Van Keuren, B. A. Dehority, and R. Cochran, biweekly, April - May, 1980.

(2) R. Cochran, Spanish tutor, Lima, fall-winter, 1980-81. Cochran has become quite fluent in Spanish.

b. Travel activities

(1) May 17-31, 1980, R. W. Van Keuren and C. F. Parker visited Peru.

a. May 19 met UNA staff and toured facilities.

b. May 20 met IVITA staff and toured facilities.

c. May 21-23 visited IVITA Research Station at Huancayo and the Central de Cooperativas Agrarias Communales, Ayaracra Unit, near Cerro de Pasco. The latter was the site selected earlier by the UNA resarchers for the range and irrigated pasture studies for Texas Tech and Ohio projects.

d. May 26-29 visited IVITA Alpaca Stations at LaRaya, the New Zealand alfalfa-orchardgrass sheep pasture studies north of Puno, and several small farm operations.

e. May 30 meeting of A. Florez, M. Carpio, G. Parodi, F. C. Bryant, C. F. Parker, and R. W. Van Keuren to draft research plans for studies on range and irrigated cultivated forages at Ayaracra.

(2) July 16, 1980, Robert Cochran, Res. Associate, left for Peru.

(3) August 3-4, 1980, A. Florez and M. Carpio visited Ohio, toured facilities and further discussed and developed research plans for Peru.

(4) August 1980, establishing irrigated pastures at Ayaracra, field preparation, 30 ha, and development of irrigation ditches.

(5) August 22, 1980, Cochran and others of the US group had to leave Ayaracra because of occupation of the SAIS by campesinos.

(6) September-November 1980, development of plans for cultivated pasture studies at SAIS Pachacutec, including seedbed preparation (approx. 10 ha).

(7) December 8-18, 1980, second visit to Peru by R. W. Van Keuren and C. F. Parker.

(a) December 10-12 visited SAIS Pachacutec with A. Florez and E. Malpartida, new site for range and cultivated forage studies.

(b) December 15-16, joint seminar of UNA, IVITA, and US SR-CRSP groups on sheep, alpaca, and goat production in Peru. R. W. Van Keuren discussed cultivated forages.

(c) December 14 and 16 meeting of US SR-CRSP group in Peru and Site Coordinator.

(d) December 14, meeting of Texas Tech, Ohio, and UNA group to discuss project and plans for research.

(8) January 15, 1981, Florez, Malpartida, and Cochran established cultivated forage grass and legume evaluation study at Pachacutec, with 25 entries.

(9) January 15, 1981, Florez, Malpartida, and Cochran established study on effect of nitrogen fertilizer on the several legume-grass mixtures that will be used in the grazing studies at Pachacutec, including eight mixtures, each of two nitrogen levels (0 and 50 kg N/ha/harvest).

(10) March 10-12, 1981, R. Valdivia and A. Sato, IVITA, visited Ohio, toured facilities and discussed research.

9. Technical Accomplishments.

We have only been in Peru since July 1980, too short a period to obtain results from forage-livestock studies. It takes considerable time to establish cultivated forages and then to subsequently evaluate them with livestock. We lost time also because of the campesino uprising at the Ayaracra site which forced us to move to another location.

The major accomplishment has been to develop collaborative projects with Peruvian counterparts and to initate studies. Another has been to learn about the agriculture of the country, and its needs for research. There will, of course, be on-going activities. Our purpose is to collaborate with the Peruvian researchers, to support them in research pertinent to Peru, and provide any training to achieve that goal.

Annual Report Form for 1980/81

(Wooster, Ohio)

1. Institution: The Ohio State University

2. Principal Investigator: Robert W. VanKeuren
3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,000
   Matching Contributions from 1980/81 subgrant. $133,126

4. Project Title: Intensive Forage Production Systems for Smallholder Sheep and Goat Producers.
5. 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 previous accomplishments.

Studies have been initiated to evaluate the conditions for gastrointestional parasitism as a constraint for improving small ruminant production through the use of intensive forage production. Biological variables are being evaluated as a basic approach for establishing non chemical methodologies to control gastrointestional parasitism. Factors being studied include age, previous contact with parasites, peripartorient response, genotypic variation and diet quality. Efforts to date have been in Ohio where greater control and more objective evaluations are possible. Findings will be utilized in the evolvement of grazing management systems at the on-site locations.

7. Statement of specific 1980/81 objectives.

   (a) Study various physiological and hematologic parameters as indicators of helminth resistance. These will include histocompatibility antigens, hemoglobin types, hematology measures, fecal egg counts with wool and animal to growth (weight) change.

(b) The relationship between breed and the magnitude and duration of periparturient rise will be studied.

(c) Lambs of various ages and breeds will be exposed to both experimental and naturally acquired infections to determine the importance of these factors on the degree of parasitosis.

(d) Experimental mating will be continued to expand the existing hair sheep populations and their crosses with indigenous types.

8. Description of work undertaken.

(a) Studies involving lambs and adults under experimental and natural infestations indicate important breed differences exist for resistance to gastrointestional parasitism.

(b) Breed type comparisons.

(c) Various physiological and hematologic parameters have been studied in an attempt to establish more objective markers of helminth resistance.

9. Technical Accomplishments.

Studies involving White Hair (St. Croix), Barbados Blackbelly, Florida Native and indigenous type lambs have shown non significant breed variation in young lambs from experimental primary infections of Haemonchus contortus. However, there were significant differences subsequently among these types from secondary infection administered artificially. Age and primary infection appear to be of importance in parasite resistance. Considerable variation among different breed types of adult age ewes has been determined during the non pregnant grazing periods.

Hemoglobin type was not related to the magnitude of gastro-intestional infestation of lambs experimentally infected.

Blast cell transformation studies were conducted utilizing antigens from L_3 larve and adult Haemonchus contortus.

Stimulation indices were not related to the level of adult or larve infestation.

Findings to date indicate important viotic factors are associated to the occurence of gastrointestional parasitism of sheep. Integration of parasite control strategies should improve the efficiency of intensive animal-forage production systems.

US/AID Title XII Small Ruminant CRSP
Annual Report for 1980/81

1. Institution: Utah State University

2. Principal Investigator: Warren C. Foote

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $65,710
   Matching Contributions from 1980/81 subgrant. $30,196

4. Project Title: Improving Female Reproduction Performance of Small Ruminants in Least Developed Countries (Peru)

5. 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 previous accomplishments.

Work Undertaken:

The first trip to Peru was in February, 1980. At that time we identified Peruvian co-Principal Investigators, and developed research and training protocol. We were invited to submit a project to be included in MOU that was just being signed. This was done. We agreed on specific research objectives and procedures with sheep and camelidae. We agreed to work in the Southern Altiplano (La Raya) and in Central Sierra. We agreed to help establish a RIA Laboratory at UNA as a part of their Radio Isotope facilities. At their suggestion we agreed to hold a short course on "Management for Reproduction" during the next year. Research with goats was discussed but our resources were too limited at that point to undertake such research.

7. Statement of specific 1980-81 objectives.

   a. To establish an advanced graduate student or a person with a PhD degree in Peru to represent the reproduction component.

   b. To complete an agreement with SAIS Tupac Amaru and SAIS Cahuide to conduct research on sheep.

   c. To develop experimental design, identify and tag experimental animals and initiate research in late March or April 1981 on reproduction capabilities in the Criollo, Corriedale and Junin breeds of sheep and in alpaca at the two SAIS's and at the La Raya station.

   d. To hold a short course for technicians on "Management for Reproduction" during the next year.

   e. To work to establish cooperative links with other SR-CRSP components in reproduction related programs.

   f. To undertake development of a functional RIA laboratory.

   g. To provide equipment essential to the conduct of the research.

   h. To identify Peruvian persons to receive graduate training in the United States.

   i. To conduct research and develop/identify research procedures at Utah State University to support work in Peru.

8. Description of work undertaken. (Listed by objectives in item No. 7)

   a. Dr. Gary E. Sides (PhD Wyoming, 1980) with training in physiology and endocrinology of reproduction and experience with RIA procedures joined the Animal Science faculty at Utah State University as a Research Assistant Professor on October 1, 1980. He will live in Peru and work on both female and male reproduction through September 1982. He came to Peru with some knowledge of Spanish and is continuing to study the language.

   b. Agreements have been completed for cooperative research with SAIS Tupac Amaru and SAIS Cahuide. They are contributing sheep, pasture, research laboratory facilities and some labor to the cooperative research.

   c. Experimental designs have been completed jointly by all cooperating scientists (W. Vivanco, C. Novoa, J. Sumar, G. Sides, E. A. Nelson, and W. C. Foote) for research in sheep (Criollo, Corriedale, and Junin) at SAIS Tupac Amaru, SAIS Cahuide in the Central Sierra and sheep and alpaca at La Raya (IVITA) in the Southern Altiplano (copy attached). Research animals have been selected and tagged (870 female sheep and 80 alpaca). Research facilities are nearing completion (renovating, fencing) and data collection will begin in April, 1981.

d. A short course entitled "Management for Reproduction" was held at IVITA (Lima) from March 9-13. Twenty-six (26) participants representing seven (7) universities, three (3) SAIS' and one (1) cooperative received Certificates of Completion. The short course was coordinated by Cesar Novoa. Instructors were C. Novoa, G. Sides, E. Nolte, M. Gamarra, E. A. Nelson, and W. C. Foote.

e. A standardized Reproduction Data Collection Form for gathering information on reproduction was developed and circulated throughout the SR-CRSP. In Peru arrangements are being made to cooperate with Montana (Breeding) and Winrock (Sociology). Other types of co-operation are also being investigated.

f. An inventory of equipment available at UNA (La Molina) and IVITA (San Marcos University, Lima) that is essential to establishing a RIA laboratory has been completed by Gary Sides. A shortage of some major pieces of equipment, in addition to software and supplies and reagents exists. The cost of providing the equipment is far more than anticipated and than can be provided by the reproduction component. Sources of equipment are being sought and a new time table for development of the laboratory is being made.

g. Critical items of equipment have been provided for conduct of research. This includes sheep restraining devices for laparotomy and laparoscopy (laparotomy cradles), surgical instruments, laparoscope, and electro-ejaculator. The La Raya Station has been attempting to get a laparoscope for several years and now that we have one there Julio Sumar, its Director, has declared 1981 to be "The Year of The Laparoscope".

h. Cesar Novoa and Walter Bravo have been selected for graduate work at Utah State University in female reproduction. Cesar Novoa will begin his PhD program at Utah State University in September, 1981 and Walter Bravo will begin his MS program in September, 1982. Research for both degrees will be conducted in Peru.

i. Research conducted at Utah State University on reproduction supports programs in both Peru and Brazil, but are more closely related to genotypes in Brazil and are being reported there. Research techniques and equipment relating to determining ovulation rate, developed or identified at Utah State University, such as laparotomy and laparoscopy have been provided to Peru.

In addition to the above items the following relevant activities were completed or are in progress.

(1) W. C. Foote visited Peru two times (August 28 - September 13 and March 5-20). He entered into site visits and selections for research, development of experimental design and procedures for research to be conducted, demonstration and training in use of research equipment, and consulted with IVITA on related programs and training activities.

(2) Two scientists presented invited papers in a Symposium on Cattle and Sheep Production in the High Andes, sponsored by the National Agrarian University. Dr. Gary Sides presented a paper entitled "The Effect of Nutrition on Reproduction" and Dr. Julio Sumar presented a paper entitled "Reproduction Physiology in Bulls and Rams".

(3) Cesar Novoa has participated in two international programs sponsored by FAO. The first was a conference in Rome (July, 1980) on Management and Conservation of Animal Genetics Resources where he presented a paper entitled "Management and Conservation of South American Cameloids". The second was a preliminary or planning conference held in India dealing with draft animal power (February, 1981). He has also written a chapter on alpaca and llamas for a book on domesticated animals, edited by Ian Mason and published by Longon-Green.

(4) William Vivanco is participating in an eight week training program in Australia on Radio Immuno Assays sponsored by the International Atomic Energy Commission. Victor Leyva received a diploma and also a MS degree in Animal Science (Sheep Production) from Lincoln College, Agriculture University, Canterbury, New Zealand.

(5) The scientists in reproduction have undertaken writing a review of the status of reproduction and reproductive performance in small ruminants in Peru. This will include sheep, cameloids, and goats. Special consideration will be given to reproductive physiology and endocrinology in cameloids. The major purpose of the review is to establish the state of the art for reproduction in these species at the beginning of the SR-CRSP. Publication is anticipated.

(6) At the request of Enrique Nolte, W. C. Foote and E. A. Nelson visited a farm (granja Geneguilla or Geneguilla farm) that may be assigned to UNA for research with goats, sheep and cuyes.

(7) E. A. Nelson along with other SR-CRSP persons visited North Coastal goat production areas (Piura) to observe goat production and to investigate the feasibility of a goat research component to the CRSP. At the request of the Site Coordinator, Benjamin Quijandria, Nelson and Foote prepared a proposal on reproduction for inclusion into an overall proposal on goat research for possible submission for contingency funding by the SR-CRSP.

9. Technical Accomplishments.

There are no technical accomplishments to be reported in terms of data collected. The planned research is scheduled to begin in April 1981. The first technical data will be reported in the 1981/82 report. Other pertinent accomplishments have been reported under item No. 8, description of the work undertaken. The reproduction project was approximately six (6) months late getting started due to earlier intentions to work in Morocco. The above schedule is the one planned on our first visit to Peru in February, 1980.

Annual Report Form for 1980/81

(Peru)

1. Institution: California State Polytechnic University, Pomona

2. Principal Investigator: Edward A. Nelson

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $100,000.
   Matching Contributions from 1980/81 subgrant. $90,456.

4. Project Title: Improving Reproductive Capability of Small Ruminants in LDC's with Emphasis on Male Reproductive Physiology

5. Project Goals:

   I. To develop methods to improve the capability of collecting, processing, storing and transporting viable sheep and goat semen to selected LDC locations.

   II. To measure the reproductive potential of selected small ruminant male genotypes in the United States and Peru. To coordinate the relative influence of males as compared to females in solving reproductive problems in developing countries.

   III. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.

   IV. 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 previous accomplishments.

   Objective I - Accomplishments to 30 May, 1980.

   a. Facility development at Cal Poly from non Title XII funds. These include buck housing facility and the development of a moderately equipped semen research laboratory (only two major pieces of equipment were purchased using Title XII funds).

   b. Literature was reviewed.

   c. Research was initiated to evaluate various extenders, the use of washing semen, different freezing times and evaluation techniques for determining the effects of treatments. Abstracts of papers to be presented at the Western Section ASAS, 1980,

indicating the results obtained from these initial studies, may be obtained from the Management Entity Office upon request.

Objectives II and III - Accomplishments to 30 May 1980.

a. Research was initiated during this period at Cal Poly that applies to Peru in the following areas to satisfy this objective.

(1) Seasonal variations in both sheep and goat semen.

(2) Body measurements leading to puberty in sheep. The breeds included Rambouillet, Suffolk, St. Croix hair sheep.

No results were available for the previous report.

b. One visit was made to Lima, Peru. Contacts were made and a reproductive component at that site was established.

Objective IV Accomplishments to 30 May 1980.

a. One prospective graduate student was identified. (H. William Vivanco of National Agrarian University, Lima, Peru)

b. A short course outline was developed in cooperation with W. C. Foote to be used to conduct a short course on reproductive physiology at SAIS Tupac Amaru, Central Sierra, Peru.

7. Statement of specific 1980/81 objectives.

I. To establish a cooperative agreement and identify males to study the reproductive characteristics of rams maintained at high elevations.

II. To cooperatively develop and conduct a short course on Reproduction of Small Ruminants, including alpacas.

III. To establish a study to evaluate the relationship of two characteristics of reproductive behavior with reproductive efficiency in alpacas.

IV. To cooperate with other components of the SR/CRSP in measuring the reproductive characteristics of males used in their studies.

V. To provide H. William Vivanco the opportunity to enroll in a graduate program leading to the MS Degree at California State Polytechnic University.

VI. To evaluate the possibility of establishing a male goat reproductive project in Peru.

8. Description of work undertaken.

I. Dr. Gary Sides has been hired as a resident scientist representing both male and female reproductive projects in Peru. After spending one month at both Cal Poly and Utah State University he arrived in Peru, Jan. 1981.

II. A five day short course dealing with reproduction of sheep, goats and alpaca was conducted March 9 - 13, 1981 at IVITA, San Marcos, Peru. Thirty participants representing 7 universities, research organizations and production organizations were included in this course. In addition to W. C. Foote, Gary Sides, E. A. Nelson and Cesar Novoa (cooperator in reproductive physiology), Enrique Nolte, Maximo Gamorra presented materials during the course. Printed materials were generated and translated into Spanish, distributed to participants and are being prepared for publication. Certificates were presented to each successful participant. The success of the short course was evident by the strong positive comments made by the participants.

III. Dr. Gary Sides and one of our cooperating Peruvian scientists Dr. Julio Sumar presented papers at the symposium dealing with cattle and sheep production in the High Andes sponsored by the National Agrarian University at La Molina. Dr. Side's paper was entitled "The Effects of Nutrition on Reproduction", and Dr. Sumar's paper was "Reproductive Physiology of Bulls and Rams". Other of our counterpart scientists have participated in special programs associated with their SR/CRSP responsibility but financed from other sources. These include William Vivanco's two month study trip to Australia relative to Radio-Amino-Assay training and Ceasar Novoa's trip to India and Italy to participate in conferences.

IV. Research on male sheep reproduction has been initiated both in the Central Sierra (at SAIS Tupac Amaru and SAIS Cahiude) and at the La Raya Station. In addition, research on male alpaca reproductive characteristics has been initiated at La Raya. The animals have been identified and tagged. In addition, a proposal for male reproductive studies in goats has been developed and presented to the Site Coordinator to be included in a request being initiated by him.

V. Laboratories for research have been strengthened in the following ways; semen collection equipment and supplies, electroejaculator and spectrophotometer have been added.

VI. H. William Vivanco has visited California State Polytechnic University and has made application for admittance to the graduate program as a candidate for the MS Degree. His program has been outlined and his research is underway as a part of the male physiology of reproduction effort in Peru.

VII. Two trips were made to Peru during this reporting period. During these trips the above activities were conducted. In

addition, other in-country trips were taken by the Principal Investigator and counterpart scientists. These included regular trips to both the Central Sierra and La Raya and special trips taken to evaluate the possible involvement in goat research. Three such trips have been taken by the Principal Investigator with E. Nolte and other representatives of the SR/CRSP in Peru.

VIII. Semen processing and freezing techniques for both sheep and goats is being studied. This is to satisfy the original charge given to Cal Poly to develop a semen bank as a possible source of germ plasm for distribution at overseas locations. The use of various extenders, freezing rates and evaluation methods have been studied. (Refer to abstracts of papers given at Western Section ASAS).

9. Technical Accomplishments.

I. The papers that were presented at the Western Section ASAS indicate results on specific facets of sheep and goat semen dilution, and processing and evaluation.

II. Fifteen male sheep were allotted to treatments of 0, 15, 30 percent jojoba meal to test the effect of simmondsin on male reproduction and growth. Treatment lasted 104 days. Weights were taken at 7 day intervals with semen being collected using the artificial vagina on a twice a week schedule. Volume, concentration and percent progressive motility were used as the measurement of semen quality. Two rams from each treatment group were sacrificed at the end of the experiment to evaluate any effects on internal organs. After the initial two to four weeks on the experimental diets, weight gains and feed consumption were very similar with the control group gaining slightly more followed in order by the 15 percent and 30 percent groups. Overall average daily gains were .52, .50 and .38 respectively for the control, 15 and 30 percent groups. There appeared to be no differences in semen characteristics or tissues that could be attributed to the level of jojoba meal in the diet.

III. Growth and reproductive measurements have been taken on three breeds of sheep (Rambouillet, Suffolk and St. Croix hair sheep) from age 4 to 5 months of age. Table Number 1 indicates the body weight and testis measurements for the above breeds at 12 months of this trial.

Table 1
Average Body Weights and Testis Measurements
of Three Breeds of Sheep at 12 Months of Age

Breed	Body Weight Kg	Scrotal Circumference cm	Testis Length cm	Scrotal Volume ML
Rambouillet	84	30.7	11.3	982
Suffolk	79	33.3	11.3	1035
St. Croix	49	29.8	11.6	755

It should be noted that scrotal circumference tends to be a more consistant measurement of the size of the testis than is scrotal volume as measured by water displacement. These data indicate that though the relative size of the St. Croix hair sheep is much lower, the scrotal and testis measurements are very similar for three breeds included in the study.

Table 2
Comparison of Testicular Circumference
and Semen Measurements of Three Breeds of Sheep for
a Three Month Period

Breed	No of Ejaculates	Average Volume ml.	Average Concentration X 10^9/ml.	Avg. Initial Motility percent	Aver. Scrotal Circumference cm.	Aver. no of spermatozoon X 10^9/ejaculate
Rambouillet	50	1.27	2.80	57.9	30.7	4.01
Suffolk	47	.80	2.30	35.1	33.3	1.80
St. Croix	39	.70	2.64	56.0	29.8	2.02

Annual Report Form for 1980/81

1. Institution: Colorado State University

2. Principal Investigator: James C. DeMartini

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $200,000
   Matching Contributions from 1980/81 subgrant. $66,667

4. Project Title: An Investigation of Small Ruminant Health Problems

5. 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:

   1. Determining the causes and prevalence of infections and non-infectious diseases of these species in smallholder production units as well as large cooperatives in Peru.

   2. Conducting research on the etiology, pathology, immunology, epizootiology, and diagnosis of chronic respiratory disease of sheep and clostridial enterotoxemia of alpaca, two disease syndromes of particular importance to Peruvian livestock production.

   3. Developing new methods for the diagnosis and control of these conditions based on the findings in Objective 2.

   4. Performing studies on the etiology, serology, or vaccines necessary to control such diseases as ram epididymitis, leptospirosis, toxoplasmosis, fascioliasis, or alpaca fever.

   5. Providing opportunities for advanced training of veterinarians interested in disease investigation.

   6. Promoting the exchange of ideas between US and Peruvian scientists.

   7. Enhancing the dissemination of research findings to Peruvian officials and lay personnel concerned with disease control in small ruminants and cameloids.

6. Summary of previous accomplishments.

   Following a site visit to Peru by Colorado State University (CSU) personnel in August, 1979, a collaborative research program on diseases of sheep and alpaca was established between scientists from CSU and IVITA, a veterinary research institute of the Peruvian government also affiliated with San Marcos University. Facilities, equipment and personnel as well

as disease mortality reports and current veterinary research were reviewed and evaluated at the IVITA stations at Lima, Huancayo, and La Raya as well as a large cooperative, SAIS Tupac Amaru. On the basis of these findings, chronic respiratory diseases of sheep, clostridial enterotoxemia of neonatal alpaca, and ovine ram epididymitis were targeted for intensive study. Further epizootiologic studies of these and other disease problems of the small producer also were suggested. On-going research at CSU relevant to these goals included enterotoxemia in lambs, Brucellosis in rams, colostral antibody transfer, and immunologic approaches to disease diagnosis.

7. Statement of specific 1980/81 objectives.

   1. Develop detailed research plans for work on chronic respiratory disease in sheep, ram epididymitis, and enterotoxemia of alpaca.

   2. Train two Peruvian scientists in new research techniques applicable to these problems at Colorado State University.

   3. Identify equipment in need of repair or replacement and facilities in need of renovation at Peruvian research sites.

   4. Initiate research projects in Peru relating to diseases listed in Objective 1 above.

   5. Continue and expand sheep disease research activities at CSU directly related to diseases listed in Objective 1.

   6. Select two graduate research associates to be assigned to this project.

8. Description of work undertaken.

In May, 1980, J. C. DeMartini and L. H. Lauerman traveled to Peru to initiate research projects for the CRSP. Drs. E. Caletti and A. Ramirez of IVITA were identified as primary collaborating scientists for the sheep chronic respiratory disease and alpaca enterotoxemia projects, respectively. Detailed lists of equipment needing repair were prepared and training sessions in clostridial toxin identification were held.

Drs. D. Huaman (enterotoxemia project) and E. Caletti (chronic respiratory disease) spent the months of July and August, respectively, in the US engaged in training in new research techniques and development of detailed research plans with US Collaborators. Dr. Caletti also spent one week at the National Animal Disease Center in Ames, Iowa.

Drs. John Ellis and Antonio Ramirez, American and Peruvian veterinarians, respectively, were selected as research associates for this program . Dr. Ellis' program on chronic respiratory disease of sheep was initiated in September, 1980. Dr. Ramirez will begin studies at CSU in January, 1982 and he will conduct research on enterotoxemia-associated toxins in Alpaca.

In January 1981, Dr. J. C. DeMartini and S. P. Snyder traveled to Peru to conduct research on ovine respiratory disease. Over 40 sheep with this condition originating from a large cooperative or small producers were necropsied and samples collected for histopathology, ultrastructure, serology, and tissue culture. Dr. L. H. Lauerman in the same month traveled to La Raya, Peru to collect data on alpaca enterotoxemia with his collaborators. Dr. John Reif, a veterinary epidemiologist from CSU spent one month in Peru establishing an epizootiology project. Several seminars and training sessions were given at IVITA, SAIS Tupac Amaru, and La Raya.

At Colorado State University, ELISA assays were developed for Brucella ovis and toxins of Clostridium perfringens. Antisera to several of these toxins were prepared and tested. A field study to evaluate diagnositic tests for ram epididymitis was undertaken. Two strains of chronic progressive pneumonia virus were studied in tissue culture in an effort directed toward developing new assays for quantitating virus and serum antibody titers specific for viral antigens.

9. Technical Accomplishments.

A. Equipment purchased or repaired for laboratories in Peru.

Because of inadequate funding for laboratory equipment maintenance and renewal at IVITA laboratories in Peru during the past decade, a major effort was required to bring these facilities to the standards required for this study. After a thorough survey of the needs at San Marcos University, Huancayo and La Raya, the following list was made:

Location	Item	Cost
IVITA-Lima	Laminar flow hood	$4,000*
	Carbon dioxide incubator	2,400*
	Water distiller	1,175*
	MSE centrifuge repairs	400
	Ultralow freezer repairs	1,000
	Autoclave repairs	1,500
	Sorvall centrifuge repairs	400
	Incubator repairs	200
	Centrifuge head-SS-34	900
	Clinical centrifuge	500
	UV microscope repairs	200
	UV spectrophotometer repairs	200
	Water bath	300
	Coldroom compressor	2,000
	Lab animal cages	1,000
	pH meter repairs	150
	Vortex mixer	500
	Microscope	3,000
	Slide projector	300
	Microscope-darkfield condenser	400
	Vacuum pump	350
	Millipore filtration system	350

Location	Item	Cost
	Microtiter diluters, pipette, reader	400
	Automatic Syringes	100
	Microscope repairs-Olympus	1,000
	Atomic absorption modules	800
	Subtotal	$23,225
IVITA-Huancayo	Freezer	1,000
	IEC centrifuge repairs	100
	Autoclave repairs	100
	Water distiller	500
	Subtotal	$1,700
IVITA-La Raya	Anacrobe chamber	4,800*
	ELISA reader	1,500*
	Vacuum pump repairs	200
	IEC Centrifuge repairs	200
	Autoclave repairs	300
	Water distiller	500
	Water bath	400
	Incubator repairs	100
	CO_2 and nitrogen tanks	1,200*
	Subtotal	$9,200
All laboratories	Glassware, filters, media syringes and other supplies	$8,000*
	Grand Total	$42,125

All items marked with an asterisk (*) have been purchased in US, shipped to Peru and installed. Remaining new equipment purchases and repairs are currently underway.

B. Chronic Respiratory Diseases of Sheep

Research and training were instituted for this project in 1980 both at CSU and in Peru. After Dr. DeMartini's trip to Peru, Dr. Caletti came to CSU and the National Animal Disease Center (NADC) in Ames, Iowa for research training and planning.

Work at CSU has been directed toward the virology and immunology of Chronic Progressive Pneumonia Virus, (CPPV) a disease of significance in Peru. Two strains of CPPV were obtained from Dr. R. Cutlip, NADC. Attempts to culture the virus in various cell types gave the following results with CFE being syncytia formation (6-30 nuclei) after passage of the cells 2 to 3 times.

Cell Type	CPE
Fetal ovine lung	+++
Fetal ovine cornea	+++
Ovine skin fibroblast	++
Monkey kidney ($LLC\text{-}MK_2$)	+
Pig kidney (PK_{15})	-
Bovine fetal spleen	-
Mouse myeloma (Balb/c)	-
Chinese hamster ovary	-

Efforts to recognize virus in these cultures included negative contrast EM on several different preparations and Ouchterlony immunodiffusion on cell supernatants and monolayer extracts. Thus far these results have been negative. Another approach was to make a glucose oxidase conjugate of CPPV antisera but this has not yet been tested for its ability to detect the virus in tissue culture or in animal tissues. Technology for producing monoclonal antibodies has been developed in Dr. Pearson's laboratory and will be applied to this problem.

Work in Peru was initiated in January 1981 when Drs. DeMartini and Snyder went to Peru. In collaboration with Dr. Caletti and his staff, 40 sheep were necropsied, sera from 46 sheep were tested for antibody to CPPV, and sera from 51 goats were tested for CAEV, a related retrovirus. Sera of 16 of 46 sheep from the Pachacayo area were positive by immunodiffusion for CPPV but none of the goat sera collected at the slaughter house were positive for CAEV.

The necropsy data and serologic data indicate that, as expected, sheep pulmonary adenomatosis (SPA) is an important cause of respiratory disease in sheep and in addition, CPPV is present. The latter disease is widely prevalent in the U.S. but has not been previously described in South America. Therefore, further studies are required to determine the contribution of each to chronic respiratory problems of sheep in small holder's flocks as well as large cooperative units. A serologic assay is needed for SPA as the only currently available method for confirming the diagnosis is necropsy examination.

C. Epidemiologic Studies.

Epidemiologic studies were added to the project in 1980. During the time spent in Peru in January 1981, two specific epidemiologic studies investigating the prevalence of economically significant disease of sheep which occur worldwide were initiated. These diseases are leptospirosis and toxoplasmosis. Work on these projects commenced during the early part of 1981.

Several approaches were taken in an attempt to ascertain the causes of mortality in the Peruvian sheep population. The first was an examination of the records from a large cooperative (SAIS Tupac Amaru). It was determined that the data collected by the SAIS were adequately reliable to be utilized for that specific population. The second approach to assessing mortality rates in Peruvian sheep involves the utilization of national slaughterhouse data. Some information may be present at a

regional level, but it is likely that visits to individual slaughterhouses and extended periods of observation will be required to accumulate meaningful data. A third approach which was evaluated was to conduct personal interviews of smallholders. We believe that important data may be obtained by field necropsy surveys which are currently in progress.

D. Ram Epididymitis Project

An ELISA technique was developed for use in assessing the levels of Brucella ovis antibodies in ram semen. The test appears to be highly sensitive and specific for the identification of B. ovis antibodies. Due to its specificity and sensitivity, this test may prove useful for detecting early cases of B. ovis infection.

Studies were conducted to evaluate the use of chlortetracycline for clearing rams infected with B. ovis. 48 rams with growth lesions typical of B. ovis infection were use for this study. Data are not complete regarding clearing of infected rams and antibody titers, but it is anticipated data will be useful in suggesting treatment procedures for B. ovis infected rams.

E. Bacterial Diseases of Young Alpaca and Sheep

Clostridium perfringens were isolated, identified, and serotyped as Type A from the intestinal contents of lambs that died with characteristic signs of enterotoxemia from Colorado, Wyoming, and Idaho. Spores of C. perfringens were demonstrated in the intestinal contents of lambs that died of enterotoxemia by stain and the heat shock procedure. The isolated C. perfringens were serotyped as Type A. C. perfringens was isolated from a case of enterotoxemia of a 9 day old alpaca cria in Peru this January, 1981.

Three ELISA tests have been developed for detection of animal species-specific antibodies to alpha toxin, enterotoxin and epsilon toxin of C. perfringens. Antiserum to beta toxin is being produced in rabbits at the present time and will be used to develop an ELISA test to detect antibodies and antigens to the C. perfringens beta toxin. An ELISA test is being developed and evaluated for detection of C. perfringens enterotoxin in the intestinal contents of animals. The crude epsilon toxin product is being partially purified by column chromatography to determine if increased sensitivity can be obtained with a purer toxin as test reagent.

A preliminary experiment was performed to study the disease pathogenesis in newborn lambs. The objective of the experiment was to determine if alpha toxin and/or enterotoxin administered orally (separately or in combination to newborn lambs) would cause disease. Two lambs were given 62.5 units each of alpha toxin orally, 2 lambs received 1 microgram each of enterotoxin orally and 2 lambs received 62.5 units each of alpha toxin and 1 microgram of enterotoxin orally. One newborn lamb composed a fourth group, and it received intestinal contents from a field of enterotoxemia. The lambs did not exhibit any clinical signs of disease during the 24 hour observation period. A more extensive study of the

disease pathogenesis will be perfomed on alpaca in Peru by Dr. Antonio Ramirez. Dr. Ramirez will come to Colorado State University in 1982 for graduate studies, and continue studies on the disease pathogenesis in newborn lambs as his thesis problem.

Alpha-Enterotoxin hyperimmune serum was produced in cooperation with Colorado Serum Company. A preliminary field trial was inititiated in the spring of 1980 in a large (12,000 ewe) lambing operation in Wyoming. There were cases of enterotoxemia during the week prior to the beginning of the trial. However, after initiating the trial, the enterotoxemia cases did not persist, and a conclusion could not be made concerning the efficacy of the hyperimmune serum in prevention of the disease. A field study is again planned to be perfomed during the spring lambing period of 1981. An evaluation of the hyperimmune serum is also planned during an outbreak of enterotoxemia in alpaca at La Raya Station in Peru.

During the next project year, the scope of this section of the project will be broadened to include other bacterial problems in young sheep and alpaca. E. coli and Streptococcus zooepidemicus will be two of the bacteria which will be emphasized in future studies. This portion of the project will be directed in the future by Dr. Robert P. Ellis, who is replacing Dr. Lauerman who has left Colorado State University.

SR-CRSP

Annual Report Form for 1980-81

PERU

1. Institution: University of Missouri-Columbia

2. Principal Investigator: Michael F. Nolan

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980-81 subgrant. $253,333
   Matching Contributions from 1980-81 subgrant. $91,727

4. Project Title: Sociological Analysis of Small Ruminant Production Systems.

5. Project Goals:

   1. To describe the social organization of sheep and alpaca production in the highland areas of central and southern Peru.

   2. To document the agro-pastoral interaction that occurs in Andean communities.

   3. To examine how different agricultural production organizations (eg, SAIS, CAPS) compare with traditional communities in terms of strategies toward and organization of agricultural production.

   4. To understand the place that animals occupy in Andean Society.

   5. To document the external forces (eg, governmental policies, access to credit, marketing problems) that restrict the options of small producers.

   The ultimate goal of the project is to be able to:

   1. Understand the economic calculus (the source of rationality) of small producers and the contraints under which they operate.

   2. Understand who among the overall population of livestock producers will benefit from technological change.

   3. Anticipate the problems which will emerge with the implementation of new technology on a large scale.

6. Summary of previous accomplishments.

   The program in Peru was initiated in February, 1980. Prior to that, some activities were undertaken among them an extensive review of the literature related to sheep and camelid production in the Andean highlands

and a Symposium on Andean Peasant Economics and Pastoralism which was hel at the University of Missouri-Columbia on January, 1980. The Symposium proceedings plus a supplementary bibliography were published in June 198(and are available on request.

7. Statement of specific 1980/81 objectives.

   1. Complete study of the distribution of sheep and alpacas in the southern Andean highlands.

   2. Complete preliminary observations on the organization of highland households engaged in sheep and alpaca production.

   3. Begin study of the dynamics of community control of public grazing lands.

   4. Begin study of past attempts to introduce range management practices in the Peruvian highlands.

   In addition, it was anticipated that a Peruvian student would be identified for graduate training and begin his/her studies this year. Also, it was expected that the literature review undertaken in previous years would be continued during this year.

8. Description of work undertaken.

   Objective 1 - Animal Distribution: Three different projects sought census and distribution data on alpaca and sheep populations in the southern highlands. One project obtained population data in the department of Punc for both sheep and alpaca. A second project undertook to enumerate the sheep and alpaca populations of the districts of Langui, Layo, and El Descanso in the province of Canas of the department of Cusco. The third project gathered official animal census figures at the district level for the department of Cusco and for selected districts in the department of Apurimac. The same project also identified the major production areas which supplied the city of Cusco with mutton.

   Objective 2 - Household Production: Five different projects have sought to obtain this information. At this point two of the projects have been completed, while the other three are still in progress. One of the completed projects offers detailed and extensive descriptions of pastoral household organization in the community of Usi, district of Quiquijana, province of Quisrpicanchi, in the department of Cusco. The other completed project obtained household information in the community of Tocra, district of Colquepata, province of Paucartanbo in the department of Cusco. The three projects in progress also are obtaining information on household organization. These projects are taking place in the departments of Cerro de Pasco, Junin, and Ayachucho.

   Objective 3 - Grazing Control: The main project for this objective is nearly completed. It is centered in the community of Tocra. A second project, to take place in the department of Ayachucho, has as its main aim

to replicate the Tocra study in a community which is much more pastoral in character and thus will help in evaluating the "representativeness" of the Tocra data. The other two projects mentioned in Objective 2 located in the departments of Cerro de Pasco and Junin, will also attempt to obtain some information on this topic. One of those, in addition, will examine issues involved in recent land invasions in the Central Sierra.

Objective 4 - Range Management: The main portion of this project has been completed. A survey of range/pasture research and development projects in the southern and central Andean regions of Peru was completed in March. In addition, a Sociologist (Dr. Jorge Flores) and a range scientist (Dr. Mario Tapia) are presently conducting a survey of range conditions and traditional range management systems in Southern Peru. This work should be completed by December, 1981.

Objective 5 - Training: A Peruvian student has been identified for MS training, and has been admitted to our Graduate Program. We expect her to begin in June, 1981.

In addition to the stated objectives in our plan of work for this year, some additional projects were also undertaken.

1. The Sociology project provided computer and analysis support to a Peruvian anthropologist (Dr. Juvenal Casaverde) from the Instituto de Estudios Peruanos. The data analyzed consisted of animal population census data for a 25 year period for the community of Vichaycocha in the department of Lima. In addition, the project financed the last stage of his field work (currently underway) which is concerned with the interplay of individual and collective strategies in sheep production.

2. A project has also been completed on the distribution of mutton in the region of Cusco. Data on the origin and other characteristics of the slaughtered animals were also obtained.

3. Finally, it should be noted that the projects underway in the departments of Junin, Cerro de Pasco and Ayachucho were initiated by three collaborating sociologists at the National Agrarian University in La Molina and funded by the Sociology project of the SR-CRSP.

9. Technical Accomplishments.

It is very difficult to briefly summarize the accomplishments achieved thus far in Peru. Our initial efforts have focused on understanding both pure pastoralism systems of production and the less studied agro-pastoral systems. We feel we have obtained numerous intriguing insights into such issues as how communities control and handle their herds, the importance of manure as a by-product of animal production and the role that children and women play in animal herding. Interested persons are encouraged to read the proceedings of the Symposium on "Peasant Economics and Pastoralism" published in June, 1980 and the forthcoming publications by Terry West, Constance McCorkle, and George Primov, all of which have been written and are in the final stages of editing and reproduction. Together they provide a very good descriptive account of many features of small ruminant production which should be of interest to all SR-CRSP projects.

Annual Report Form for 1980/81

(Peru)

1. Institution: Winrock International Livestock Research and Training Center

2. Principal Investigator: A. John De Boer

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $233,333
   Matching Contributions from 1980/81 subgrant. $82,295

4. Project Title: Economic Analyses of Small Ruminant Production and Marketing in Peru.

5. 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 multidisiciplinary 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 inter-disciplinary 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 previous accomplishments.

   Project Year 1 (October 1978 - April 1980)

   (i) International Travel
   - De Boer visited Peru for 1 week, July, 1979. Established relationships with collaborators in Agricultural Economics and inspected Central Sierra research sites.

   - De Boer visited Peru for 4 days, October, 1979 to prepare Phase III Work Plan and consult with counterparts. Also visited Centro Internacional de Agricultura Tropical, Cali, Colombia to visit economists and research stations.

- Domingo Martinez, Peru Collaborator, visited Winrock in January, 1980 on way to attend University of Missouri Symposium.

(ii) Staffing - Mr. Edward Lotterman hired as Research Associate in Agricultural Economics for Peru assignment March 27, 1980.

(iii) Training - Preliminary arrangements made for Domingo Martinez and Corinne Valdivia to attend graduate school in USA for MS degrees in agricultural economics.

(iv) Contract signed with SACI and money transferred to Peru to initiate research activities. A part-time secretary and 6 part-time research assistants were hired and a coordinated set of surveys initiated in the Central Sierra.

(v) Purchase of equipment for Peru project including TI 59 calculator, PC-100C printer, and Rollei A350 slide projector.

7. Statement of specific 1980/81 objectives.

(i) Establish long-term staff member in Peru.

(ii) Initiate a series of coordinated research projects.

(iii) Support and strengthen MS program in Agricultural Economics at Universidad Nacional Agraria (La Molina) through teaching and research activities.

(iv) Begin formal training of Peruvian counterparts in USA.

(v) Continue field surveys on production economics of cooperative sector sheep and alpaca producing units.

(vi) Initiate marketing studies of sheep and alpaca fibers.

(vii) Initiate a very limited survey of the structure of goat production in Peru and identify any research opportunities open to the SR-CRSP.

(viii) Conduct economic analysis on previously collected data sets for range, pasture and animal health research projects.

8. Description of work undertaken.

(i) International travel.

- De Boer. Two weeks in Peru in December 1980 to complete Phase III Work Plan details, work on specific research projects, establish collaborative links with other projects in Peru and participate in SR-CRSP La Molina IVITA seminar.

- Ed Lotterman and family. Moved to Peru in November, 1980. Language training to advance Mr. Lotterman from FS-3 to FS-5 rating in Spanish during June-August, 1980.

- Domingo Martinez and Corinne Valdivia from Peru to Winrock in December 1980 and on to Columbia, Missouri to begin graduate school in January, 1981.

(ii) Short courses, symposiums, seminars - De Boer, Lotterman, Martinez and Echevarria participated in SR-CRSP/La Molina/IVITA Seminar, December 1980.

- Lotterman presented two papers at IDRC Conference on SAIS Ramon Castilla pasture and range improvement project.

(iii) Staffing - In addition to Ed Lotterman, the following have served or are currently serving as research assistants, field assistants, and support staff:

Name	Position	Academic Status
Martha Bernal	Support Staff (Secretarial)	None
Martha Cruces	Research Assistant,	Undergraduate, La Molina
Roxana Diaz	Research Assistant, 1/2 time	Undergraduate, La Molina
Jose Gols	Research Assistant, 1/2 time	Undergraduate, La Molina
Juan Machuca	Research Assistant, 1/2 time	Undergraduate, La Molina
Luis Peralta	Research Assistant, 1/2 time	Undergraduate, La Molina
Jesus Ruiton	Research Assistant, 1/2 time	Undergraduate, La Molina
Ruben Velarde	Research Assistant, 1/2 time	Undergraduate, La Molina
Isabel Luque	Research Assistant, 1/2 time	Licenciatura candidate, La Molina
Armando Espinoza	Research Assistant, 1/2 time	None
Beatriz Santana	Gov't of Peru employee	Zootechnician Huancavelica Dept.
Alfredo Callahuanca	Research Assistant, 1/2 time	MS candidate, La Molina
Percy Vilca	Research Assistant, 1/2 time	MS candidate, La Molina
Teodora Quispealaya	Research Assistant, 1/2 time	MS candidate, La Molina
Gorki Llerena	Research Assistant, 1/2 time	Licenciature candidate, La Molina

(iv) Research projects.

(a) Economics of Cultivated Pastures in the Central and Southern Sierra of Peru. Julio Echevarria, Ed Lotterman, Alfredo Callahuanca.

(b) Production Costs and Resource Productivity in Three Alternative Sheep Producing Enterprises. Domingo Martinez, Juan Machuca, Jesus Ruiton, Roxana Diaz, Ruben Velarde, Luis Peralta.

(c) Social Obligations and Capital Investments in Two Types of Sheep Enterprises. Corinne Valdivia, Juan Machuca, Jesus Ruiton, Roxana Diaz, Ruben Velarde, Luis Peralta, Martha Cruces, Jose Gols.

(d) Marketing Activities for Sheep and Alpaca Wools by Different Marketing Agents in Peru. Isabel Luque, Vilma Gomez, Juan Machuca, Ruben Velarde.

(e) Resource Use on Peasant Farms and Profitability of Small Ruminant Activities. Domingo Martinez, Beatriz Santana, Ed Lotterman, Armando Espinoza.

(f) Technology Transfer for Sheep and Alpaca Production. Julio Echevarria, Ed Lotterman, Percy Vilca, Teodore Quispealaya.

(g) Market Models of Alpaca Price Formation. Julio Echevarria, Gorki Llerena, Ed Lotterman.

(h) Use of Automated Accounting Techniques for Improving Public Sector Ranch Decision Making. Julio Echevarria, Alberto Bellido, CPA.

(i) Investment Requirements of Small Cooperativa Agrarian Produccion Units and Private Ranches for Implementation of Improved Small Ruminant Technologies. Julio Echevarria, Ed Lotterman.

9. Technical Accomplishments.

(i) Unpublished papers:

- Domingo Martinez, "A Study of Three Sheep Associative Production Units in Pasco Department, Peru," January, 1981, pp. 25.

- Corinne Valdivia, "A Comparative Analysis of Capital Formation in Two Peruvian Highland Livestock Associative Enterprises: Agrarian Production Cooperative (CAP) 'El Diezmo Palcan' and Social Interest Agrarian Society Ramon Castilla," January, 1981, pp. 9.

- Ed Lotterman, "Tecnicas de Investigacion Economica en Produccion Ganadera" paper presented to IDRC workshop on range management in Peru, Lima, February, 1981.

- Ed Lotterman, "Produccion de Ovinos en los Estados Unidas: Problems Antiguos y Technologias Nuevasa, "paper presented to IDRC workshop on range management in Peru, Lima, February 1981.

Annual Report Form for 1980-81

(Peru)

1. Institution: Texas A & M University

2. Principal Investigator: T. C. Cartwright

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $190,000
   Matching Contributions from 1980/81 subgrant. $63,333

4. Project Title: Systems Analysis and Synthesis of Small Ruminant Production

5. Project Goals:

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

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.

2. 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.

3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Peru.

4. To supply input/output data of sheep production systems for use in economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of sheep production systems to alterations or interventions requested or agreed upon by INIA, IVITA and UNA.

6. Summary of previous accomplishments.

One visit was made to Peru by the PI and T. C. Nelson. (1) Dr. Luis Coronado and Dr. Jorge Velasco of IVITA and Alberto Pumayalla of UNA were identified as Co-PIs, (2) arrangements for Luis Coronado to enter graduate training at Texas A&M were made, (3) data collected at the IVITA Montaro Valley station were identified as suitable for initial validation simulations and arrangements for use of these data made, (4) data available from SAIS and cooperatives through UNA were reviewed and preliminary agreements for analysis and use of these data were made, (5) increased understanding of sheep and alpaca production by SAIS, cooperatives and smallholders were gained.

The PI organized and chaired a meeting of all CRSP PIs, co-PIs and interested parties at UNA.

The sheep model was conceptually outlined, programmed and compiled and was communicated to collaborators. Their inputs were incorporated into model design. Development of structural and biological components of the model was begun.

7. Statement of the specific 1980/81 objectives.

1. Complete development of a sheep production systems model.
2. Gain additional understanding of small ruminant production systems in Peru.
3. Finalize agreement of Co-PIs, other collaborators and use of data collected and maintained by IVITA and UNA.

8. Description of the work undertaken.

T. C. Cartwright, J. W. Bassett and G. M. Smith traveled to Peru during December, 1980 to (1) finalize arrangements for Luis Coronado to enter Texas A&M, (2) agreed upon the roles of Co-PIs and Coronado's Co-PI while at Texas A&M, (3) visited Montaro Valley Research Station, SAIS Tupac Amaru, SAIS Pachacutec, and UNA Fiber Laboratory to determine data that have been collected, suitability of the data for system analysis validation and simulation, and availability for use by the systems analysis PI, Co-PIs and other collaborators.

Arrangements were made for J. W. Bassett to work A. Pumayalla during May and June of 1981 to develop an alpaca fiber classification system that will more accurately and consistently identify alpaca mohair classification since mohair and alpaca are processed by similar methods into similar fabrics.

Luis Coronado entered Texas A&M University in January, 1980 for a semester of language training after which time he begins work toward a Master of Science degree in Animal Breeding with emphasis on systems analysis.

Development of a sheep production systems model was the major accomplishment during the past year. This activity has required review of literature, development of functional biological relationships and programming for computer application. This research has involved the concentrated efforts of a research team at Texas A&M.

9. Technical Accomplishments.

A sheep model has been developed and programmed but is not yet operational. A number of biological parameters must yet be specified. A number of literature reviews have been completed.

1. Growth Rates for Various Breeds of Sheep* (HDB, 3/80).
2. Effect of Type of Birth and Rearing on Growth* (HDB, 3/80).
3. Effects of Ewe Age on Lamb Birth Weights and Weaning Weights* (HDB 3/80).
4. Birth Rate Comparisons for Various Breeds of Sheep* (HDB, 5/80).
5. Postpartum Interval and the Correction Factor for Time (HDB, 5/80).
6. Puberty in Ewe Lambs (HDG, 4/80).
7. The Effect of Ad Lib and Restricted Water Intakes on Sheep (HDB, 5/80).
8. Embryonic Mortality in Sheep (HDB, 9/80).
9. Summary of Some Phenotypic Characteristics of East African Indigenous Breeds of Sheep (GH, 9/80).
10. Milk Production in Sheep (HDB, 11/80).
11. Nursing Lamb Intake (JM, 12/80).
12. Mineral Requirements (GLB, 3/81).

* Tabular reviews

PART IV
PARTICIPATING INSTITUTION ANNUAL REPORTS

KENYA

TITLE XII
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

Small Ruminant CRSP
Annual Project Report 1980-81

(Kenya)

1. Institution: University of California, Davis

2. Principal Investigator: G. E. Bradford

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
   Matching Contributions from 1980/81 subgrant. $105,926

   (These are total funds for the entire project)

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

5. Project Goals:

   1. 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.

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

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

   4. Provide training opportunities for Kenya personnel.

6. Summary of previous accomplishments.

   During the first program year the principal achievements were:

   (1) Planning trip to Kenya to identify collaborating organizations and personnel, and to survey potential work sites.

   (2) Initiation of analyses of US DHIA dairy goat records to:

   a) Obtain information about sources of variation in milk production of dairy goats.

   b) Identify bucks to provide semen for use in the crossing project in Kenya.

(3) Admission of FAO - supported member of Kenya SGDP staff to graduate study in animal breeding at the University of California, Davis.

7. Statement of specific 1980/81 objectives.

Three goals were listed for program year two:

1) Summarize breeding data from small farms survey.

2) Establish base flocks of East African and Galla goats.

3) Identify a station where a breeding project for 300 to 600 breeding goats can be maintained, and augment facilities as needed to initiate the breeding project.

8. Description of work undertaken.

In July, 1980 Mr. Yves Berger, MS, was hired to serve as US co-ordinator for SR-CRSP activities (half-time) and in-country supervisor of the work on this project (half-time). He took up his duties in August.

The Principal Investigator spent most of the month of September in Kenya, participating in the CRSP Planning Workshop, conferring with Mr. Berger, discussing project site selection, and working with Mr. William Odenya, FAO Trainee at UCD, in collection of data for his MS thesis.

The breeding project Workshop activities involved participation of the following persons in addition to the PI and Mr. Berger: Dr. Kimenye, University of Nairobi; Mr. Odenya, Mr. Angwenyi, Mr. Okeyo, SGDP; Mr. Kiriro, Egerton College; Dr. Dolan and Mr. Rege, University of Nairobi. Decisions made in the Workshop included:

(4) Choice of Ol Magogo Farm of the Naivasha Animal Husbandry Research Station as the principal site for breeding project (subject to approval by Dr. Chema, and by Mr. Kamau, Director of NAHRS - subsequently obtained).

(5) Modification of the experimental plan to exclude crosses between East African and Galla breeds, in the interests of producing a larger number of dairy and local breed crosses, and because of possible recent crossing between the two local types.

(6) A target number of 480 breeding females for the base flock, 240 each East African and Galla.

(7) Provision at the earliest possible date of 50 F_1 females for the comparisons of goats with cattle at Maseno.

(8) Provision of local breed and dairy crossbred male kids for the typanotolerance research project at ILRAD.

(9) Breed data from the small farms survey (see objective 1 under no. 7) will not be summarized by Breeding Project personnel, since it will be summarized as part of the Winrock Project.

The following activities have taken place since the workshop:

(1) A specific assignment of land at Ol Magogo Farm was made to this project.

(2) Mr. Berger developed plans for 20 breeding pens for this site. Materials were purchased with Breeding Project funds, and the pens have been built by personnel provided by MLD.

(3) The planned number of East African goats has been purchased, with animals sampled from different parts of the country. Acquisition of Galla goats has been more difficult, but is progressing. Mating is scheduled to begin May 15. The dairy bucks used for the first mating season will be acquired in Kenya, from SGDP and private breeders, with importation of semen and use of AI deferred until later.

(4) A vehicle was purchased and put into use for the Breeding Project.

(5) Forms for recording reproduction, growth and milk production data for project animals have been developed.

(6) In the training area, travel funds were provided for Mr. Odenya to attend the Workshop in Kenya and to gather additional data for his MS thesis. Mr. Okeyo's application for graduate study at Davis has been received and is being processed.

(7) Dr. David Kimenye, Co-Principal Investigator, spent Winter Quarter 1981 at the University of California, Davis. This study leave was funded by the University of California Education Abroad Program and not by the CRSP, but provided a very good opportunity for Dr. Kimenye to become familiar with training opportunities at UCD, and for the Principal Investigator and Co-Principal Investigator to discuss plans for the CRSP project.

9. Technical Accomplishments.

The only data analyses under way are those by Mr. Odenya of SGDP sheep data, both previously collected data which he himself collected in March 1980 and September 1980. A small amount of computing funds were also provided for Dr. Kimenye's analyses of cattle crossbreeding data from Naivasha. No publications have resulted as yet, but there should be publications later from both projects.

Small Ruminant CRSP
Annual Project Report 1980-81

(US)

1. Institution: University of California, Davis

2. Principal Investigator: G. E. Bradford

3. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
Matching Contributions from 1980/81 subgrant. $105,926

(These are total funds for the entire project)

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

5. Project Goals:

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

1. To provide training in sheep and goat breeding and management for persons from participating countries, other developing countries, and the US.

2. 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.

3. 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.

4. 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.

5. To provide backup support for overseas activities.

6. Summary of previous accomplishments.

The principal technical accomplishment was identification, from analysis of the goat DHIA records, of a major difference between dairy goats and dairy cattle in the effect of parity on milk production. It had been assumed that correction of dairy goat milk records for environmental effects would be done using the same procedures as in dairy cattle, in which correction for age removes effects of parity (lactation sequence). However, the analyses showed that in goats there is a major effect of parity, independent of age, which must be taken into account.

7. Statement of specific 1980/81 objectives.

1. In collaboration with the UCD CRSP Animal Health Project, to establish the capability of conducting dairy goat research at Davis, for training and for research to support the overseas components.

2. To identify bucks for semen collection, from the genetic evaluation of DHIA milk production records.

3. To aid in analysis of available sheep and goat data from developing countries.

8. Description work undertaken.

Estimation of factors to remove environmental variation due to parity, age and season was completed, using 10 years US DHIA data.

Adjusted records from California herds were used to provide a genetic evaluation of approximately 500 bucks with 5 or more daughters and of approximately 6000 does. The rankings are being used to identify bucks to be shipped to Kenya and to be used as a source of semen for both the US and Kenya (and other CRSP work sites if there is interest).

An existing building and associated pens have been adapted for use as a goat research facility capable of handling up to 100 animals. Equipment to collect, process and preserve semen has been purchased and training of support personnel in this area has been initiated. A limited amount of semen collection and A.I. has been done, with expanded activity in these areas planned for the 1981 breeding season.

Funds have been provided for analysis of data from a long term goat crossbreeding project in the semi-arid tropics. The data were collected at the "El Cuji" Experiment Station in Venezuela, and are being analyzed by Mr. Omar Garcia, PhD candidate in Genetics at UCD. Records on fertility, prolificacy, seasonality of breeding, survival, growth, and milk production and composition make this one of the most comprehensive sets of goat data available to date from a tropical country.

Data from a long term sheep breeding project in Colombia involving comparison over 16 years of the lamb and wool production of Criollo sheep with four imported breeds of sheep, were analyzed by Miss Anne Alderson, MS. This project was carried out in cooperation with the Montana State CRSP Breeding Project, because of that project's involvement in the Latin American altiplano, which was also the source of the Colombian data.

Three graduate students, one from Chile, one from Uruguay and one from the US are analyzing data from a long term UCD sheep selection experiment. The project is providing an assistantship for one of the students, G. Gonzalez from Uruguay, and some funds for computing for all three. In addition to providing training for persons likely to work with small ruminants in developing countries, these analyses will provide new knowledge on selection methods and effectiveness of selection in sheep.

9. Technical Accomplishments.

Results of the study of parity, age and season effects on milk and fat records were reported to the 1980 meetings of ADSA and will be published shortly in the Journal of Dairy Science. This work provides for the first time a set of correction factors which take parity as well as age into account, which should result in a significant increase in accuracy of dairy goat records for genetic evaluations. Further analyses of the DHIA records are being carried out in an attempt to determine the basis of the unexpectedly large parity effects.

The first genetic evaluation provides information of potential value in both the US and Kenya portions of the project. To make the results more available in the US, they are being published by UC Cooperative Extension.

Three papers for presentation at the International Goat Conference in 1982 are being prepared by Mr. Garcia from the results of analyses of the Venezuelan data.

The results of the sheep study in Colombia show that while some of the imported sheep were larger or had more wool, the local Criollo sheep consistently were more fertile and produced more lambs per ewe than any of the imported temperate breeds, even though the study was conducted at high elevation. The paper, which is being submitted to International Sheep and Goat Research, provides cogent evidence for focusing more effort on locally adapted animals and less on importation of exotic breeds.

Analyses of the US sheep selection data have not yet reached the stage of publication. One of the important conclusions to date is that heritability of early growth rate in sheep differs markedly between environments, being much lower for sheep reared under range conditions than on a higher plane of nutrition.

Annual Report Form for 1980/81

(Kenya)

1. Institution: The Ohio State University

2. Principal Investigator: Robert W. VanKeuren

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,000
   Matching Contributions from 1980/81 subgrant. $133,126

4. Project Title: Intensive Forage Production Systems for Smallholder Sheep and Goat Producers

5. 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 previous accomplishments.

We have been in Kenya since February 1980 with the project site at Maseno selected in May 1980. Development of the site was initiated during the summer and fall of 1980. Some crops were established and construction of facilities for animal feeding and fodder shrub production was initiated at Maseno. Much of the 10 months was utilized in becoming familiar with agriculture, and the edaphic and climatic conditions, research needs, laboratory and other facilities available, and generally becoming acquainted with the Kenyans with whom the project would be involved. A number of Kenyans were identified for training, T. C. Quick returned to the US in November 1980 to assist in developing research plans for Kenya. The PAC requested in January 1981 that Quick remain in the US, pending negotiations concerning the project.

7. Statement of specific 1980/81 objectives.

   a. To identify and characterize the forages and feed available in the humid tropics.

   b. To develop forage-feed/animal production systems and evaluate plant/animal response.

8. Description of work undertaken.

a. Languages

T. C. Quick, Ohio research associate, by diligent self-study, learned Swahili during his stay in Kenya, February-December, 1980 and was able to converse quite fluently with the Kenyans in this language.

b. Travel

(1) February 1-29, 1980 R. W. Van Keuren's first visit to Kenya, T. C. Quick accompanied him and stayed in Kenya to work on the project.

(a) February 10-13, visited Matuga Research Station, Kwale, Kikambala Training Center, Mariakani Research Station, Buchuma Range Research Station, and several farms in Mombasa area. Purpose was to determine a location for the forage/livestock studies and become familiar with the agriculture.

(b) February 14-18, visited research centers and goat co-operatives in Western Kenya, including Kakamega, Busia, Alupe, Maseno, Kitale, Ol Magogo, and Naivasha, similarly to determine study location.

(c) February 25, visited staff at U. of Nairobi agricultural campus at Kabete.

(2) September 6-19, 1980, R. W. Van Keuren's second visit to Kenya.

(a) September 8-10, general meetings in Nairobi.

(b) September 11-13, visited Maseno, Samia, Kitale, Ol Magogo, and Naivasha Stations.

(c) September 14-18, general meetings in Nairobi.

c. Project activities at Maseno Site by Ohio Project.

(1) October-December, 1980.

Established 15 ha sweet potatoes, cv Toilo
Established 1 ha bananas
Initiated construction of animal feeding facility
Initiated construction of fodder shrub structure
Planted 1000 Leucaena in plastic bags
Took soil samples of fields

9. Technical Accomplishments.

The first year has been involved in the usual groundwork necessary with any project. It takes time to establish the crops necessary for the evaluation studies and facilities needed for the animal feeding studies.

Feeding studies probably could have been initiated by this time (March 1981), but our research associate in Kenya has not been able to return following his visit to the US in December 1980, to aid in developing research plans.

The technical accomplishments of the Ohio Project through the first year involved the laying of groundwork, establishment of contacts and support within the Kenyan and expatriate scientific community, the preparation of facilities, and the development of short and long term research proposals, all preliminary and critical to the implementation of the research program in early 1981.

At Maseno, plans were made and construction initiated on a feeding facility for dairy goats for the evaluation of forages and feeds, and on a fodder shrub establishment unit 1000 leucanena shrubs were established. Land was cleared and then plowed. Five ha were planted to sweet potoatoes cv. Toilo under five treatments single superphosphate: 600, 400, 200, 100, and 0 kg/SSP/ha. Sweet potato vines were to be used with napiergrass (3 ha of established Maseno cv Uganda Hairless) in initial feeding trials. One ha of bananas were established for evaluation of leaves and pseudostens in goat feeding. Contact was made with KARI/Maguga to secure cassava cutting for establishment and multiplication. It was arranged with Dr. Raanas, FAO. Drylands Research Project at Alupe to establish a regional trial for nutritive value by chemical analysis and in vivo evaluation. Additionally, 1/2-1 ha each of improved red and white sorghum varieties were to be planted for feeding trials. Arrangements were made with Dr. S. O. Keya, Professor of Soil Science, University of Nairobi, to collaboratively evaluate fodder legumes of potential on the highly acadic soils of the Maseno area (pH 4-5). Soil samples were taken and analyzed preliminary to this work at the Maseno Station.

Three months were spent by Ohio's research assistant, Tim Quick, at the National Agricultural Research Station (Kitale) assisting the FAO Forage Collection and Evaluation Project, which was completing the Phase I National and Regional Trials for the agronomic and chemical analyses of forage/fodder grasses, legumes, and fodder shrubs, prior to moving into Phase II Pre-extension. Napier rootsplits were transferred from Kitale to the Busia Dairy Goat Project and plans were initiated for further consultations and extension activities with the goat bomas for the development of forage/feeding programs in collaborations with the FAO Sheep and Goat Development Project.

Annual Report Form 1980-81

(Kenya)

1. Institution: Washington State University

2. Principal Investigator: Francis R. Abinanti

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $200,000
   Matching Contributions from 1980/81 subgrant. $88,906

4. Project Title: Improvement of Sheep and Goat Production by Reduction of Disease Loss.

5. Project Goals:

   1. To assess the prevalence and economic significance of major small ruminant diseases and ectoparasites.

   2. 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 therapeusis.

   3. To coordinate information regarding small ruminant diseases, nutrition, genetics, animal husbandry and land management in the establishment and implementation of a Herd Health Program (HHP).

   4. To expand the technologies within Kenya through interaction with their scientists and provide graduate education for selected students from Kenya.

   5. To assist Kenya in training existing personnel as animal health technicians (para-professionals) in disease control programs, diagnostic, extension, and research techniques important to HHP.

   6. To assist Kenya in developing a health care delivery system incorporating the application of new technologies to small ruminant resources.

6. Summary of previous accomplishments.

   The 01 year was not as productive as we hoped due to delays in getting the MOU signed by the Kenyan government.

   I did make contact with the central and provincial livestock and veterinary officers to be involved with the implementation of our program. Additionally, we acquired the services of Dr. Paul Sayer to implement our program in Kenya. Dr. Sayer conducted the examination of

two hundred goats in Samia, an area contiguous to the proposed survey area in Siaya. These examinations were conducted as described in Methods (A), in Appendix A of Objectives #1 of our 01 year Progress Report. Also, examination of goats coming to abattiors in the coastal area of Kenya was initiated.

Domestically, research projects in parasitology and microbiology were initiated with WSU College of Veterinary Medicine personnel. These activities were associated with diseases of sheep and goats relevant to both Kenya and the US.

Implementation of Objective #3 was started by the development of field forms for recording data to be collected from goats in the survey areas.

7. Statement of specific 1980/81 objectives.

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 para-professional staff, both within Kenya and graduate training at WSU.

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

8. Description of work undertaken.

A reconnaissance was made of the two districts in which the Kenya SR-CRSP is operating with the assistance of provincial and district MLD personnel - these are Siaya and Kakamega.

Various methods of farm selection were open to us. Previously, during the planning phase, emphasis has been placed on varying ecological zones and therefore differing areas of disease potential. This however, did not take into account the variations in population densities. With the help of advice from many sources we opted to use random sampling techniques rather than the use of transects which would have been extremely difficult to initiate as will be appreciated from a description of the way in which farms were later selected.

Apart from the statistical desirability of a random selection, the Veterinary Economics group needed this approach but within this random selection of locations, ecological characteristics were also utilized to ensure that fully representative areas were chosen.

(Please see insert 8-A for further detail)

Insert 8-A

RANDOM SAMPLING TECHNIQUE for selection of locations or sub-locations:
Three locations or sub-locations in each of three divisions within each of the two study districts were selected by using a combination of population numbers and random numbers table and ecological features. Within each of these locations, three farms were selected with the assistance of the local administration through the chief or assistant chief. It was found that visits to these farms were essential prior to confirmation as being suitable for study. These final visits were needed because of the tendency by the chiefs to select larger farms belonging to influential personalities. A stipulation was introduced that no farm be taken into the survey where more than 12 cattle were kept. In addition, the presence of some goats was considered mandatory.

The result was that approximately 70 farms were selected in 18 locations. On these farms, a total of 495 animals were sampled and ear tagged (316 goats, 179 sheep). A further 151 were ear tagged but not sampled. (This information is summarized in the appended tables.)

SURVEY PROCEDURE:
The district veterinary officers were visited and briefed on the objectives of the small ruminant survey. At the same time a written description of the objectives and the type of smallholder farm suitable for the project's assessment was handed out. On the day prior to a survey team's visit, the chief for that location, and if possible the farms he had chosen, were visited and checked for size and animal numbers. It was imperative that the owner or person responsible for the farm be present on the day of the survey visit. This was true both for the veterinary economics questionnaire and the information regarding the stock.

On each farm, all the small ruminants were ear tagged. A color code is being used to distinguish those sampled from those noted to be present.

SAMPLING PROCEDURE:
Each animal was ear tagged, weighed, aged by teeth and a detailed examination of all the body systems performed. This included an evaluation of body condition. External parasites were noted and collected for identification. Blood was collected for blood parasite examination and future serologic examinations. Thick and thin blood films on a single glass slide were also prepared from each animal. Microcapillary hematocrit tubes were filled at the time of bleeding, centrifuged on the farm, the packed cell volume recorded and the buffy coat area examined on slides both microscopically for trypanosomes and micofileria. Feces were collected both fresh and in formalin for future analysis. The fresh fecal samples were cooled immediately.

Information was recorded on prepared sheets using code numbers. The serum was allowed to separate and decanted after 24 hours.

SAMIA DAIRY GOAT DEVELOPMENT PROJECT:

The opportunity to monitor the health of 200 East African, Toggenburg, Anglo Nubian goats and their crossbred offspring, arose early in 1980. These animals have been followed in a similar manner to the major small farm survey, with the addition of extra monthly visits between major sampling visits every four months. Initially, there were four flyproof goat houses, built in different villages in Samia. These were each managed by a different women's cooperative. The exotic breeds were placed in two of these goat houses and fed by zero grazing of hand cut and carried fodder. The health and husbandry is overseen by an experienced animal health assistant.

9. Technical Accomplishments.

The mass of information needs analysis but differences in tick numbers and species are evident. The results of the fecal analyses in our view, are too low to be reliable. Recent improvements in storage techniques have improved this aspect.

The blood smears are being stained in batches and will take a long while to examine carefully.

All sera have been checked for Brucellosis by DRFT and found to be negative.

Mineral assays initially presented a problem but are now underway. The methods routinely used at Kabete required a large volume of serum for each assay and were therefore not feasible for the CRSP survey. This has now been improved to allow five minerals to be assayed per milliliter.

(Please see insert 9-A for further detail)

Insert 9-A

The provision of new lamps by WSU for the Perkins atomic absorption spectrophotometer has greatly improved sensitivity. When or even before Dr. Mbwiria returns to Kenya, it is proposed to ensure that he will have up-to-date technical support in that laboratory. This will be achieved by a visiting technician from WSU and by further training or overseas experience for one of the technicians currently in the lab.

A summary of the activities in the Siaya and Kakamega districts can be seen in the appended tables. The 200 goats in the Siaya Cooperative Goat Project have now been examined for the third time and this data is being evaluated.

Three MLD veterinarians have participated in our field program as Kenyan counterparts. Drs. Mbwiria and Bari, who are now enrolled at WSU, were these earlier counterparts and presently, Dr. Njanja is engaged as a collaborator with Dr. Sayer. This experience has provided these young veterinarians with practical training in the conduct of field veterinary investigations.

TRAINING:

Two MLD veterinarians, Drs. W. Mbwiria and J. Bari have been enrolled in the masters degree program at WSU, starting the Spring Semester of 1981. The candidates will have a year of academic studies at WSU, then return to Kenya in their second year to engage in a masters degree research project. During the summer break at WSU, Dr. Bari will be trained in microbiological techniques for determining mineral content of animal serums and tissues. A Sheep and Goat Farm has been established at WSU for the training of Kenyan graduate students and to support research on sheep and goats.

Arrangements have been completed for two technicians from WSU to spend six weeks during June and July at the MLD Veterinary Research Laboratories in Kabete. They will be instructing Kenyan technicians on one of the newer serologic techniques being used for microbiological assays, namely the ELISA test and updating the spectrophotometry methodologies of technicians engaged in mineral assays.

SR-CRSP -- ANIMAL HEALTH SURVEY -- SUMMARY

DISTRICT	DIVISION	LOCATION	NO. OF SUBLOCATIONS	NO. OF FARMERS	ANIMALS SAMPLED/TOTAL ON FARM		
					GOATS	SHEEP	TOTAL
SIAYA	Bondo	South Sakwa	4	15	106/141	40/77	146
		North Sakwa	1	4	7/7	8/8	15
	Yala	North Gem	3	10	35/47	17/21	52
	Boro	West Alego	3	10	52/63	35/48	87
TOTAL			11	39	200/358	100/154	300
KAKAMEGA	Ikoromani	Isukha	4	12	33/40	27/37	60
	Malava	South Kabras	3	9	46/57	37/44	83
	Butere	Marama	3	9	37/39	15/15	52
TOTAL			10	30	116/136	79/96	195
GRAND TOTAL FOR THE TWO DISTRICTS			21	69	316/394	179/250	495/644

SR-CRSP -- ANIMAL HEALTH SURVEY

DISTRICT	DIVISION	LOCATION	SUBLOCATION	VILLAGE	FARMERS	ANIMALS SAMPLED			ANIMALS NOT SAMPLED		
						GOATS	SHEEP	TOTAL	GOATS	SHEEP	TOTAL
Kakamega	Malava	South Kabras	Shamberere	Malimali	Peter Munandi	2	5	7	--	--	--
					Wilson Muira Andonje	7	5	12	--	--	--
					Ogonya Menga	6	5	11	2	2	4
Kakamega	Malava	South Kabras	Lukume	Mutsuma	Pauls M.Lironjera	4	4	8	2	3	5
					Peter Namusia Ofule	4	5	9	--	1	1
				Burundu	Phelesie Elijah Musambayi	6	2	8	2	1	3
Kakamega	Malava	South Kabras	Chesero	Kurasali	Simeon Sasala	6	3	9	2	--	2
					Charles Ngundia	4	4	8	1	--	1
					Japheth Keya	7	4	11	2	--	2
Kakamega	Butere	Marama	Buchenta	Bumamu	Ham Wanzala	2	--	2	--	--	--
					William Luta	5	5	10	--	--	--
				Mukangu	Malaki Lichuma	6	--	6	--	--	--
Kakamega	Butere	Marama	Shianda	Manyuria	Sophia Maina	4	--	4	--	--	--
					Habili Siome	3	--	3	--	--	--
					Mark Randiki	5	--	5	--	--	--
Kakamega	Butere	Marama	Shinamwenyuli	Bukome	Robert Oule	6	5	11	2	--	2
					Keffa Ambache Wanga	2	1	3	--	--	--
					Samuel Wangembe	4	4	8	--	--	--

SR-CRSP -- ANIMAL HEALTH SURVEY

DISTRICT	DIVISION	LOCATION	SUBLOCATION	VILLAGE	FARMERS	ANIMALS SAMPLED			ANIMALS NOT SAMPLED		
						GOATS	SHEEP	TOTAL	GOATS	SHEEP	TOTAL
Siaya	Bondo	South Sakwa	Migwena	Yenga	Hezron Mawere	18	12	30	4	24	28
					William Mewere	5	--	5	--	--	--
					James Oduor Ogore	5	--	5	1	--	1
					Abayo Okwanga	9	1	10	1	--	1
Siaya	Bondo	South Sakwa	Nyengunda	Nyengunda	Richard Odido Marigo	7	5	12	--	4	4
					Joshua Okeyo	5	--	5	--	--	--
					Michael Rubiero	5	--	5	--	--	--
				Otuma	Henry Seda	5	2	8	6	1	7
Siaya	Bondo	South Sakwa	Nyangoma	Kamkwaya	Petro Ogutu	7	3	10	9	1	10
					Oloo Oyaro	8	1	9	2	--	2
					Marichus Oracha	8	4	12	2	4	6
Siaya	Bondo	North Sakwa	Ajigo	Ajigo	Philip Alako Ogwang	2	4	6	--	--	--
					Samson Ojwang Milanya	2	3	5	--	--	--
					Michael Twenya Ongong	1	1	2	--	--	--
					James Donga	2	--	2	--	--	--
Siaya	Bondo	South Sakwa	Barkawino	Aver	William Ohroch	6	4	10	1	--	1
					Ginasio Ogila	4	--	4	3	--	3
				Kochara	Joseph Arianda	7	3	10	3	--	3
				Atilili	Matthew Ochongo Jagugo	7	5	12	3	3	6
Siaya	Yala	North Gem	Maliera	Magonda	Jotham Odira	2	--	2	2	--	2
					Walter Noah Mwato	2	--	2	2	--	2
				Maliera	John Wamgunga	5	--	5	2	--	2
				Sirandu	Samuel Olera	7	--	7	1	--	1
Siaya	Yala	North Gem	Malenga	Sidade	Abzarom Odera Sande	6	3	9	--	3	3
				Sigosi	Gerald Thuna	4	--	4	3	--	3
					Paul Oboyo	3	6	9	--	1	1

SR-CRSP -- ANIMAL HEALTH SURVEY

DISTRICT	DIVISION	LOCATION	SUBLOCATION	VILLAGE	FARMERS	ANIMALS SAMPLED			ANIMALS NOT SAMPLED		
						GOATS	SHEEP	TOTAL	GOATS	SHEEP	TOTAL
Siaya	Yala	North Gem	Malunga	Kamjibuop	Timotheo Obenge	2	2	4	--	--	--
					Samson Oram Osweta	3	4	7	1	--	1
					Isiah Odunga Ogora	1	2	3	1	--	1
Siaya	Boro	West Alego	Mahola Ulawe	Bar Odiegi	Joseph Owino Omondi	8	--	8	--	--	--
				Mehola Ulewe	Alex Obwaka	7	5	12	8	3	11
					Opondo-Marum Odera	4	6	10	1	8	9
Siaya	Boro	West Alego	Kaugagi	Sanda Ulawi	Clementine Adlianbo	6	--	6	5	--	5
					Wanyando Owohr	2	2	4	--	--	--
					Joseph Wanyandi	6	4	10	3	--	3
					Joab Oduoga	6	3	9	2	--	2
Siaya	Boro	Eest Alego	Komenya Kalaka	Nyaluanga	Dalmas Otiero Obiero	6	5	11	--	--	--
					Cleopas Odaha	3	5	8	2	1	3
				Nyasita	Jacob Ochora	4	5	9	--	1	1
Kakamega	Ikoromani	Isukma	Shilele	Matende	Paul Chuonyo	7	6	13	2	4	6
				Shitali	Litali Butinyu	9	4	13	5	4	9
Kakamega	Ikoromani	Isukma	Murande	Bukhewa	Elisle Lukale	3	1	4	--	--	--
					Jethero Lukale	3	--	3	--	--	--
					Anne Mukhwana	--	3	3	--	1	1
Kakamega	Ikoromani	Isukma	Sherere	Musha/	Reheme Shirako	1	1	2	--	--	--
				Rostemer	Hamisi Mhoandi	3	2	5	--	1	1
					Peris Thika	2	5	7	--	--	--
Kakamega	Ikoromani	Isukma	Sindondo	Mundulu	Salome Shura	3	--	3	--	--	--
					Peter Khayeka	1	3	4	--	--	--
					Alphonce Shabukulula	1	--	1	--	--	--
				Mukumu	Regina Maseno	--	2	2	--	--	--

ANNUAL REPORT
1980/81

1. Institution: Winrock International Livestock Research and Training Center

2. Principal Investigator: H. A. Fitzhugh

3. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $46,665.10
Matching Contributions from 1980/81 subgrant. $31,704.38

Period Covered: June 1, 1980 to February 28, 1981

4. Project Title: Dairy Goat Production Systems for Smallholder Agriculturists

5. Project Goals:

The goals of the dairy goat production systems project 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 augment the number of technical and scientific personnel interested and qualified in interdisciplinary research relevant to the needs of the developing countries.

6. Summary of previous accomplishments.

Foreign activities in Program Year 1 were primarily devoted to design and initiation of research program on dual purpose goat systems for small farms in humid tropics. In the dual role of Regional Coordinator and Principal Investigator, Fitzhugh spent 2.5 months in Kenya working with SR-CRSP, Kenyan and other collaborating scientists to identify research priorities and negotiate agreements to support collaborative research program in Kenya. 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 research program in Year 2. In the United States work initiated included: bibliography of literature on goats, dairy goat performance records computer programs, kid rearing experiments. Results from these activities completed in Year 2 are reported in the following sections.

7. Statement of specific 1980/81 objectives.

Foreign site - Kenya

A. Production Systems Survey

1. Characterize small scale farm systems in Kenya, including biological, economic and human resources, constraints and potential competition between livestock and cropping activities for land, labor and capital resources.

2. Establish research priorities relevant to dual purpose goat component for small scale farm systems.

3. Provide baseline data for assessment of biological, economic and sociological interventions to small farm systems.

B. Goat and Cattle Comparison

1. Compare resource requirements (feed, labor), productivity (milk, meat), feed preferences and efficiency of goats and cattle.

2. Evaluate health and management problems associated with holding cattle and goats in confinement or semi-confinement conditions.

3. Evaluate techniques for processing and preserving feedstuffs to improve nutritive qualities and to ensure sufficient supplies in periods of shortage.

C. Training

1. Provide training in multidisciplinary systems research methods.

2. Identify and support qualified candidates for advanced study.

US Site - Petit Jean Goat Dairy

1. Compare performance of dairy goat kids raised on lamb milk replacer, cold goat milk ad libitum and suckling of does.

2. Compare udder health and total milk yield of dairy goats which suckle kids for the first 30 days post-partum (no milking) or post-machine milking (residual milk) to those milked by machine without suckling.

3. Document amount and sources of phenotypic variation for growth, lactation, fertility and health traits for five dairy breeds (Saanen, Alpine, Toggenburg, Nubian and La Mancha).

4. Develop bibliography of international literature on goats.

8. Description of work undertaken.

A. Foreign Travel and Activities

H. A. Fitzhugh

3-24 July, 1980, Kenya.
Coordination of program activities; negotiate terms of collaboration on survey with Central Bureau of Statistics; organize Research Planning Workshop held in September 1980. Plan Nutrition-Forage research (with Sands, Quick) at Maseno Research Station.

5 September - 5 October 1980, Kenya.
Coordination of project and program activities with SR-CRSP and Kenya collaborators; Research Planning Workshop for 1980-81 program in Kenya; Initiate Small Farm Systems Survey.

24 February - 22 March 1981, Kenya.
Review progress and develop future plans for Survey and Nutrition-Forage research with SR-CRSP and Kenyan collaborators; attend meetings of Program Administrative Committee (with Abinanti, Berger and Robinson) where major policy decisions were agreed upon; lecture at Egerton College on dual purpose goat production systems.

J. A. Yazman

5 September - 6 October 1980, Kenya.
Research Planning Workshop with primary attention to Nutrition-Forage research plans; seminar on dairy goat production to Kenya Goat Breeders Society.

M. E. Sands

March 1980 to present, Kenya.
Primary responsibility for supervising Small Farms Systems Survey; participated with Quick (Forage) in implementation of Nutrition-Forage research project.

B. Domestic Travel and Activities

H. A. Fitzhugh

7-9 April 1980, Estes Park, CO. SR-CRSP Technical Committee Meeting.

29-30 May 1980, Davis, CA. SR-CRSP Executive Committee (substituted for Van Keuren)

4-6 August 1980, Ithaca, NY. SR-CRSP PI Meeting (during ASAS Annual Meeting.)

21-23 December 1980, Chicago, IL. SR-CRSP Nutrition Seminar.

28-30 January 1981, Denver, CO. SR-CRSP Kenya PI Meeting.

J. A. Yazman

1 November, 1980, Pomona, CA. California Dairy Goat Day.

21-23 December 1980, Chicago, IL. SR-CRSP Nutrition Seminar.

C. Research Activities (in collaboration with SR-CRSP and Kenyan personnel)

Kenya (M. W. Sands, H. A. Fitzhugh)

Small Farms Systems Survey (80 farms)
Enumerator Training Workshop (October 1980)
Baseline Survey (October-December, 1980)
Monthly monitoring survey (December 1980 - present)

Nutrition-Forage Research on Maseno Station
Planted sweet potato (1.5 ha), sorghum (.5 ha), maize (.5 ha), leucana (.2 ha)

Identified goats and cattle for feeding trails (to start May 1981)

US (L. Turillo, B. Henderson, G. Perkins, J. Yazman, H. Fitzhugh)

Bibliography of international literature on goats.
Computer programs for dairy goat performance records (growth, fertility, health, lactation).
Experiment on preweaning rations for kids (lamb milk replacer, cold goat milk, suckling)

D. Training

Daniel Kitivo (currently SR-CRSP Co-manager in Kenya) will study for MS degree in Ruminant Nutrition.

M. W. Sands (Research Associate, Production Systems project in Kenya) will utilize survey data for PhD, Cornell University.

9. Technical Accomplishments:

A. Small Farm Systems Survey. This survey is designed to characterize the biological, economic and sociological aspects of small farms in western Kenya. This characterization will identify research priorities and provide the baseline against which to measure the impact of future interventions.

The survey is a joint activity of the SR-CRSP Production Systems, Sociology and Economics projects in Kenya. It is coordinated with the Animal Health Survey. Six Kenyan enumerators from the regions sampled (and proficient in local languages) were hired through the Kenyan Central Bureau of Statistics.

Components of the survey (which continues through the production year) include: baseline; monthly monitoring of livestock, crops, labor, cash flow and consumption; and special modules on attitudes and values, change orientation, family nutrition, labor utilization, animal management practices.

Eighty households (20 in each of two districts in two provinces, Western and Nyanza) are surveyed. They are in medium to high agricultural potential (primarily based on rainfall) areas. Farms are small (averaging less than 1.5 ha) and intensively cultivated. Number of persons per household ranges between 1 and 15. Approximately one-half of households are headed by women primarily because of migration of men to urban areas to seek employment.

Capital resources, other than livestock and buildings, are limited. Typically, tools consist of two or three pangas (machetes), hoes and baskets or pails.

Cropping activities are centered around two rainy seasons: October-December and March-May. Principal crops are maize, beans, sorghum, sweet potatoes, bananas, cassava. Substantial areas are left fallow, at least during short rainy season (Oct. -Dec.). Animals, especially poultry, were found on almost all farms. Cattle, (primarily small Zebu) are the most valued livestock, although productivity is low. Many five-year-old cows have not yet calved; milk yield is two liters per day. Hair sheep are found on less than half of the farms; goats on less than ten percent. Sheep and goats are generally tethered. Goats are reported to be difficult to control.

Principal feed resources are crop residues. Animals are penned nightly for protection against predators and thieves. Dipping for tick control is practiced in the Siaya clusters but to a lesser extent (or not at all) in the Kakamega clusters.

Preliminary observations suggest that research to develop the following interventions would be useful:

Weaning - young ruminants suckle for long periods, probably a factor in the long post-partum anestrus of females.

Night Confinement - ruminants remain in night bomas for 12 or more hours including the cool hours of morning and evening; when the tsetse fly is not a problem, early morning and late evening grazing would likely improve performance.

Goat Management - prevailing concern about control of goats, especially during crop growing season, must be answered by effective control management if dual purpose goats are to be accepted.

Crop Residues - land to grow animal feed is extremely limited so emphasis should be on use of food crop residues (maize thinnings, sweet potato vines, stover).

Feed Preservation - feed for animals is especially scarce during dry season; low cost, effective means must be developed for conserving feed in rainy season for use in dry season.

B. The Ministry of Livestock Development assigned land, facilities and personnel at the Maseno Research Station (Nyanza Province) to the SR-CRSP. Approximately 5 ha of land have been cultivated and planted to crops (sweet potato, maize, sorghum) commonly grown on small farms in the area. Confinement facilities for future feeding trials have been designed and construction initiated. Costs of land preparation and construction have been shared by Production Systems and Forage Program.

Twelve dairy cross does from Egerton College herd, plus an additional 10-15 dairy cross does purchased from private herds, will be used in experimental comparisons of goats and cattle. Cows from the Maseno Station herd will be used. Experiment will start in June, 1981 pending completion of facilities at Maseno.

Preliminary evaluation of feed preservation techniques will be integrated with the feeding comparisons. These techniques include drying and ensiling of small quantities of forage (sweet potato vine, maize and sorghum thinnings). Anticipated problems are the effects of high ambient humidity, mold growth and low levels of soluble carbohydrates. Experience gained in these preliminary trials should improve design of future evaluations.

C. Accomplishments in training activities have been limited to date. M. W. Sands (Research Associate on Production Systems project) will utilize data from Small Farm Systems Survey for PhD dissertation at Cornell University (expected completion date, December 1981). Daniel Kitivo has been nominated by the Ministry of Livestock Development (MLD) to study for MS degree in ruminant nutrition at a United States University (funded by Production Systems project); however, his current administrative responsibilities preclude his starting studies before January 1982. A workshop in Kenya on interdisciplinary research originally scheduled for September 1980 was postponed to November 1981 at the request of MLD.

D. An inherent conflict exists in dual purpose goat systems. It stems from use of milk for human consumption versus for feeding kids prior to weaning. Three preweaning rations were evaluated in an experiment at the Petit Jean Goat Dairy:

Cold goat milk fed ad libitum, cold commercial lamb milk replacer fed ad libitum, suckling of does (not necessarily the dams) twice daily. Sixty-eight female kids from six breed groups (Saanen, Alpine, La Mancha, Nubian, Toggenburg and Crossbred) were randomly assigned at three-days to these three treatments. Kids were weighed at birth and, subsequently, at seven-day intervals to weaning at 42 days of age.

Mean for birth weights, preweaning ADG, % days scouring are shown below for three treatments (pooled across breed groups).

Treatment	N	Birth Wt., Kg.	ADG kg./Day	% Days Scouring
T_1 Cold Goat Milk	29	3.4	.159	5.2
T_2 Cold Milk Replacer	17	3.5	.100	24.6
T_3 Suckled	22	3.3	.135	4.3
TOTAL	68	3.4	.135	9.8

Treatment differences for birth weight were not statistically significant; differences in treatment effect on preweaning ADG and % days scouring were significantly different ($P < .05$) with the major effect due to T_2. Only one kid died during the experiment.

Conclusions from this experiment are (1) the commercial milk replacer as currently formulated is not recommended for raising kids; (2) feeding cold goat milk ad libitum and suckling of does were satisfactory regimes for raising kids.

Additional details of experimental procedure and results have been summarized in the report, "Systems of Feeding Preweaning Dairy Goat Kids", by Yazman, Turillo and Fitzhugh.

Observations on the effect of suckling on udder health and total milk yield of does in the current and subsequent lactations have not yet been analyzed.

E. Performance data (weights, milk production, group feed consumption, health) are recorded for the Petit Jean Goat Dairy. Development of computer programs to process dairy goat records and analyses of these records are partially supported by Winrock Project matching funds. Analyses to-day have been limited to cross-classification summaries. The following table indicates the effects of breed and parity on litter size, kid birth weight and survival. Weights are in kg; deaths include stillbirths and others prior to three days of age.

Doe Breed (No.)	Parity: First Litter Size 1	First Litter Size 2	First Litter Size All	Second Plus Litter Size 1	Second Plus Litter Size 2	Second Plus Litter Size 3	Second Plus Litter Size All	Combined
Alpine (28)								
No. Survived	6	4	10	7	14	5	26	36
Birth Wt.	3.6	3.4	3.5	4.1	3.8	3.3	3.8	3.7
No. Died	1	-	1	2	2	1	5	6
Birth Wt.	3.5	-	3.5	4.3	1.9	2.3	2.9	3.0
% Survival	86	100	91	78	88	83	84	85
La Mancha (22)								
No. Survived	4	2	6	4	18	7	29	35
Birth Wt.	2.5	2.6	2.5	4.0	3.2	2.7	3.2	3.1
No. Died	-	2	2	-	-	2	2	4
Birth Wt.	-	1.6	1.6	-	-	2.4	2.4	2.0
% Survival	100	50	75	100	100	78	94	90
Nubian (19)								
No. Survived	5	3	8	3	12	6	21	29
Birth Wt.	3.5	2.9	3.3	3.7	3.4	3.4	3.4	3.4
No. Died	-	3	3	-	-	-	-	3
Birth Wt.	-	1.3	1.3	-	-	-	-	1.3
% Survival	100	50	73	100	100	100	100	91
Saanen (18)								
No. Survived	2	2	4	3	15	3	21	25
Birth Wt.	2.8	3.7	3.3	5.2	3.5	3.1	3.7	3.6
No. Died	1	2	3	-	3	-	3	6
Birth Wt.	2.3	1.6	1.0	-	3.9	-	3.9	2.9
% Survival	67	50	57	100	83	100	88	81
Toggenburg (23)								
No. Survived	2	5	7	4	16	5	25	32
Birth Wt.	3.5	3.7	3.6	4.0	3.5	2.9	3.5	3.5
No. Died	1	3	4	1	2	1	4	8
Birth Wt.	2.7	2.5	2.6	3.2	2.9	2.9	3.0	2.8
% Survival	67	63	64	86	88	83	86	80
Crossbred (4)								
No. Survived	-	-	-	-	6	2	8	8
Birth Wt.	-	-	-	-	4.6	3.4	4.3	4.3
No. Died	-	-	-	-	-	1	1	1
Birth Wt.	-	-	-	-	-	4.1	4.1	4.1
% Survival	-	-	-	-	100	67	89	89
Overall (114)								
No. Survived	19	16	35	21	81	28	130	165
Birth Wt.	3.3	3.3	3.3	4.2	3.5	3.1	3.5	3.5
No. Died	3	10	13	3	7	5	15	28
Birth Wt.	2.9	1.8	2.0	3.9	3.1	2.8	3.2	2.6
% Survival	86	61	73	89	92	85	90	86

F. Other accomplishments in the past year include:

1. A bibliography of international literature on goats has been developed. This bibliography is stored on the Winrock International computer. At present it includes 2271 entries; approximately 1200 entries were added in the past 12 months to the original file based on "A World Bibliography on Goats" (M. W. Sands and R. E. McDowell, Cornell International Mimeograph 70). All entries are indexed by topic and region to facilitate literature searches. Searches will be made for SR-CRSP and other scientists on request.

2. An annotated bibliography, "Goat Management-Reproduction, Lactation and Growth" consisting of 149 abstracts was prepared and distributed to SR-CRSP scientists.

3. A confinement livestock housing facility suited to Kenya climate was designed. The design document provides detailed construction instructions: concrete floor foundation, roof support posts, trusses, roof, pens, gates, key hole feeders, and a bill of materials. This document has proven especially useful for preparation of proposals by MLD for PL-480 funds to develop facilities for future use of Sheep and Goat Project and SR-CRSP in Kenya.

SR-CRSP
Annual Report Form for 1980-81

(Kenya)

1. Institution: University of Missouri-Columbia

2. Principal Investigator: Michael F. Nolan

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $253,333
   Matching Contributions from 1980/81 subgrant. $91,727

4. Project Title: Sociological Analysis of Small Ruminant Production Systems.

5. Project Goals:

   1. To understand the potential role for goats in the intensive crop production areas of Western Kenya.

   2. To understand the role of women in crop and small ruminant production.

   The ultimate goal of the project is to be able to:

   1. Understand the economic calculus (the source of rationality) of small producers and the constraints under which they operate.

   2. Understand who among the overall population of livestock producers will benefit from technological change.

   3. Anticipate what problems will emerge with the implementation of new technology on a large scale.

6. Summary of previous accomplishments.

   In previous years a program plan was developed for Kenya and the Principal Investigator and Co-Principal Investigator made a total of six trips to Kenya in an attempt to establish collaborative contacts and develop a time table for implementing the program plan. In addition, an extensive literature review for Kenya was undertaken focusing both on the intensive production areas and the extensive (range) areas. This is available in a computerized data base.

7. Statement of specific 1980/81 objectives.

   Three objectives specific to Kenya were identified in the Sociology work plan for 1980-81.

1. Begin study of social organization of agriculture in Western Kenya with special emphasis on the role of women and women's groups.

2. Participate in interdisciplinary production-system baseline survey in Weste.n Kenya.

3. Initiate an in-depth farm survey on decision making/risk taking.

8. Description of work undertaken.

1. Women and Goats: In July, 1980 a graduate student was placed in western Kenya to begin a study of the women's goat cooperatives in that region. The location was in the town of Sio Port and she worked directly with members of four cooperative groups. Her objectives were to gain an understanding of the historical origin and the contemporary dynamics of the groups and, more generally, develop appreciation for the role that women play in the agricultural production system of that region. She used a combination of field methods and in-depth interviews with 80 women. The data collection phase of her study was completed in February, 1981 and data analysis and report preparation are now beginning.

2. Production System Survey/Risk Survey: The two survey objectives were combined into a single undertaking. Sociology is participating in the broad-based production systems survey of 80 western Kenya farms and, in addition to general production information, is collecting data on attitudes towards change and new technology, institutional contacts, and the role of family members in various aspects of agriculture production, particularly regarding animals. The sociological component of the questionnaire was administered in February and March, 1981 and the raw data should be available soon. The sociological portions of the questionnaire used in the western Kenya survey have been adopted by the government of Kenya, Central Bureau of Statistics and will be used in their national surveys during 1981 and 1982. Their large sample of small farmers in Kenya will provide a national data set on which to base program planning. We expect to undertake a significant amount of data analysis during this calendar year.

3. Training: We have supported, as part of our training efforts in Kenya, the master's thesis research project of a Kenyan student who is an employee of the Ministry of Livestock Development (A. Aboud). He is doing an evaluation of several range management projects. This study was initiated in February of 1981 and should be completed by July, 1981. The direct costs of his thesis research is being borne by the CRSP. In addition, we anticipate funding a short-term (6 months) training program for a Kenyan graduate student from this years funds.

9. Technical Accomplishments.

With data just now coming in, it is too soon to have any findings to report. We anticipate a major program of writing and analysis for Kenya this year and the production of a number of reports during the year.

Annual Report Form for 1980/81

(Kenya)

1. Institution: Winrock International Livestock Research and Training Center

2. Principal Investigator: A. John De Boer

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $233,333
   Matching Contributions from 1980/81 subgrant. $82,295

4. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Kenya

5. 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 inter-disciplinary 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 previous accomplishments.

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

   (i) Visited Kenya for 7 days in March 1980 to work on Phase III Work Plan and visit potential counterparts.

   (ii) Interviewed candidates for Research Associate position in agricultural economics to serve in Kenya. Mr. Morgan Job subsequently hired on February 14, 1980.

   (iii) Collected material on Veterinary Economics and Epidemiology for project research in Kenya.

(iv) Worked on data collection survey forms for subsequent use in Kenya.

7. Statement of specific 1980/81 objectives.

(i) Establish long-term staffing for agricultural economics in Kenya.

(ii) Complete Phase III Work Plan.

(iii) Initiate collaborative research on animal health economics with veterinary health components of FAO Sheep and Goat Development Project and Washington State University.

(iv) Initiate collaborative research and support services with Central Bureau of Statistics in Nairobi.

(v) Review work on dairy development problems in developing countries.

(vi) Initiate research on goat milk product markets and demand with emphasis on methodological aspects of applicability to developing countries.

(vii) Initiate formal training of Kenyan collaborators.

(viii) Establish long-term survey program on Kenyan small farms for monitoring and analysis of technological interventions.

8. Description of work undertaken.

(i) International travel - Mr. and Mrs. Morgar Job to Kenya in July, 1980 for long-term assignment on project.

-- John De Boer to Kenya for 3 weeks in September-October, 1980.

-- Ms. Danna Mortimer, MS candidate from Washington State University, to Kenya 5-month assignment, September, 1980 - January, 1981. Includes trip to Institute for Veterinary Epidemiology and Economics, Reading University, U.K.

(ii) Seminars - De Boer, Job and Mortimer participated in Small Ruminants Seminar, University of Nairobi, September 15-19, 1980.

(iii) Survey work with 60 farmers on animal health economics completed during October, 1980 - January, 1981 period.

(iv) Long-term small farm survey collaborative research initiated and data analysis started.

(v) Collaborative work began with Central Bureau of Statistics, Nairobi.

(vi) Paper entitled "Socio-Economic Aspects of Dairying in Developing Countries" presented to American Dairy Science Association Annual Meetings, Blacksburg, Va., June, 1980.

(vii) Ms. Pamela Jo Howard, MS candidate, Department of Food and Resource Economics, University of Florida hired on ½ time Research Assistantship to carry out research on Economics of Goat Milk Product Market and Demand Characteristics. Period January 1 - December 31, 1981.

(viii) Mr. James Njukia, a Kenyan PhD candidate, Department of Agricultural Economics, Texas A&M University granted a ½ time Research Assistantship from January 1 - June 30, 1981 to continue studies at Texas A&M.

(ix) Accepted assignment as Vice-Chairman, Symposium on Goat Product Markets and Marketing, III International Conference on Goat Production and Diseases, January, 1982 in Tucson, Arizona.

9. Technical Accomplishments.

(i) Publication - De Boer, A. John. "Socio-Economic Aspects of Dairying in Developing Countries", J. Dairy Science (in press).

(ii) Survey results.

(a) Animal health economics - Survey data on socio-economic characteristics of 60 survey farms being tabulated and coded at Washington State University. The project hired enumerators, trained them in survey procedures, and sampled farmer populations from Kakamega and Siaya districts. The districts were subdivided into ecological zones which served as sample strata. Each strata was assigned a sampling weight based on human population estimates. Three locations were then selected in each district by random sampling. Further stratification was carried out at the sublocation level. Each strata was again assigned sampling units weighted accordingly by percent of total location population. Three sub-locations were chosen per location. Farmers in each sublocation were selected by going to every farm until enough farmers were found to complete preselected sample size. Ecological sampling of this nature assures variation in terms of soil, rainfall, cropping, and adaptation of farming practices to environmental conditions. The characteristics of the sample are given in Table 1.

Table 1. Strata Selected and Number of Sample Units

District	Location	Sub-Location	No. of Farmers
Kakamega	Marama	Buchienya	3
		Shianda	3
		Sinawenyali	3
	South Kabras	Chisero	3
		Lukame	3
		Shamberere	3
	Isukha	Muhanda	4
		Shidodo	4
		Shirere	4
Siaya	Sakwa	Ajigo	4
		Nyangoma	3
		Barkowino	4
	West Alego	Manola-Ulawe	3
		Komeya-Kalaka	3
		Kaugagi	4
	North Gem	Malanga	3
		Malunga	3
		Maliera	3
		TOTAL	60

The Washington State University Animal Health Research project collected information on animal characteristics, including detailed information on goat health status, on these same 60 farms. The two sets of data are being pooled for analysis. This will result in a Masters thesis to be submitted to the Department of Agricultural Economics at Washington State University in September, 1981.

(b) Production Systems Survey - Details of this work on which Morgan Job is collaborating are included in the Annual Report of the Production Systems project.

Annual Report Form for 1980/81

(Kenya)

1. Institution: Texas A & M University

2. Principal Investigator: T. C. Cartwright

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $190,000
   Matching Contributions from 1980/81 subgrant. $63,333

4. Project Title: Systems Analysis and Synthesis of Small Ruminant Production

5. Project Goals:

The broad objective is to increase productivity of small ruminant production systems in Kenya and other LDC's 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 US and by providing a method of effectively evaluating application of research results and other recommended practices by smallholders in Kenya. The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep and goat production systems.

2. 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.

3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Kenya.

4. To supply input-output data of dairy and dual-purpose goat production systems for use in economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of 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 previous accomplishments.

An additional visit was made to Kenya during which (1) a Co-Principal Investigator was tentatively identified, (2) arrangements for Mr. 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.

The sheep and goat models were conceptually outlined and communicated to collaborators. Their inputs were incorporated into model design. Development of structural and biologial components of the model was begun. Efforts were made to coordinate with other CRSP projects relative to data needs for intensive dual purpose goat production systems.

7. Statement of specific 1980/81 objectives.

1. Complete development of a sheep production systems model and continue development of goat production systems model.

2. Gain additional understanding of small ruminant production systems in Kenya.

3. Finalize agreement on Co-Principal Investigator, other collaborators and use of UNESCO data.

8. Description of work undertaken.

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 role of Co-Principal Investigator, (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 traveled to Kenya in September, 1980 to participate in CRSP workshop. In addition, he (1) reached agreement on a MOU involving UNESCO, (2) gained final agreement for Dr. Carles to serve as Co-Principal Investigator, (3) identified Mr. Semenye (ILCA) as a collaborator and (4) discussed graduate training with Mr. 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.

Z. Gathuka began a graduate program at Texas A&M in September, 1980. J. Mathenge (a Kenya student but not a part of the Kenyan project) began a graduate program in June, 1980.

Gerald Smith made detailed plans for a January, 1981 trip to Kenya which was not approved.

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

9. Technical Accomplishments.

A sheep model has been developed and programmed but is not yet operational. A number of biological parameters must yet be specified. A number of literature reviews have been completed.

1. Growth Rates for Various Breeds of Sheep* (HDB, 3/80)
2. Effect of Type of Birth and Rearing on Growth* (HDB, 3/80)
3. Effects of Ewe Age on Lamb Birth Weights and Weaning Weights* (HDB, 3/80)
4. Birth Rate Comparisons for Various Breeds of Sheep* (HDB, 5/80)
5. Postpartum Interval and The Correction factor for Time (HD3, 3/80)
6. Puberty in Ewe Lambs (HDB, 4/80)
7. The Effects of Ad lib and Restricted Water Intakes on Sheep (HDB, 5/80)
8. Embryonic Mortality in Sheep (HDB, 9/80)
9. Summary of Some Phenotypic Characteristics of East African Indigenous Breeds of Sheep (GH, 9/80)
10. Milk Production in Sheep (HDB, 11/80)
11. Nursing Lamb Intake (JM, 12/80)
12. Mineral Requirements (GLB, 3/81)

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* Tabular reviews

PART IV
PARTICIPATING INSTITUTION ANNUAL REPORTS

INDONESIA

TITLE XII
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

Small Ruminant CRSP
Annual Project Report 1980-81

(Indonesia)

1. Institution: University of California, Davis

2. Principal Investigator: G. E. Bradford

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
   Matching Contributions from 1980/81 subgrant. $105,926

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

5. Project Goals:

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

   2) To compare the performance of sheep and goats on different rations (collaborative with nutrition/forage project).

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

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

   5) To provide training opportunities for Indonesian scientists.

6. Summary of previous accomplishments.

   During the first program year a planning trip was made by the PI to Indonesia, and Dr. J. M. Levine was recruited to work full time on the project in Indonesia.

7. Statement of specific 1980/81 objectives.

   The primary objective was to initiate work on long term objective 1, characterization of local breeds and types of sheep and goats, through work with LPP and Provincial Multiplication Centers.

8. Description of work undertaken.

A system for regular, detailed recording of performance data was set up at the LPP Stations at Cicadas (sheep) and Cilebut (goats), and in the village of Ciburuy near Bogor, and data have been collected routinely since early to mid 1980 at these locations. In addition, two data collecting trips were made to the East Java Regional Center at Garahan, in August and October 1980, and contacts were established with the West Java Multiplication Station at Margawati with a view to future collaboration there. The project has provided animal identification supplies for most of these stations.

Considerable emphasis was placed on training activities and personnel development during 1980-81. Activities included:

1) A two week series of lectures and demonstrations in sheep and goat management by Mr. Donald Torell, University of California Sheep Specialist at the Hopland Field Station, as part of the CRSP training program at LPP, Bogor in July 1980.

2) A seven week intensive training period in sheep and goat management in California for Mr. Subandriyo, LPP staff member in charge of the Cicadas Station. This session, in January and February 1981, included work at both Davis and the Hopland Station. Primary emphasis was on sheep management and recording, but some time was also spent at the UCD dairy goat facility, and some on summarization of data from Cicadas and Garahan Stations.

3) Provision of funding for graduate study in Indonesia for Mr. Rahmat Setiadi, O.I.C. of the Margawati Station.

4) Provision of funds for Levine and Subandriyo to attend the Asian Animal Science Conference, Malaysia, September 2-6, 1980.

The Principal Investigator spent two weeks in Indonesia in November 1980. Principal activities included:

1) Review of data collection and summarization activities with Dr. Levine, Mr. Subandriyo (Cicadas) and Mrs. Endang (Cilebut); development of improved identification and data recording systems. Development of detailed breeding plans for Cicadas and Cilebut for 1981-82.

2) Development, in collaboration with Dr. Astuti of Gaja Mada University, Jogjakarta, of a plan to collect data on sheep and goat performance in villages representing three different farming systems/feed sources in Jogjakarta and Central Java. Dr. Astuti will be project leader, with funds provided by the breeding project.

3) Drafted guidelines for "Development of Multiplication Programs for Sheep and Goats". Discussed a draft with LPP staff and representatives from Multiplication Centers in West and Central Java. Draft revised, with contribution from Dr. Neil Thomas, and submitted, by LPP, to O.I.C.'s at Margawati, Pangarasan, etc.

Dr. Levine resigned his position on the project at the end of 1980, and the position has been advertised. Mr. Subandriyo and Mrs. Endang, with the assistance of Dr. Thomas, are continuing the performance recording at Cicadas, Cilebut and Ciburuy.

9. Technical Accomplishments.

Two reports were prepared for presentation at the Indonesia Animal Science Seminar, March 1980.

1) A preliminary report on performance of Javanese thin tailed sheep under experiment station conditions. Subandriyo, P. Sitorus, J. M. Levine and G. E. Bradford.

2) Performance of Javanese fat tailed ewes and their crossbred progeny at the Garahan Multiplication Center. Subandriyo, P. Sitorus, D. Sudarhan, J. M. Levine and G. E. Bradford.

The Javanese thin tailed sheep are generally classified as highly prolific, but actual performance data are quite limited. The data collected in this project to date (see #1, above) not only confirm the breed's prolificacy, but document an unusal pattern of variation in litter size; there were 8 sets of quadruplets in the first 64 litters recorded at Cicadas, in a flock with a mean of approximately 2. Among temperate breeds of sheep, the precentage of quadruplets, with this mean litter size, would normally be very low, zero to 2%. There are also reports from villages of unusual prolificacy, e.g. a ewe with 7 consecutive sets of quadruplets.

Australian workers have recently reported that the high fecundity of the Booroola strain of Merinos, which also is characterized by a very high variability in litter size, is apparently due to a single Mendelian gene causing very high ovulation rate. The possibility that such a gene may also be involved in the Javanese sheep merits investigation, as the breeding plan to control and utilize the high prolificacy potential of these sheep will differ greatly depending on whether the variation is due to one or to many genes. Investigating this question will be one of the emphases of the project in the coming year.

Annual Report Form for 1980/81

INDONESIA

1. Institution: North Carolina State University

2. Principal Investigator: William L. Johnson

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
   Matching Contributions from 1980/81 subgrant. $89,985

4. Project Title: By-product and crop residue utilization in intensive sheep and goat production systems for limited-resource farmers

5. Project Goals:

   The five-year project objectives as originally outlined in December, 1978, are still operative. They are:

   1. To characterize the nutritional value of by-product and crop residue feedstuffs that are available for small ruminants in the target countries, and to determine the relative importance of factors which contribute to variability in nutritive value of such materials.

   2. To develop guidelines for the formulation of balanced, maximum-profit rations for various types and classes of sheep and goats, utilizing by-product materials to the maximum degree possible, and to determine the expected productivity of animals that would consume these rations.

   3. To study methods of storage which will maintain the nutritional value of residue and by-product feedstuffs, and methods of treatment which may enhance their intake and digestibility.

   4. To test the reliability of simple feedstuff evaluation parameters for prediction of animal performance.

   5. Insofar as permitted by the studies implied above, to generate information on the nutritional requirements and comparative efficiencies of sheep and goats of various types, breeds, and productive life stages.

6. Summary of previous accomplishments.

   From January 1979 through May 1980, the period of the first "program year," two major goals were achieved: first, to establish workable administrative and scientific relationships with collaborating institutions in Indonesia; and second, to effectively marshall existing programs and resources in the Department of Animal Science, at our Raleigh campus,

in support of the new Title XII effort.

Overseas, Memoranda of Understanding with collaborating institutions were signed in time for a research plan to be developed, but no experiments to be completed within the first year. Those research results obtained were entirely from the Raleigh campus.

Corn stover was ensiled with broiler litter or soybean meal and fed with or without additional energy (ground maize) to growing-finishing lambs; low intake on broiler litter silage was a serious limiting factor for adequate growth rates. Wheat straw and ensiled screened dairy manure solids were evaluated as fiber sources in mixed rations for growing lambs or kids; at certain levels of the fiber source, intakes were satisfactory to support acceptable growth rates. In another experiment, soybean meal and urea were compared as protein supplements for lambs or kids, again with intakes adequate to support acceptable growth.

In general, Year One was the start-up year. As is recorded, Year Two was the year of solid research accomplishments and build-up of momentum toward a long list of expected achievements during the remaining expected lifetime of the project.

7. Statement of specific 1980/81 objectives.

1. Initiate village surveys in West and Central Java, aimed at understanding existing feeding practices and animal productivity.

2. Evaluate intake and relative preference for crop byproducts and forages, by sheep and goats of native breeds.

3. Study the effect of different planes of energy and protein nutrition on small ruminant productivity.

4. Study the effect of dietary interventions on rumen function in sheep.

5. Study influences of environmental variables on the nutritive value of warm-season forage crops.

8. Description of work undertaken.

A. Experiments completed.

1. Title - Intake preferences for cassava, sweet potato, banana and napier grass foliages by Priangan sheep and Cacang goats.

Leaders - Budi Haryanto, Neil Thomas, W. L. Johnson.

Location - LPP, Bogor.

Procedures - Four green forages were offered ad libitum to eight sheep and eight goats with or without supplemental concentrate (200 g/day). Two experimental periods allowed all animals to receive both treatments. Samples of feed offered and feed refused were analyzed, to allow a measure of selective intake within plant species, as well as total DM intake, intake of protein and fiber, and preference ranking of the four feedstuffs.

2. Title - Environmental effects on nutritional value of forages.

Leaders - Jose DaSilva, W. L. Johnson.

Location - NCSU campus, Raleigh.

Procedures - Three forage species representing two warm season types (coastal bermudagrass and Pennisetum flaccidum) and one cool season type (Tall fescue) were grown in pots under controlled environment at 9 and 12 hours of daylength and 18/14, 22/18, 26/22 or 30/26^{o}C of day/night ambient air temperature. Successive harvests were made after 1.5, 3.0, 4.5 or 6.0 weeks of regrowth. Measurements included total and DM yield per pot, stem/leaf rations, proportion of vascular tissue area in stem and leaf cross-sections, chemical composition, and in vitro dry matter digestibility.

3. Title - Coastal bermudagrass and tall fescue intake and digestibility by sheep, goats and dairy steers.

Leaders - Jean-Marie Luginbuhl, W. L. Johnson.

Location - NCSU campus, Raleigh.

Procedures - Eight Toggenburg wether kids and eight wether lambs were assigned in a Latin square design (with four periods) to burmudagrass or fescue hays, each at two stages of maturity. The same two fescue hays were also fed to six Holstein steers in a single reversal design. Measurements were made of voluntary intake and digestibility of total dry matter, crude protein, and fiber constituents.

B. Experiments in progress.

1. Title - Baseline survey of small ruminant production in villages of West and Central Java.

Leaders - (Nutrition component) - Neil Thomas, Wayan Mathius.

Location - Three villages in West Java; two villages in Central Java.

Procedures - Complete information on small ruminant production is being gathered as part of a collaborative project involving all disciplines of the Small Ruminants program. Within the feeding and nutrition area, the baseline survey will include a

description of cropping systems (with crop residue and byproduct availability to be inferred) and qualitative information on types of feed offered to small ruminants, whether purchased or provided from within the village resources.

2. Title - Monitoring village small ruminant production.

   Leaders - Neil Thomas, Wayan Mathius, Andi Djajanegara, Soekanto.

   Location - Two villages of West Java; LPP, Bogor; Gadjah Mada University, Jogjakarta.

   Procedures - As a follow-up to the baseline survey, more detailed input/output data will be gathered for a full year from a smaller number of production units. Animal productivity parameters to be measured include fertility data, mortality, and periodic animal weights. The kinds of feeds on offer will be recorded, and periodic samples of all feedstuffs will be taken at the time they are offered to animals. Feed samples will be dried in kerosene fueled ovens (designed, developed and constructed in Bogor) and remitted to the laboratory at LPP, where they will be analyzed for crude protein, fiber constituents, and *in vitro* digestibility. Important minerals will be analyzed at Gadjah Mada University.

3. Title - Levels and sources of protein for small ruminants.

   Leader - Andi Djajanegara.

   Location - LPP, Bogor

   Procedures - An on-going series of experiments have been conducted in an attempt to determine optimum protein levels for native goats and sheep. Non-conventional protein sources such as the Gliricidia plant are included in these evaluations.

Facilities development.

LPP has adequate animal houses, pens, and metabolism cages for the collaborative projects that have so far been agreed upon. The main limiting factor is the capacity of their nutrition analytic laboratory to handle the greatly expanded number of samples which will be generated, as well as new (to them) analytical procedures. New equipment for the LPP laboratories has been ordered, using site development funds. Certain reagents, difficult to obtain or unusually expensive in Indonesia, have also been purchased by the CRSP.

Travel to and from Indonesia.

The Principal Investigator visited Indonesia twice during 1980: January 13 - February 1, and September 21 - October 14. The January trip included a week-long orientation tour of villages, experiment stations, government farms, and universities in West and Central

Java. The September - October visit was based in Bogor but included a visit to Gadjah Mada University as well.

Dr. Neil Thomas, Small Ruminant CRSP Liaison Officer who is devoting 50% of his activity time to the NCSU nutrition projects, spent two weeks at the Raleigh campus in May and arrived in Bogor to take up his assignment in early July.

Several members of the nutrition/forages research team attended the Asian-Australian Animal Science Congress in Malaysia, September 1-5, 1980. Receiving partial or total support from the nutrition research subgrant were Andi Djajanegara (nutrition), M. E. Siregar and Budi Haryanto (pastures) and Neil Thomas.

Two members of the LPP scientific staff traveled to the United States to begin graduate studies (see below).

E. Training for LPP scientific staff.

Budi Haryanto arrived at N. C. State University, Raleigh, in January 1981 to begin studies for the Master of Science degree in animal nutrition and pasture utilization. Although financed by Indonesian (World Bank) funds, Mr. Haryanto will conduct his thesis research on a topic related to Small Ruminant Nutrition.

Sorta Siratonga was at the University of Minnesota, St. Paul, accompanying her husband during 1980. She returned for a short visit to LPP in September, at which time it was agreed that she would receive partial financial support for a Master of Science program if she were accepted by the U. M. Graduate School. During Winter quarter 1981, she has been enrolled in intensive English courses, and subsequently was admitted to the Graduate School. Her program emphasis will be ruminant nutrition.

F. Personnel.

Lembaga Penelitian Peternakan (Bogor)

Project Leaders

S. Rangkuti, Nutrition
M. E. Siregar, Forages
A. Djajanegara, Nutrition
B. Haryanto, Forages
W. Mathius, Nutrition and Village Survey

Collaborators

L. Batubara, Animal Management and Nutrition
A. Rays, Laboratory Analysis
Rosasri, Laboratory Analysis

Bogor Agricultural Institute (Bogor)

Collaborator

Dr. Toha Sutardi, Animal Nutrition

Gadjah Mada University (Jogjakarta)

Collaborator

Dr. Soekanto, Animal Nutrition

North Carolina State University (Raleigh)

Project Leaders

W. L. Johnson, Animal Nutrition (Principal Investigator)
W. J. Croom, Animal Nutrition
Neil Thomas, Forages and Animal Nutrition (at Bogor)

Collaborators

Jennifer Bausman, Animal Science (Technician)
Jose DaSilva, Animal Science (Graduate student)
Jean-Marie Luginbuhl, Animal Science (Graduate student)

Student Assistants: Mary Ann Cramer, Rex Gaskins, Jerry Phelps, Denise Robertson, Maury Todd.

9. Technical Accomplishments.

Village survey results - Partial summaries of the initial survey in Ciburuy, Cirebon and Garut, three villages of West Java, are available. The table below shows a few of the parameters related to feeding practices.

	Ciburuy	Cirebon	Garut
No. families surveyed	129	100	145
No. families with -			
Goats only	54	56	0
Sheep only	48	41	140
Goats and sheep	12	0	0
Neither	15	3	5
Avg. per family (± SE)			
Goats	2.5 ± 1.3	2.2 ± 1.1	0
Sheep	3.8 ± 3.0	4.8 ± 4.0	2.8 ± 2.5
Percent of families practicing -			
Grazing, goats	5	0	--
Grazing, sheep	20	74	1
Total confinement, goats	85	100	--
Total confinement, sheep	71	26	99
Percent of farms using the following feeds -			
Native grasses	96	86	100
Banana leaves			72
Cassava leaves	26	3	22
Corn tops		2	70
Legume straw		1	32
Jackfruit leaves	5		10
Rice straw	8		13
Sweet potato leaves	1		3
Sesbania		20	
Leucaena	5	1	1
Napier (elephant) grass	1		1

Intake and relative palatability of four forages by sheep and goats - Eight growing Priangan sheep and eight growing Cacang goats were offered four fresh, green forages each day. After a suitable adaptation period, dry matter intake from each forage was measured each day. Half of the animals were offered 200 g/day of ricebran (78%), ground maize (11%), and soybean cake (11%). In a second period of the trial, the treatments were reversed. The sheep consumed all of the concentrate offered; the goats refused most of the concentrate.

Total daily DM intake from forage was 496 g for sheep with concentrate, 573 g for sheep without concentrate, and 540 g for all goats. The four feeds contribute to the daily intake as follows:

	Sheep	Goats
Percent of total intake		
Cassava leaves	49%	51%
Sweet potato vines	18	19
Banana leaves	14	21
Napier (elephant) grass	19	8
Relative preference		
Cassava leaves	100	100
Sweet potato vines	37	38
Banana leaves	28	41
Napier grass	41	18

The differences in daily intake of banana leaves and napier grass were significant ($P<.01$) between goats and sheep.

Temperature, light, and maturity effects on yield, morphology, anatomy, and nutritive value of warm and cool season forage species - Tall fescue (Festuca arundinacea Schreb.), coastal bermudagrass (Cynodon dactylon (L.) Pres.) and Pennisetum flaccidum Griseb. were propagated vegetatively in 25.4 cm diameter pots. After 3 weeks of regrowth under standard conditions the forage from all pots was clipped at stubble height of 4.8 (bermudagrass), 7.2 (fescue) or 9.6 cm (P. flaccidum) and placed inside eight chambers of the NCSU Phytotron, set at combinations of 9 or 12 hours of day length and 18/14, 22/18, 26/22 or 30/26°C of day/night temperatures. There were two replications in time and two successive harvests were made after either 1.5, 3.0, 4.5 and 6.0 weeks of regrowth.

At the same chronological age, dry matter yields of bermudagrass with 9 hours of light and P. flaccidum and fescue (both day lengths) increased with increasing temperatures, except at 1.5 weeks. Under longer days, bermudagrass yields were not affected by temperature. Stem-to-leaf ratios were positively correlated with dry matter yields in all species; $r = 78$, .68 and .55 ($P<.01$) for bermudagrass, P. flaccidum and fescue, respectively. Stem-to-leaf ratios increased with increasing age in all species ($P<.01$) and with temperature in bermudagrass and P. flaccidum.

Sections cut from the midportion of the second leaf and the second internode above the clipping height of 8 plants randomly selected from each pot were prepared for histological determinations. The areas were calculated from lengths, widths and diameters directly measured by means of an ocular grid calibrated with a stage microscope. Cool and warm-season grasses differed in the proportions of vascular bundle sheath. In leaves and stems, the average bundle sheath areas were 27.9, 11.6 and 9.7, and 7.9, 8.9 and 19.0 percent in bermuda, P. flaccidum and fescue, respectively ($P<.01$). These proportions were affected by age of harvest in the leaves (all species) and by temperature in the stems of P. flaccidum. The average distance between bundles and the ratio of this distance to vascular bundle diameter were greater in fescue than in the two warm-season species. P. flaccidum had the lowest ($P<.01$) area-percent of lignified vascular tissue in leaves, but also a lower average distance between bundles and a higher ratio of leaf thickness to vascular

bundle diameter, suggesting a higher proportion of structural tissue outside the vascular bundles, especially at high temperatures. In stems (including leaf sheaths) tall fescue had the lowest area of ground tissue per number of vascular bundles. This ratio decreased at a higher rate as temperature increased in fescue than in either of the other species.

Compared with fescue, the two warm-season grasses had higher ($P<.01$) levels of all cell wall fractions measured. Total cell wall constituents (neutral-detergent fiber) increased with maturity in all species. The values ranged from 54.7 to 59.6 and from 48.4 to 61.7 percent ($P<.01$) in bermudagrass and P. flaccidum harvested between 1.5 and 6.0 weeks of regrowth, respectively. Bermuda had higher levels of hemicellulose and acid insoluble ash but lower levels of cellulose than P. flaccidum. Cellulose increased with age of harvest and temperature in both species; hemicellulose remained unchanged in bermudagrass and decreased in P. flaccidum with increased temperatures. The higher level of neutral detergent fiber in P. flaccidum is a reflection of increased rates of cellulose deposition due to maturity as compared to bermudagrass and a greater effect of temperature (T) on lignin content (Y) at early (1.5 weeks) stage of harvest ($Y = 1.9 + 0.07\ T$, $P<.0003$) of P. flaccidum.

In vitro dry matter (IVDMD) and cell wall (IVCWD) digestibilities declined with temperature and age of regrowth and their interactive effects, especially in the warm-season species. The average values of IVCWD were 69.5, 70.2 and 75.1 percent (± .53) for bermudagrass, P. flaccidum and fescue, respectively. There was an apparent association between the declines in digestibility and changes in chemical composition, proportions of different tissues, and percent of leaves and stems. In leaves of all species the age-influenced decline in digestibility and increase in cell-wall constituents were accompanied by increases in the ratio of leaf thickness to vascular bundle diameter. Warmer temperatures brought about similar declines in digestibility in the warm-season grasses. The inclusion of some of these variables along with chemical components in multiple regression models for the prediction of in vitro digestibility significantly increased the precision of such predictions.

Publications

DaSilva, Jose H. 1981. The effects of age of regrowth, daylength and ambient air temperature on the growth and quality of three forage species. PhD thesis, North Carolina State University, Raleigh. xi plus 197 pp.

DaSilva, Jose H. and W. L. Johnson. 1980. Daylight and ambient air temperature interactions on the growth of three forage species. Phytotron Annual Report, North Carolina State University, Raleigh.

Johnson, W. L. 1980. Los residuos de cosecha como estrategia para la alimentacion de rumiantes menores (Crop residues as a strategy for small ruminant feeding). Proceedings, Workshop on Strategies for Crop Residue Use in Animal Feeding. CATIE. Turrialba, Costa Rica.

Johnson, W. L. and Jose DaSilva. 1980. Cell-wall structure and digestibility in forage plants. Proceedings, 29th Annual Dairymen's Conference, North Carolina State University, Raleigh. p. 58

SR-CRSP
Annual Report Form for 1980-81

(Indonesia)

1. Institution: University of Missouri-Columbia

2. Principal Investigator: Michael F. Nolan

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $253,333
   Matching Contributions from 1980-81 subgrant. $91,727

4. Project Title: Sociological Analysis of Small Ruminant Production Systems.

5. Project Goals:

   1. To describe the social organization of small ruminant production at various locations on the island of Java.

   2. To describe the place that small ruminants occupy in what is predominantly an intensive crop production system.

   3. To understand what role, if any, small ruminants play in the socio-religious-cultural milieu on Java.

   4. To understand the role that governmental institutions (e.g., credit, marketing, extension services) play in facilitating the production of small ruminants.

   The ultimate goal of the project is to be able to:

   1. Understand the economic calculus (the source of rationality) of small producers and the constraints under which they operate.

   2. Understand who among the overall population of livestock producers will benefit from technological change.

   3. Anticipate the problems which will emerge with the implementation of new technology on a large scale.

6. Summary of previous accomplishments.

   The only work that was undertaken prior to the signing of the Memorandum of Understanding in February, 1980, was to initiate an extensive review of the literature related to agricultural production in Indonesia. This has been accomplished and while no literature review is ever complete, we do have a substantial number of references on this topic. They are available in a computerized bibliographic data base and can be accessed by any interested party.

7. Statement of specific 1980/81 objectives.

Two specific objectives were identified for Indonesia for the 1980-81 grant year.

(1) Participate in a multidisciplinary production system baseline survey in Central and West Java.

(2) Conduct a seminar with Indonesian rural sociologists on the social organization of Javanese agriculture.

In addition, there were two other general objectives which had direct relevance for the Indonesian site.

(1) Continue literature search for materials related to the social aspects of small ruminant production.

(2) Identify an Indonesian student and have him/her start graduate training.

8. Description of work undertaken:

Five major areas of activity have been undertaken this year.

1. Training: An MS student, Mr. Kedi Suradisastra from LPP/Bogor, has started a Master of Science degree program in rural sociology at the University of Missouri. This was begun in January, 1981 and it is expected to take approximately two years to complete. Mr. Suradisastra is being supported by CRSP funds.

2. Seminar/Workshop: The Principal Investigator participated in a month-long, village survey/production systems training workshop in Bogor in June-July, 1980. This seminar was designed to train the village level survey workers and acquaint LPP professional staff with the techniques of doing baseline survey work at the village level. Areas covered ranged from the techniques of survey research to more substantive discussions of the goals of sociology, economics, nutrition, etc. By all accounts it was a highly successful investment of time and resource and there are plans to do something similar in the future.

3. Village survey data collection: The baseline survey data collection effort is now underway with sociology, economics, and the animal science disciplines cooperating in the effort. Three villages in West Java have been selected for study and data collection is underway. In addition, it is anticipated that similar efforts will begin very soon in Central Java with the signing of the regional agreement for that region. Our attempts to begin work in East Java have been stymied by the lack of a regional agreement. Although the survey covers a variety of issues, those of particular concern to sociology include: contacts farmers have with institutions (credit, markets, extension, etc.); baseline family nutrition data; farmers' attitudes towards change and new technology; migration/population questions.

In addition, data are also being collected on the role that various family members play in the production of small ruminants as well as information on the distribution of small ruminants in villages.

4. Collaboration: A major accomplishment of the sociology project has been the establishment of a close working relationship with Dr. John Ihalauw of Satya Wacana University in Salatiga, Central Java. Dr. Ihalauw is a rural sociologist and has expressed considerable interest in working with the SR-CRSP on a long-term basis. We are supporting some research he and his students are conducting in Central Java villages. In addition, Dr. Ihalauw has been working closely with the LPP/Bogor staff in helping to integrate sociology into their progam, particularly in terms of the village survey data collection effort.

5. Literature review: This is an ongoing process and involves collecting and categorizing relevant literature for the Indonesian site. We have recently computerized our literature holdings in order to make them more available to other users. This should be completed by April, 1981.

9. Technical Accomplishments:

It is still somewhat early for mention of specific outputs for the Indonesian program. At the same time, it should be noted that a large amount of baseline data should be in-hand within the next two/three months and considerable analysis should be started during the 1981 calendar year.

The two most significant accomplishments this year are:

1. Identifying and initiating the training program for Mr. Suradisastra, who will within two years return to LPP/Bogor to continue the sociology program activities within that organization.

2. The establishment of a close collaborative relationship with Dr. Ihalauw which allows the program to move forward in the absence of the Principal Investigator.

Annual Report Form for 1980/81

(Indonesia)

1. Institution: Winrock International Livestock Research and Training Center

2. Principal Investigator: A. John De Boer

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $233,333
   Matching Contributions from 1980/81 subgrant. $82,295

4. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Indonesia.

5. 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 previous accomplishments.

   (i) Visited Indonesia as leader of SR-CRSP Asian Site Selection team and made initial scientific and institutional contacts.

   (ii) 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.

   (iii) Began organization of "Sheep and Goat Production Short Course" scheduled for June-July, 1980.

7. Statement of specific 1980/81 objectives.

(i) Selection of counterpart scientist and joint formulation of Phase III Work Plan.

(ii) Conduct training, as needed, to orient all Indonesia project participants to the SR-CRSP, set out the plan of activities of each project carrying out research in Indonesia, discuss research techniques, and orient village enumerators to the field survey program and field survey techniques.

(iii) Set up a smoothly functioning farm survey program including establishing procedures for village selection; farmer selection; frequency of enumeration; data checking, processing, storage retrieval and analysis.

(iv) Construction of survey instruments for village selection, farmer selection, initial survey and continuing monitoring survey.

(v) Identification of candidates for long-term formal training.

(vi) Recruitment of long-term research scientist in agricultural economics.

(vii) Assess the possibilities for incorporation of Small Ruminants research into transmigration areas on outer islands of Indonesia.

(viii) Establish local formal training component in Indonesian Universities by supporting local student research on sheep and goats.

8. Description of work undertaken.

(i) International travel - John De Boer for 1 week January, 1979, 10 days in March 1980, 8 weeks in June-August, 1980.

-- Jerry Perkins to FAO Headquarters, Rome, 5 weeks, Oct-Nov, 1980.

-- Dr. Panjaitan for 3 days at Winrock International in November, 1979.

-- Mr. Stephen Mink in Indonesia for 13 weeks, June-September, 1980 to learn Bahasa Indonesia language, participate in LPP/SR-CRSP training course and conduct field research in transmigration areas of Sumatra.

-- M. Sabrani to Serdang, Malaysia to give paper at 1st Australian Conference on Livestock Production.

(ii) Languages learned - Mr. Stephen Mink, medium fluency in Bahasa Indonesian. Mr. Agus Muljadi, continuing English language training for US graduate study.

(iii) Training - De Boer, Mink and Indonesian agricultural economics counterparts (Muljadi, Sabrani) participated in 18 day training course at LPP Headquarters in Bogor, June 23-July 18, 1980.

-- Ing. Sugiyanto provided research assistantship at Institut Pertanian, Bogor to complete coursework and assist on agricultural economics research program at LPP. Assistantship covers period July 1, 1980-June 31, 1982 and will result in M.S. thesis on village level sheep and goat production economics.

-- M. Sabrani and A. Muljadi, LPP counterparts submitted application forms to U.S. Universities for training at PhD and MS degrees, respectively.

(iv) Collaborative work with Farm Management Services Section, Agriculture Division FAO, Rome. Jerry Perkins helped design micro computer version of Farm Management Data Collection and Analysis System. This will be used in Indonesia. Also helped improve livestock section of the package.

(v) Advertising for research scientist in agricultural economics began Feb., 1981.

9. Technical Accomplishments.

(i) FAO collaborative research to improve data collection and analysis of small farms in developing countries (also applicable to Kenya research program).

-- Jerry Perkins worked on three aspects of the FAO Farm Management Services Division Farm Management Data Collection and Analysis System:

(a) Condensing the current program to allow it to be run on much smaller computers such as the DEC 1170 System at Winrock International. This was accomplished in early 1980 and the computer software transmitted to FAO, Rome. This gives the current system a much expanded range of users around the world.

(b) Development of a livestock feed demand module for the new micro computer version of the farm management data collection and analysis system (FARMAP) and design of the software and documentation for this module. This was completed at Winrock in December, 1980.

(c) Development of a herd parameter model for the same system. This was completed in Rome in November, 1980 with a User's Guide and Programmer's Guide provided to FAO, Rome. FAO provided all local costs in Rome.

(ii) Goat Production in Transmigration Areas -
The final report on this project was completed on October 14, 1980 and transmitted to Indonesia. The report is entitled: Prospects for Small Farm Goat Production in a Transmigration Area of Indonesia: Results of a Survey, by Stephen Mink, Winrock International Livestock Research and Training Center in conjunction with Lembaga Penelitian Peternakan and Lembaga Pusat Penelitian Pertanian, Bogor and Woodrow Wilson School of Public and International Affairs, Princeton University, October 14, 1980, pp. 44. The Woodrow Wilson School provided all international air fare cost.

This study 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 Keneana 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 transmigrants in goat production, characteristics of transmigrant farming systems, and growth potential and research needs of goats in transmigration areas. The study covered land use, labor use, feed supplies, cropping technology, livestock technology, and livestock marketing. Goat ownership had the following pattern:

		%
(1)	Farmers who own all goats currently held	41
(2)	Farmers who raise goats on a share system	54
(3)	Farmers who lease out goats on share system	10

*Not equal to 100% because 2 farmers are in (1) and (3).

This study identified a number of specific constraints on expanding goat populations and goat productivity; some of which involved researchable problems and others involving institutional and resource problems.

(iii) Small farm production systems survey work on Java - This program has involved all the SR-CRSP projects in Indonesia. The agricultural economics group and the Site Coordinator have played lead roles in the formulation and conduct of the survey work. The following sample stratum were chosen using land ownership as the substratum:

Primary Stratum	Area of Land Owned	
- Stratum I	0 - 200 m^2	(Landless & near landless)
- Stratum II	200 - 1500 m^2	(Subsistence farmers)
- Stratum III	1500 - 3000 m^2	(Small farmers)
- Stratum IV	3000 - 10000 m^2	(Medium farmers)
- Stratum V	10000 m^2	(Large farmers)

The number of respondents by primary stratum for the west Java Province Surveys are given in Table 1. The survey is proceeding in three stages. First, a baseline survey is carried out after which sampling based on animal populations is carried out. Second, a long-term periodical survey is conducted to learn about 11 aspects of the farming system. Finally, this core group of farmers provide project-specific information on animal breeding, health, feeds, systems etc., as well as serving as experimental units for technology testing and transfer.

Two papers based on this data were presented at LPP during a seminar on Animal Husbandry Research, March 24-26, 1981, in Bogor:

(a) "Prospects for Small Ruminant Development in Ciburuy Village, West Java", by M. Sabrani and A. Muljadi.

(b) "Land Tenure and Livestock Ownership Patterns in Ciburuy Village, West Java", by A. Muljadi and M. Sabrani.

Table 1. Total number of farmers and number of respondent for each village in West Java.

Stratum	VILLAGE				
	Ciburuy	Purwawinangun	Kartasura	Tenjonagara	Sindangratu
Total farmers:	230	80	20	234	236
Stratum I	49	16	5	3	6
II	26	29	5	11	21
III	17	1	1	15	22
IV	25	23	7	32	38
V	12	11	2	3	0
Number of Respondents	129	80	20	64	81

Annual Report Form for 1980/81

(Indonesia)

1. Institution: Texas A & M University

2. Principal Investigator: T. C. Cartwright

3. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $190,000
Matching Contributions from 1980/81 subgrant. $63,333

4. Project Title: Systems Analysis and Synthesis of Small Ruminant Production

5. Project Goals:

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

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.

2. To obtain parameters needed to model production systems in the West Java and other appropriate ecozones of Indonesia; to validate the model and input parameters for each of these specific zones; and to use these validated simulations as baseline simulations.

3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Indonesia.

4. To supply input-output data of sheep and goat production systems for use in economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of sheep and goat production systems to alterations or interventions requested or agreed upon by LPP.

6. Summary of previous accomplishments.

   1. Initial visits were made to Indonesia during which a Co-Principal Investigator was tentatively identified; later a different Co-Principal Investigator was named.

   2. An overview of the systems analysis project was presented to the LPP staff involved in the SR-CRSP.

   3. Field sites where data is being collected were visited to determine suitability of data already collected for use in systems analysis.

   4. Agreements were reached on a training program for Agus Muljadi at Texas A&M in cooperation with the Economics projects; also, a tentative agreement for A. P. Siregar to come to Texas A&M to work with systems analysis techniques was reached.

   5. Increased understanding of cut-and-carry, confined production of sheep in Indonesia.

7. Statement of specific 1980/81 objectives:

   1. Complete development of a sheep production systems model.

   2. Gain additional understanding of small ruminant production systems in Indonesia.

   3. Finalize agreement of Co-Principal Investigator and other collaborators.

8. Description of work undertaken.

   T.C. Cartwright traveled to Indonesia during November, 1980 to:

   1. Make arrangements for training at Texas A&M of Agus Miljadi in Agricultural Economics cooperating with Systems Analysis and of A. P. Siregar to spend time working in systems analysis at Texas A&M.

   2. Agreed upon a Co-Principal Investigator and his role in systems analysis.

   3. Visited village survey sites and Margawati, Cicadas and Cilebut stations.

   4. Gained additional information and insight about sheep production in Indonesia.

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

9. Technical Accomplishments.

A sheep model has been developed and programmed but is not yet operational. A number of biological parameters must yet be specified. A number of literature reviews have been completed.

1. Growth Rates for Various Breeds of Sheep* (HDB, 3/80)
2. Effect of Type of Birth and Rearing on Growth* (HDB, 3/80)
3. Effects of Ewe Age on Lamb Birth Weights and Weaning Weights* (HDB, 3/80)
4. Birth Rate Comparisons for Various Breeds of Sheep* (HDB, 5/80)
5. Postpartum Interval and the Correction Factor for Time (HDB, 3/80)
6. Puberty in Ewe Lambs (HDB, 4/80)
7. The Effects of Ad Lib. and Restricted Water Intakes on Sheep (HDB, 5/80)
8. Embryonic Mortality in Sheep (HDB, 9/80)
9. Summary of Some Phenotypic Characteristics of East African Indigenous Breeds of Sheep (GH, 9/80)
10. Milk Production in Sheep (HDB, 11/80)
11. Nursing Lamb Intake (JM, 12/80)
12. Mineral Requirements (GLB, 3/81)

*Tabular reviews

PART IV
PARTICIPATING INSTITUTION ANNUAL REPORTS

BRAZIL

TITLE XII
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

TITLE XII SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM
ANNUAL REPORT (April 1, 1980-March 31, 1981)

1. Institution: Texas A&M University

2. Principal Investigator: Maurice Shelton

3. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $212,800
Matching Contributions from 1980/81 subgrant. $70,974

4. Project Title: Evaluation of Meat Goats and Hair Sheep

5. Project Goals: (Refer to original subgrant agreement)

6. Summary of previous accomplishments.

This project has been fully functional for less than one year previous to that covered by this report. Not all of the funds budgeted for the previous year were expended. The previous year's effort consisted of a survey of animal populations (breeds or types) and potential experimental work sites in Brazil. A manuscript was prepared and has been accepted for publication describing the genetic resources available in Brazil. It was determined that, in the case of goats, breed characterization studies were needed to identify those types deserving further study. Work of this type is underway by Brazilian co-workers. One breed of sheep was identified as sufficiently unique and important to initiate studies to estimate genetic parameters and to initiate long-term improvement programs. Dr. J. O. Sanders and the project leader traveled to Brazil and inspected potential research sites. A station at Quixada (Ce.) operated by EPACE was selected as the primary site for this effort and work plans were drawn up and agreed to with Brazilian co-workers. In the U.S. experimental flocks of meat goats, hair sheep and fat-tail types of sheep were established and data collection was initiated. The types of data being collected included reproductive performance, growth rate, foraging behavior, slaughter and meat qualities and evaluating of feeding behavior and various blood parameters. More traditional types of sheep and goats were also included in the above studies to obtain comparisons.

7. Statement of specific 1980/81 objectives.

The general objectives remain the same as stated in the project document and first year work plan. Specific and more limited objectives for the time period covered by this request are:

A. Continue to establish flocks and make observations at this institution with relevance to LDC locations and to the overall CRSP.

B. Complete work plans and initiate data collections on meat goats and hair sheep breeding projects in Brazil.

C. Confer with Brazilian scientists on the development of alternative or prototype production systems for sheep or goats and the integration of genetic and management aspects.

D. Explore the potential of development in Brazil or at an alternate site a collaborative project involving the adaptation of fat-tail carpet wool sheep in LDC environments.

E. Participate with co-workers in Brazil and other contributors to the Small Ruminant CRSP on the conduct of needed training exercises.

8. Description of work undertaken.

OBJECTIVE A. Flocks of meat goats, hair sheep and fat-tail sheep have been established in the US. With two of these, long-term breeding programs having the potential of producing superior genetic stock have been initiated. With the third (fat-tail sheep), only a minimal flock is planned for use in maintenance and characterization of this genotype. Breeding programs are of long-term duration and the first year's results have little meaning. However, during the time period covered by this report considerable effort has been devoted to characterization of broad types of sheep and goats with a view of delineating where they each fit into various climatic and resource areas. This has involved a study of grazing behavior, meat qualities, feeding behavior, various blood parameters, etc. Much of this work has been completed. Some of these will be abstracted in brief form in section 9 to follow.

OBJECTIVE B. A project outline covering a breeding project for sheep has been completed and approved as an EMBRAPA project. This should increase the likelihood that this project will continue sufficiently long to make a contribution. Facilities (fencing, water, animal handling, etc.) have been completed at Quixada to provide a base for this work. Data have been collected for the first year's mating lambing records. Less detailed data have been collected on approximately 1,000 animals maintained on the EPACE Station at Quixada. These will be utilized to determine the economic importance of various traits in the selective program.

OBJECTIVE C. No specific projects or studies have been undertaken on this objective. However, some deviations from the traditional management systems have been initiated with the study flocks. If these preliminary observations appear favorable the possibility of integrating these into more formal studies will be explored.

OBJECTIVE D. This objective concerned with study sites for fat-tail sheep has not been accomplished. It has been discussed with workers in Brazil and in Turkey. Perhaps by the end of this subgrant period definite proposals will be developed.

OBJECTIVE E. Specific or formal training programs in Brazil have not been initiated. The principal collaborator in Brazil traveled to the US for one month on-site training. The Principal Investigator spent one month in Brazil working with individual counterparts. Workers in this project are prepared to participate in formal programs proposed or requested by Brazilian workers or by overall efforts of the CRSP. The Principal Investigator will be traveling to Brazil in May to present a paper at the First National Symposium on Tropical Sheep and Goats.

9. Technical Accomplishments.

There appeared to be a need to investigate the similarity or dissimilarity of various types of sheep and goats in terms of grazing behavior and the potential to alter this through selection. Meat type goats were found to be more efficient browsers than Angora goats. Fine-wool sheep and fat-tail sheep are very similar in grazing behavior and substantially different from goats. Hair sheep are intermediate between goats and the other types of sheep in that they browse more than Merino type sheep. This would contribute to their being better suited to an environment such as the "Caatinga" of Brazil. In terms of meat qualities the more tropically adapted meat goats and hair sheep deposit relatively small amounts of fat, and much of this is deposited internally. Feeding studies show that when fed ad libitum they have a lower level of feed intake. By contrast the fat-tail types have a high level of feed intake when fed ad libitum and this is confirmed by a large amount of body fat. This no doubt contributes to their ability to survive periods of nutritional stress and perhaps their potential utility in a wet-dry climate such as Northeast Brazil.

A number of manuscripts will be completed in the near future and copies of these will be provided. Many of these will be completed in the period covered by the Second Year Subgrant request. Others will be completed in the early part of the next year.

Annual Report Form for 1980/81

(Brazil)

1. Institution: Utah State University

2. Principal Investigator: John C. Malechek

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $333,070
   Matching Contributions from 1980/81 subgrant. $111,340

4. Project Title: Rangeland Research for Increasing Small Ruminant Production

5. Project Goals:

   A. Ecological assessment of range forage resource.

      1) Determine successional status and productivity.

      2) Determine ecological status and productivity.

      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 behavior.

      2) Describe the annual forage cycle.

      3) Ascertain forage intake in relation to nutritive requirements.

   C. Range Improvement

      1) Assess potential for using introduced forage species.

      2) Determine applicability of brush management practices (eg controlled browsing, controlled burning, hand removal) for increasing forage production.

   D. Establish controlled grazing trials to test applicability of improved range management technology developed in work under objectives A-C, above.

6. Summary of previous accomplishments.

Potential sites for research were visited. These included Turkey and Morocco initially, and finally Brazil. The decision to locate the Range Management project in Brazil was reached in January 1980. Subsequently a site visit was made in March 1980 by Malechek and Norton. Specific locations investigated on that visit included Sobral (CNPC station) and Petrolina (CPATSA station). Based on that visit, we elected to center the project in Petrolina, however, administrative discussion with EMBRAPA motivated us to shift project location to Sobral.

A research associate (Robert Kirmse) was recruited and hired to oversee and administer the work in Brazil. Additionally two PhD graduate research assistants (Joao Queiroz and James Pfister) were recruited and hired. A half-time secretary (Mrs. Robin Scherting) was recruited and hired to assist in administrative work in Utah.

On-campus research facilities were renovated for use in the Utah companion studies. This included construction of a hay shed and installation of plumbing and heating in a metabolism barn.

7. Statement of specific 1980/81 objectives.

A. Administrative/Logistical.

1) Establish an in-country presence of a full-time scientist and two graduate students.

2) Secure experimental pastures, animals, support personnel, housing, vehicles, and other material.

3) Install fiscal, administrative, communication, and logistical relationships necessary for project work.

B. Technical.

1) Ecological assessment of caatinga.

a) Initiate plant collections for a reference herbarium.

b) Investigate use of satellite imagery for inventory of soils and vegetative resources of the caatinga.

c) Investigate soil-plant relationships.

d) Explore alternatives for development of appropriate range condition criteria.

e) Initiate studies on productivity and forage dynamics of caatinga vegetation.

2) Forage plant introduction and evaluation.

a) Expand existing plant introduction program.

b) Develop a systematic forage testing program for nutritive evaluation of introduced species.

3) Brush management.

a) Evaluate existing brush control trials.

b) Select study sites and establish experimental designs for additional brush management research.

4) Range animal nutrition.

On a seasonal basis for native caatinga, cleared caatinga, and buffle grass pasture determine:
-- diets of sheep and goats.
-- nutritional value of diets (N,P, in vitro digestibility).
-- forage intake.
-- quantities of forage available.

8. Description of work undertaken.

A. Administrative/Logistical.

The following three people and their families have been located in Sobral and are now fully engaged in project technical activities:

Robert Kirmse, Research Associate, project administrator and scientist. Bob and his wife Mireille arrived in Rio de Janeiro in September where they spent a month in intensive language training, they then transferred to Fortaleza where they engaged in an additional month's language training. They have been in Sobral since November.

Joao Queiroz, PhD Graduate Assistant, and his wife Rosemary have been in Sobral since late November. Joao is conducting baseline inventory work on plant communities and will be defining relationships between soils and plant communities for caatinga vegetation. He is a Brazilian native, hence he did not require language training.

Jim Pfister, his wife Roxanne and young daughter have been in Sobral since November. Jim is a PhD Graduate Assistant and is responsible for the initial studies on range animal nutrition. The Pfisters took all of their language training in Fortaleza. Roxanne, who is a professional commercial artist, will assist the project by doing the artwork (line-drawings) for a handbook on the important woody plants of the caatinga.

Two vehicles (a Fiat sedan and a Fiat "Fiarino") have been purchased for project use. The Fiarino is a van-like auto and has been modified for hauling either animals or people.

Two houses and an apartment have been rented in Sobral as accomodations for the three families mentioned above.

B. Technical.

In Brazil: Forty hectares of land on the CNPC have been assigned to the range nutrition work and fencing is currently underway to enclose this area. Additionally, about 30 head each of sheep and goats have been purchased for esophageal fistulation and for use as collector animals for studies on forage intake. Fistulae will be established in these animals in April.

Kirmse has begun work toward establishment of a reference herbarium for CNPC lab. He has worked closely with Luis Vale on this project. A number of species have been collected and pressed and an agreement has been reached with a recognized botanical authority at the Federal University in Fortaleza for verification of specimens.

Kirmse will also supervise compilation and publication of the plant handbook mentioned above. EMBRAPA has made a tentative commitment to publish this booklet as one of their regular publication series. It will be in both English and Portuguese languages.

Work is well underway on correlating soil characteristics with plant community features. Joao Queiroz is conducting this work under the supervision of B. E. Norton. A study site roughly 100 sq. km. and including the CNPC station has been delineated and spot-visits have been made throughout this area to begin characterization of the soils and plant communities involved. To augment this work and to provide a possible vehicle for extending the work to broad areas of the Northeast, satellite imagery will be tested as a means of identifying and mapping the soil and vegetation units that are defined on the ground by conventional techniques.

In Utah: Range sheep and goat research in Utah has focused on the effects of forage "anti-quality" compounds as they influence range feeding behavior and animal nutrition. Two shrub species have been studied: blackbrush (Coleogyne ramosissima), a tannin producer, and big sagebrush (Artemisia tridentata), a prolific producer of various volatile oils constituted mainly of monoterpenoids.

The blackbrush study has involved goats and cattle, with the original hypothesis that goats can be used to control the shrub, at least to the point where the plant community is opened sufficiently that annual and perennial grasses will become established. These grasses would then provide sufficient fine fuel for controlled burning of remaining shrubs.

C. Site Visits - Project Personnel.

Malechek (PI). January 12-30, 1981. Consulted with graduate students and research associate relative to planned research. Reviewed their projects and plans. Assisted in selection of research animals and research pasture in native caatinga. Reviewed on-going research and suggested modifications in work by Roberto Mesquita, CNPC Collaborator. Visited Santa Quitera and Quixada stations to review their potential as field research sites.

Norton (Co-Investigator). January 17-30, 1981. Consulted with graduate students, research associate and Ambrosio Araujo and Jose Gerardo de Oliveira, both of the Federal University of Ceara, relative to soil-vegetation work. Inspected the Santa Quitera station.

Box (Co-Investigator). March 13-22, 1981. Visited CNPC station, Quixada, and CPATSA station at Petrolina to obtain over-view of potential research problems and to select a study site(s) for future work on brush management which he will supervise.

D. Education/Training.

Established preliminary relationships for graduate study at Utah State University for:

Roberto Mesquita; MS program, range management-range animal nutrition. Begins 1982.

Ederlon Oliveira; PhD program, range animal nutrition. Begins 1983.

Additionally, the following graduate students have been partially or wholly supported on CRSP funds.

Name	Degree	Location of Research	Level CRSP Support
Linda Howell	MS/PhD	Brazil (beg. 1982)	partial
Hamid Narjisse	PhD	Utah	partial
Fred Provenza	PhD	Utah	partial
James Pfister	PhD	Brazil	total
Joao Queiroz	PhD	Brazil	total

9. Technical Accomplishments.

Work in Brazil has not progressed to the stage where technical data are available. The following two paragraphs summarize companion-project work that has been completed in Utah.

Effects of tannins on dietary selection of blackbrush by range goats. F. D. Provenza and J. C. Malechek, Utah State University, Logan.

Domestic goats were used to modify the growth form of blackbrush (Coleogyne ramosissima), a spinescent shrub occuring in nearly monospecific stands on several million hectares of rangeland in the southwestern United States, in an attempt to improve these rangelands for cattle. Goat browsing stimulated twig production of current season's growth (CSG) and increased yields by approximately 400 percent over that of control plants. Compared to old growth, CSG contained more phosphorus (9.13 vs 0.09 percent), crude protein (7.1 vs 5.0 percent), and in vitro digestible dry matter (48 vs 38 percent), however, the palatability of new growth was reduced by high levels of tannins. Tannin levels were 2.1 times higher in current than in old twigs. Within blackbrush plants, CSG produced by older branches growing on the outer edges of the plant canopy (terminal branches) contained 1.3 times more tannin than did CSG produced

by sprouts and young branches (basal branches) growing within the shrub canopy. On heavily stocked pastures, goat utilization of old terminal vs CSG basal branches averaged 29 vs 30 and 11 vs 14 percent for moderately and lightly stocked pastures, respectively. Blackbrush apparently employs a chemical defense system to reduce its risk of being over-browsed; the occurence and distribution of tannins within blackbrush is supported by plant-antiherbivor theory. The implications of this research to blackbrush are (1) new growth, while apparently more nutritious than older material, as determined by standard chemical tests, is not as palatable as older growth; (2) treatments that stimulate browse production may be counter productive in the short-run if they result in reduced utilization of plants. (Submitted for presentation to 73rd Annual Meeting, Am. Soc. Anim. Sci., Raleigh, NC)

Acceptability of big sagebrush (Artemisia tridentata) to experienced and naive sheep and goats as affected by season and monoterpenoid level. H. Narjisse and J. C. Malechek, Utah State University, Logan.

Small pastures of native sagebrush-dominated rangeland were heavily stocked by esophageally-fistulated sheep and goats having varying levels of previous dietary experience on sagebrush ranges. Trials were conducted in June, botanical composition of diets selected and monoterpenoid concentrations in sagebrush. Big sagebrush was available at about 220 kg ha^{-1} during all three trials, whereas herbaceous species, grasses and forbs, were exceedingly scarce, averaging 24 and 5 kg ha^{-1}, respectively. Yet neither sheep and goats consumed appreciable amounts of sagebrush. Dietary levels of big sagebrush for experienced sheep averaged 42%, 19% and 9% during June, August, and November, respectively. Naive sheep never consumed more than 6% of their diet as sagebrush. Naive goats refused sagebrush entirely. Monoterpenoid levels were 1.33%, 2.18% and 1.87% of the dry matter in big sagebrush during June, August, and November. Implications of this research are that sheep and goats are probably of limited value for controlling big sagebrush, even at intense stocking pressures. Previous dietary experience is potentially important in consumption of unpalatable plants and probably justifies further inquiry.

Annual Report Form for 1980/81
BRAZIL

1. Institution: North Carolina State University

2. Principal Investigator: William L. Johnson

3. Funds allocated from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $266,666
Matching Contributions from 1980/81 subgrant. $89,985

4. Project Title: By-product and crop residue utilization in intensive sheep and goat production systems for limited-resource farmers

5. Project Goals:

The five-year project objectives as originally outlined in December, 1978, are still operative. They are:

1. To characterize the nutritional value of by-product and crop residue feedstuffs that are available for small ruminants in the target countries, and to determine the relative importance of factors which contribute to variability in nutritive value of such materials.

2. To develop guidelines for the formulation of balanced, maximum-profit rations for various types and classes of sheep and goats, utilizing by-product materials to the maximum degree possible, and to determine the expected productivity of animals that would consume these rations.

3. To study methods of storage which will maintain the nutritional value of residue and by-product feedstuffs, and methods of treatment which may enhance their intake and digestibility.

4. To test the reliability of simple feedstuff evaluation parameters for prediction of animal performance.

5. Insofar as permitted by the studies implied above, to generate information on the nutritional requirements and comparative efficiencies of sheep and goats of various types, breeds, and productive life stages.

6. Summary of previous accomplishments.

From January 1979 through May 1980, the period of the first "program year," two major goals were achieved: first, to establish workable administrative and scientific relationships with collaborating institutions in Brazil; and second, to effectively marshall existing programs and resources in the Department of Animal Science, at our Raleigh campus, in support of the new Title XII effort.

Overseas, Memoranda of Understanding with collaborating institutions were signed in time for a research plan to be developed, but no experiments to be completed within the first year. Those research results obtained were entirely from the Raleigh campus.

Corn stover was ensiled with broiler litter or soybean meal and fed with or without additional energy (ground maize) to growing-finishing lambs; low intake on broiler litter silage was a serious limiting factor for adequate growth rates. Wheat straw and ensiled screened dairy manure solids were evaluated as fiber sources in mixed rations for growing lambs or kids; at certain levels of the fiber source, intakes were satisfactory to support acceptable growth rates. In another experiment, soybean meal and urea were compared as protein supplements for lambs or kids, again with intakes adequate to support acceptable growth.

In general, Year One was the start-up year. As is recorded, Year Two was the year of solid research accomplishments and build-up of momentum toward a long list of expected achievements during the remaining expected lifetime of the project.

7. Statement of specific 1980/81 objecives.

1. Establish a survey and sampling network for crop residue feedstuff evaluation, with assistance from EMATER agencies.

2. Evaluate the digestibility, intake, and relative preference by small ruminants for several forages and crop residues.

3. To test the effect of plane of energy nutrition during growth on weight and age at puberty in Morada Nova ewe lambs.

4. Evaluate the practical and economic feasibility of dry season supplementary feeding for wether lambs.

5. Test different methods of storing (ensiling) maize crop residues.

6. Study the effect of dietary interventions on rumen function in sheep.

8. Description of work undertaken.

A. Experiments completed.

1. Title - Maize plant residues for Santa Inez sheep in confinement.

Leaders - F. Arruda, N. Barros, E. Oliveira, W. L. Johnson, A. Azevedo.

Location - CNPC, Sobral.

Procedures - Eighteen partly grown wether lambs (average initial weight 27.1 kg) were randomly assigned to four treatments. Six wethers were slaughtered immediately; carcass data were obtained. Six pens and two lambs each were assigned to receive one of three experimental rations based on maize residues, supplemented with maize grain and cottonseed meal. After 80 days of continuous feeding, all animals were slaughtered.

This experiment will serve as part of a master's thesis for Mr. Francisco de Assis Arruda at the Federal University of Ceara. Mr. Arruda is on leave of absence from the CNPC.

2. Title - Palatability of maize residues for goats.

Leaders - E. Oliveira, N. Barros, W. L. Johnson.

Location - CNPC, Sobral.

Procedures - Eighteen weanling SRD goats (average initial weight about 10 kg) were offered a choice of two of the following feeds: whole plant maize stover, maize husks, maize cobs, or chopped green napier grass (Pennisetum purpureum). The six treatment combinations were offered to all animals in six experimental periods. Individual daily feed intakes were recorded.

3. Title - Maize stover ensiled with soybean meal or broiler litter for growing lambs and wintering stocker steers.

Leaders - L. Goode, R. W. Harvey, T. O. Johnson.

Location - NCSU campus, Raleigh.

Procedures - Maize stover was ensiled after high moisture grain harvest or after regular grain harvest, and compared with standard maize silage in trials with wintering stocker steers or growing lambs. The lamb trial provided voluntary feed intake and digestibility data.

4. Title - The use of fermentable carbohydrate and Lactobacilli additives with ensiled maize stover.

Leaders - L. Goode, R. W. Harvey, T. O. Johnson.

Location - NCSU campus, Raleigh.

Procedures - The effects of adding graded levels of ground maize or molasses, with or without an inoculum of lactic-acid producing bacteria, were studied in a laboratory fermentation trail.

5. Title - Forage utilization by Dorset, Barbados Blackbelly, and D x B crossbred ewes.

Leaders - J. C. Brasfield, L. Goode.

Location - NCSU campus, Raleigh.

Procedures - Four mature, non-gravid ewes of each breed and the F_1 cross were used in a series of trials to compare voluntary intake and digestibility of alfalfa hay, tall fescue hay, and a mixture of 50% fescue hay with 50% maize stover. The Barbados Blackbelly breed used in this experiment has many similar characteristics to the tropical hair sheep prevalent in Northeast Brazil.

6. Title - Digestibility and intake of rations with varying levels of wheat straw by growing sheep and goats.

Leaders - Lynn E. Brown, W. L. Johnson.

Location - NSCU campus, Raleigh.

Procedures - Chopped wheat straw was fed at 35, 50 and 65% of the total ration to wether kids and lambs. Other components of the three treatments were 37, 20, and 4% ground maize and 13, 15 and 16% soybean meal, respectively; 9% molasses and 6% water were also added. Nine observations of intake and digestibility were obtained for each treatment within each breed.

7. Title - Urea vs. soybean meal as protein supplement for sheep and goats.

Leaders - A. L. Ordoveza, W. L. Johnson, D. Mann.

Location - NCSU campus, Raleigh.

Procedure - Trial 1 - Nine grade Toggenburg wether kids were assigned to one of three levels of urea (0, 1 or 2%) in an incomplete Latin square with two experimental periods, to allow six observations per treatment. The experimental periods were based on chopped wheat straw (44%), chopped alfalfa hay (21%), ground maize (18%) and cane molasses (11, 10, or 9%, respectively).

Trail 2 - Eight grade Toggenburg wether kids and eight grade Suffolk wether lambs were assigned to four diets in a 4 x 4 Latin square, across four experimental periods. Chopped wheat straw and alfalfa hay was the forage base (70%); ground maize and molasses provided supplemental energy. Diets contained either 1.3% urea, 2.1% urea, 9% soybean meal or 14% soybean meal; alfalfa hay levels were adjusted to maintain crude protein (equivalent) at about 13%.

Data from these two trials are presently being summarized.

8. Title - Voluntary intake and digestibility of wheat straw, soybean straw, and maize stover by sheep, goats and dairy steers.

Leaders - W. L. Johnson, D. Mann, J. Bausman, L. Evini

Location - NCSU campus, Raleigh.

Procedures - Three trials were conducted to compare sources and levels of fiber in similar rations fed to three ruminant species. Voluntary intake and digestibility were measured in all trials. Trial 1 used six sheep (wether lambs) and six goats (wether kids); three experimental rations were fed, identical except for roughage source. In trials 2 and 3, eight Holstein steers were assigned to four rations in an incomplete Latin square with three periods, so that six observations were obtained for each ration. Roughages used were the same as those fed to the goats and sheep in trial 1.

Chemical procedures and data summization are presently underway.

9. Title -Effect of Avoparcin or high levels of salt (NaCl) on rumen function.

Leaders - W. J. Croom, Mark Froetschel, Rex Gaskins

Procedures - The nonionophore antibiotic Avoparcin was fed to sheep with high or low fiber diets in an effort to modulate rumen fermentation toward higher levels of propionate production and more effective bypass of ruminal degration by dietary protein. In a separate experiment, growing steers were offered diets with NaCl as 5% of total dry matter, to test the hypothesis that the resulting increased water intake will help flush easily soluble nutrients from the rumen to the lower gastrointestional tract, where enzymatic degradation and absorption is more efficient. These data are currently being summarized.

B. Experiments in progress.

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

Leaders - E. Oliveira, N. Barros, 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 in storage in Sobral, awaiting analysis for crude protein, total cell-wall fiber, in vitro digestibility, and important minerals.

2. Title - Digestibility of rations containing maize crop residues, by sheep.

Leaders - F. Arruda, A. Alves, W. L. Johnson.

Location - Federal University of Ceara, Fortaleza.

Procedure - A conventional digestibility trial (at ad libitum intake) is being conducted with wether lambs, Santa Inez breed, using rations based on maize crop residues. This experiment will comprise part of Mr. Arruda's master's thesis.

3. Title - Effect of energy levels on weight and age at puberty, Morada Nova ewe-lambs.

Leaders - E. Oliveira, N. Barros, W. L. Johnson, Aurino Simplicio, Simon Riera.

Location - CNPC, Sobral.

Procedure - Twenty-four weanling lambs were assigned to one of four levels of maize grain: 50, 200, 350 or 500 g/day, with all animals receiving a roughage mixture (maize shucks plus cobs, ground) free choice, plus 150 g/day of cottonseed meal. Lambs are housed in groups of three per pen, with two pens on each treatment for continuous feeding until diagnosed pregnant. All animals are checked twice daily for estrus with teaser rams, and will be bred at second estrus, and subsequently until confirmed pregnant.

C. Facilities development.

Because the National Goat Research Center is one of the newest in the EMBRAPA system, its construction program is not yet complete, and existing laboratories are not yet fully operational.

The Small Ruminant CRSP, through the nutrition project, this year provided some assistance to EMBRAPA in the construction of pens of intensive feeding research. Two units, each with 16 pens that can house from 1-4 animals, were designed in a collaborative exercise with CNPC scientists, and constructed entirely with locally available materials. A small storeroom-workroom was built adjacent to these pens. The location and layout of these facilities will allow for their expansion as needs expand.

An agreement was also made with EMBRAPA to provide assistance in establishing an analytical laboratory for the nutrition program. This assistance will be in two forms: a PhD level person with skills in analytical procedures and experience in laboratory management, whose duties will include the organization of the laboratory and training technicians; and material assistance in the form of reagents and supplies. Most of the necessary equipment has been purchased or is on order through EMBRAPA; the notable exception is a Kjeldahl nitrogen digestion/distillation unit, which has been purchased with CRSP site development funds.

D. Travel to and from Brazil.

The Principal Investigator visited Brazil for the purpose of planning, implementing, and evaluating collaborative experimental work twice during the report period: from June 1 - July 11, 1980, and January 4-24, 1981.

Dr. Ederlon Oliveira, principal collaborator in nutrition and Technical Chief of the CNPC, visited the United States in order to attend the coordination meeting for Brazil program participants in February, 1981. He was on the Raleigh campus for nutrition project consultation, February 26 - March 1, 1981.

E. Training for CNPC scientific staff.

Mr. Francisco Arruda began his MS studies in animal production and nutrition at the Federal University of Ceara early in 1980. Although supported with local funds, Mr. Arruda is conducting his thesis research as part of the Small Ruminant CRSP nutrition program.

F. Language study.

The Principal Investigator devoted approximately 50 hours to intensive Portuguese tutoring prior to his first Brazil visit in 1980. The enhanced conversational ability which resulted made this effort more than worthwhile.

G. Personnel.

Centro Nacional de Pesquisa em Caprinos - EMBRAPA (Sobral)

Project Leaders

Ederlon Ribeiro de Oliveira, Animal Nutrition
Nelson Barros, Animal Nutrition

Collaborators

Francisco de Assis Arruda[1], Animal Management
Aurino Alves Simplicio, Reproduction
Simon Riera Guzman, Reproduction

Universidade Federal de Ceara (Fortaleza)

Collaborators

Abelardo Ribeiro de Azevedo, Animal Science
Antonio Alves, Animal Science

[1]Graduate student at Universidade Federal de Ceara, Fortaleza.

EMATER - Ceara (Sobral)

Collaborator

Francisco Bernadone Telles Pinto, Small Ruminant Extension Specialist

North Carolina State University (Raleigh)

Project Leaders

William L. Johnson, Animal Nutrition (Principal Investigator)
W. J. Croom, Animal Nutrition
Lemuel Goode, Animal Science

Collaborators

Jennifer Bausman, Animal Science (Technician)
John Brasfield[2], Animal Science
Lynn E. Brown[2], Animal Nutrition
Lucas Evini[2], Animal Nutrition
Mark A. Froetschel[2], Animal Nutrition
R. W. Harvey, Animal Nutrition
Thomas O. Johnson[2], Animal Science
Debora Mann[2], Animal Science
A. L. Ordoveza[3], Animal Science

Student Assistants: Mary Anne Cramer, Jerry Phelps, Denise Robertson, Donald Shuping, Tammy Spohn, Maury Todd, Karen Whitlow.

9. Technical Accomplishments.

Maize plant residues for Santa Inez wethers in confinement - Six lambs (randomly selected) were slaughtered at 25.5 ± 6.1 kg liveweight; carcass yield was 44.1 ± 3.4%. Twelve lambs from the same group, initial weight 28.0 ± 2.5 kg, were fed one of three maize-residue rations for 80 days. Final weights were 37.8 ± 2.1 kg, for an average daily gain of 143 ± 31 g per animal, and carcass yields of 50.5 ± 2.5%. Whether the roughage base was maize stover (whole plant), maize cobs, or a mixture of cobs with husks (1:1 by weight) did not significantly influence the results. The rations consisted of 51% maize byproduct, 28% cottonseed meal, 20% maize grain, and 1% common salt. Preliminary economic analysis indicated that the dry season confinement feeding period was profitable. Substitution of cottonseed meal by a forage legume could further decrease ration cost.

Palatability of maize crop residues for goats - Eighteen observations of voluntary intake of napier grass (green-chop) and three maize crop residues, offered to weanling SRD goats in all possible paired

[2]Graduate students at North Carolina State University.
[3]Visiting Professor from the University of the Philippines at Los Banos.

combinations, showed that daily dry matter intake was approximately 40% higher when napier grass was one of the feeds on offer, regardless of which maize crop residue was offered with it. Approximate relative palatability ratings of the residue feeds, if napier grass is considered as 100%, were whole plant maize stover 60%, maize shucks 50%, and maize cobs 30%. Data on crude protein and estimated digestible dry matter intakes will all be available at a later date.

Maize stover ensiled with soybean meal or broiler litter - In trials with growing lambs and stocker steers conducted at Raleigh, voluntary intake and animal rates of gain were higher when the maize stover was ensiled after high-moisture grain harvest, compared to mature (dry) stover ensiled after regular grain harvest. Both treatments were inferior to standard maize silage. Digestibility data from these rations are being summarized.

Additives with ensiled maize crop residue - Since poor packing and lack of readily fermentable carbohydrates are problems when ensiling maize stover with broiler litter, a fermentation study was conducted to test the addition of incremental levels of ground maize or molasses, with or without a lactic-acid producing bacterial culture. Either ground maize or molasses improved fermentation characteristics; the microbial inoculum had no effect.

Forage utilization by Dorest, Barbados Blackbelly, and DXB crossbred ewes- Four mature, nongravid ewes each, of a temperate breed (Dorset, D), a tropical breed similar to those found in Northeast Brazil (Barbados Blackbelly, B) and the F_1 cross of the two breeds (B x D) were used in a series of trials to compare their voluntary intake and digestibility of alfalfa hay, tall fescue hay, and a mixture of 50% tall fescue hay and 50% corn stover. When dry matter intake was corrected for metabolic body size (weight $^{.75}$) there were no differences between B and D; however, the B x D had a significantly higher intake for all three forages. Digestibility of dry matter and fiber constituents was slightly higher for D than B for all feeds, and slightly higher for the D x B than for either parent breed. The implication of heterosis for these variables needs to be verified with larger numbers of animals.

Intake and digestibility of wheat straw rations fed to goats and sheep - Chopped (1-4 cm) wheat straw (WS) was fed at 35, 50, and 65% of the total ration to nine Saanen X Toggenburg wether kids and nine Suffolk X Barbados Blackbelly wether lambs averaging 23 ± 3 and 45 ± 4 kg, respectively. Nine observations of intake and digestibility were obtained per treatment per species. Other components of the three treatments were 37, 20, and 4% ground corn and 13, 15, and 16% soybean meal, respectively; 9% molasses and 6% water were added to all treatments. Goats consumed 12, 19, and 21% more dry matter per kg of body weight than did sheep ($P < .01$). Intakes adjusted for metabolic body size were not significantly different between species; however, the species X treatment interaction was significant ($P < .01$) with the goats consuming relatively more of the 65% WS treatment and relatively less of the 35% WS treatment. Dry matter digestibility was not significantly different between species. A non-significant species X treatment interaction was apparent in the digestibility coefficients.

% wheat straw in ration	35		50		65	
Animal Species	G	S	G	S	G	S
% NDF in ration	34	35	44	46	56	58
Intake DM (gm/kg/day)	27	25	25	21	22	18
Intake DM (gm/kg$^{.75}$/day)	59	63	55	53	48	47
DM Digestibility (%)	71	70	63	64	52	57

Effect of energy levels on weight and age at puberty, Morada Nova ewe-lambs - Twenty-four weanling lambs were assigned to one of four levels of maize grain: 50, 200, 350 or 500 g/day, with all animals receiving roughage mixture (maize shucks plus cobs) free choice, plus 150 g/day of cottonseed meal. During 13 weeks, average daily gains for the four groups were 49, 55, 73 and 76 g per animal. All animals are checked twice daily for estrus and will be bred at the second standing estrus. It is too early to assess effects of treatments on age and weight at puberty. However, it is apparent that the highest level of maize is not totally consumed by the animals, and that there is a partial substitution of grain for roughage consumption at all treatment increments.

Publications

Brasfield, John C. 1980. A comparison of voluntary intake and digestibility in sheep breeds and crosses fed diets varying in composition and quality. Master of Science thesis, North Carolina State University, Raleigh, pp. 51.

Brown, Lynn E. and W. L. Johnson. 1981. Low quality roughages in rations for growing cattle. NCSU Department of Animal Science Annual Report, pp. 58-59.

Goode, Lemuel and R. W. Harvey. 1980. The use of corn stover ensiled with either soybean meal or broiler litter for wintering stocker steers. NCSU Department of Animal Science Annual Report, pp. 24-25.

Johnson, W. L. 1980. Los residuos de cosecha como estrategia para la alimentacion de rumiantes menores (Crop residues as a strategy for small ruminant feeding). Proceedings, Workshop on Strategies for Crop Residue Use in Animal Feeding. CATIE. Turrialba, Costa Rica.

USAID Title XII Small Ruminant CRSP
Annual Report for 1980/81

1. Institution: Utah State University

2. Principal Investigator: Warren C. Foote

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $94,889
   Matching Contributions from 1980/81 subgrant. $43,452

4. Project Title: Improving Female Reproduction Performance of Small Ruminants in Least Developed Countries (Brazil).

5. 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 previous accomplishments.

Work Undertaken:

The first trip to Brazil was in January and February, 1980. At that time we (1) met with administrators and researchers in EMBRAPA/CNPCaprinos, Sobral and discussed potential reproduction research, (2) identified Dr. Aurino A. Simplicio as the Brazilian collaborator with Dr. Simon Riera, IICA consultant to EMBRAPA/CNPC also as a cooperating scientist, (3) reviewed and consulted on research in reproduction already underway or planned by EMBRAPA/CNPC, (4) developed general outlines of research to be conducted with goats and sheep, with a specific outline for one project to be initiated in July 1980 dealing with the reproduction capability of three breeds of goats under two nutrition management systems, (5) agreed upon a PhD graduate program at Utah State University for Dr. Simplicio, (6) determined animal facility and pasture needs and laboratory needs for research to be conducted at Sobral and agreed upon sources of funds required, (7) accepted the responsibility to cooperate in development and conduct of a short course on reproduction to be held in September, 1980, and agreed to examine the possibility of establishing a Radio Immuno Assay laboratory for hormone analysis.

7. Statement of specific 1980/81 objectives.

   a. To provide animal facilities including pasture and laboratory with minimum equipment needs for research.

   b. To complete experimental design, identify and tag experimental animals and initiate research at Sobral and also with producer cooperators.

   c. To conduct a short course on reproduction.

   d. To continue to investigate the establishment of a RIA laboratory in Brazil.

   e. To finalize a graduate program for Aurino Simplicio at Utah State University.

   f. To work to establish cooperation with other SR-CRSP components in reproduction related programs.

   g. To continue research and to develop/identify research procedures at Utah State University to support work in Brazil.

8. Description of work undertaken.

   a. New animal sheds and corrals have been constructed and physiology of reproduction laboratories have been remodeled to better accomodate research and training in reproduction. Costs have been paid from EMBRAPA/CNPC and SR-CRSP (reproduction), and site development funds. Surgical and animal restraining equipment have been provided by the SR-CRSP (reproduction). Plans have been completed for additional animal shed and holding facilities from cooperative funding.

   b. Experimental design, selective and individual identification (ear tags) of animals and initiation of research have been completed for four experiments listed by title as follows:

      (1) Reproduction capabilities of selected genotypes of goats in Northeast Brazil (research to be used for Aurino Simplicio's dissertation for the PhD degree) (108 goats plus 350 goats already being studied in the breed evaluation sub-project).

      (2) Reproductive performance following kidding at different periods of the wet season (90 goats).

      (3) Reproduction efficiency in producer flocks receiving different levels and periods of supplementation beginning in late pregnancy (100 goats).

      (4) Reproduction and production performance of goats subjected to selected practices at the producer level (20 flocks of approximately 100 goats each or 2,000 goats).

Each of these experiments have components in addition to reproduction which could provide a basis for cooperation with other SR-CRSP components. Each of the experiments provide information directly on reproduction and also on the influence of genetics, nutrition and other aspects of management and climatic environment on reproduction.

c. A five day short course entitled "Management for Reproduction" involving both lecture and laboratory sessions was held at EMBRAPA/CNPC facilities September, 1980. Certificates of completion were presented to nineteen (19) participants from nine (9) different States in Northeast Brazil. The participants were selected from University and government personnel. The short course was a success as measured by participation during the course and from participant evaluations. Both EMBRAPA/CNPC and SR-CRSP personnel served as instructors. Plans for the second short course on reproduction will be finalized during our visit in May, 1981 and will be presented during the next fiscal year.

d. Arrangements have been made among EMBRAPA/CNPC, University of Belo Horizonte and Utah State University to establish a RIA laboratory at Belo Horizonte for use by the reproduction project. The resources are largely available at Belo Horizonte, including technical/scientific personnel. Initial hormone analysis will be progesterone and LH. Other capabilities can be added later as needs and resources are identified. Use can be extended to other SR-CRSP projects. Written agreements are in the process of being finalized.

e. A PhD graduate program for Dr. Aurino A. Simplicio has been planned at Utah State University. His research for the dissertation is being conducted at the EMBRAPA/CNPC facilities and was initiated in July, 1980. He will spend approximately two years in Utah beginning in the Fall of 1982.

f. Our research has been presented to other SR-CRSP PI's working in Brazil indicating areas of possible cooperation and invitations to cooperate. Also a standardized reproduction data collection form has been developed and circulated throughout the CRSP (copy attached). Tentative arrangements are being made to cooperate with Nutrition, By-products (North Carolina) and Sociology (Winrock).

W. C. Foote worked in Brazil in September. The time was spent preparing for and instructing in short course, reviewing and conducting research, reviewing facilities completed and planning additional facilities including remodeling of laboratory, and a visit to University of Belo Horizante to determine feasibility and arrangements for a cooperative RIA laboratory.

9. Technical Accomplishments.

Preliminary data are available on ovulation rate and related reproductive parameters for three genotypes of goats (Marota, Moxoto, SRD) in Northeast Brazil managed under natural pasture and under confinement. Results

on the occurrence and rate of ovulation and on body weight are presented in Tables 1-3.

No apparent differences occurred to date due to management/nutrition. The goats under confinement experienced some problems adjusting to confinement and feeding conditions, and the natural pasture conditions have been affected by continued drought. Relatively high proportions of all genotypes are ovulating. The SRD appears to have a higher ovulation rate and also are larger as indicated by body weight.

Two research projects are underway at Utah State University as a part of the SR-CRSP which deal with influence of genotype on reproduction. One of these, where the genotypes are just being developed, compares straightbred Spanish goats with crossbred (Nubian and Saanen X Spanish goat) F_1 dam with offspring from backcross to Dairy breeds. The numbers are limited and the oldest dams are two years. The adult does are straightbred Spanish goats from which the straightbred and crossbred dams are being developed. Some of the preliminary data are summarized in Tables 4-6. The does are kept on pasture or in dry lot and the two genotypes are managed together except for breeding. There are no apparent advantages to the crossbred does at this early stage of the study.

The second project deals with the reproductive performance of the St. Croix breed, the Rambouillet breed, and their cross. Only younger ages of particularly the crossbred group, but also the Rambouillet are available. They are in a controlled breeding program for accelerated lambing with two 40-day breeding periods beginning August 1 and February 1. Some results are summarized in Tables 7 to 9. These results demonstrate the reproduction capability of the straightbred St. Croix and Rambouillet to respond to a two times a year lambing program under Utah climatic conditions. The St. Croix is highly prolific and has the capability to lamb two times per year because of its relatively long breeding season and short postpartum interval. The Rambouillet is much less prolific and fails to lamb two times per year because of a relatively long postpartum interval. Size and growth rates of Rambouillets are greater than the St. Croix. Insufficient data are available to date on the crossbred to make comparisons.

Table 1. Percent does ovulating of those observed by genotype and nutrition/managemen

Breed Type	No.	Month						
		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Natural Pasture								
Marota	4	25.0	75.0	100.0	100.0	75.0	50.0	75.0
Moxoto	4	25.0	25.0	50.0	25.0	100.0	75.0	100.0
S.R.D.	4	50.0	75.0	100.0	50.0	100.0	50.0	75.0
Combined	12	33.3	58.3	83.3	58.3	91.7	58.33	83.33
Confined								
Marota	4	50.0	50.0	62.5	37.5	50.0	87.50	50.00
Moxoto	4	37.5	0.0	25.0	25.0	12.50	87.50	37.50
S.R.D.	4	87.5	75.0	100.0	75.0	87.50	100.0	75.0
Combined	12	58.3	41.7	62.5	45.8	50.00	91.67	54.17
Overall		50.0	47.2	69.4	50.0	63.89	80.56	63.89

[1] No. observed each month. 12 does per sub-group. One-third are observed one month each quarter. This schedule is repeated each quarter.

Table 2. Ovulation rate per does ovulating by genotype and nutrition/management.

Breed Type	No.	Month						
		Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Natural Pasture								
Marota	4	1.00	1.33	1.50	1.50	1.66	2.00	1.67
Moxoto	4	1.00	1.00	1.00	1.00	1.20	1.33	1.50
S.R.D.	4	1.50	1.67	1.75	2.00	2.25	1.00	1.67
Combined	12	1.25	1.43	1.50	1.57	1.73	1.43	1.60
Confined								
Marota	4	1.25	1.25	1.00	1.00	1.25	1.14	1.50
Moxoto	4	1.00	--	1.00	1.00	1.00	1.00	1.00
S.R.D.	4	1.43	1.50	1.75	1.56	1.29	1.75	1.33
Combined	12	1.29	1.40	1.40	1.27	1.25	1.32	1.31
Overall		1.28	1.41	1.44	1.39	1.48	1.34	1.43

Table 3. Body weight of does by genotype and nutrition/management.

Breed Type	No.	Month				
		Sept.	Oct.	Nov.	Dec.	Jan.
Native Pasture						
Marota	12	23.47	24.51	25.75	26.03	24.54
Moxoto	12	20.21	21.30	22.51	23.78	22.45
S.R.D.	12	26.70	28.45	28.96	30.10	27.36
Confined						
Marota	24	22.87	21.69	21.29	22.45	23.16
Moxoto	24	19.95	19.08	18.78	19.93	20.27
S.R.D.	24	25.67	25.72	25.02	26.21	26.74

Table 4. Fertility in Spanish goats and Spanish goats X dairy goat crosses. (Utah State University) (Preliminary data)

Age of Dam	Straightbred			Crossbred		
	Number exposed	Percent kidding	No. kids per doe	Number exposed	Percent kidding	No. kids per doe
1978-79						
1 year	12	25	1.00	10	40	1.25
2 year	--	--	--	--	--	--
Adult (2 yr & >)	36	75	1.63	--	--	--
1979-80						
1 year	11	9	1.00	7	0	--
2 year	12	83	1.70	10	80	1.50
Adult (2 yr & >)	36	72	1.68	--	--	--
Combined Years						
1 year	23	18	1.00	17	24	1.40
2 year	12	8	1.70	10	80	1.50
Adult (2 yr & >)	72	76	1.65	--	--	--

Table 5. Body weights in straightbred Spanish goats and in dairy goat X Spanish goat cross at birth, in kg.[1] (USU preliminary data.)

Treatment	Straightbred				Crossbred			
	Weight				Weight			
	Birth		5 mo.		Birth		5 mo.	
1978-79								
Age of dam:								
1 year	(3)	2.26	(2)	15.9	(5)	2.27	(4)	15.2
2 year	-	--	-	--	-	--	-	--
Adults (2 yr & >)	(40)	2.19	(31)	17.5	-	--	-	--
1979-80								
Age of dam:								
1 year	(1)	2.27	(1)	11.8	-	--	-	--
2 year	(16)	2.25	(11)	11.0	(10)	2.44	(9)	14.0
Adults (2 yr & >)	(43)	2.49	(34)	13.8	-	--	-	--
Both Years								
Age of dam:								
1 year	(4)	2.23	(3)	14.5	(5)	2.27	(4)	15.2
2 year	(16)	2.25	(11)	11.0	(10)	2.24	(9)	14.0
Adults (2 yr & >)	(81)	2.33	(65)	15.6	-	--	-	--

[1] Not adjusted for sex or type of birth; number in () is number contributing to mean.

Table 6. Average body weights of does at postpartum compared by year, genotype, and age of dam (1978-80). (USU preliminary data.)

Age of Dam	Straightbred		Crossbred	
	No.	Avg. Wt. (kg)	No.	Avg. Wt. (kg)
1978-79				
1 year	13	28.44	10	29.57
2 year[1]	--	---	--	---
Adult (2 yr & >)	35	37.98	--	---
1979-80				
1 year	11	24.39	9	21.42
2 year	11	31.23	10	32.13
Adult (2 yr & >)	27	42.95	--	---
Combined Years				
1 year	24	26.42	19	25.50
2 year	11	31.23	10	32.13
Adult (2 yr & >)	62	40.38	--	---

[1] No 2 year dams in 1978-79.

Table 7. Reproductive traits of straightbred St. Croix ewes in accelarated lambing (4 years combined).

Classification	n	Fertility (%)	Prolificacy
Winter Lambing			
Age of Ewe:			
1	16	42.10 ± 7.59	1.31 ± .15
2	14	45.16 ± 8.41	1.86 ± .18
3	11	73.33 ± 12.09	2.27 ± .43
4	5	55.56 ± 15.06	1.80 ± .37
5	2	50.00 ± 23.41	-----
Combined	48	50.00 ± 5.37	1.81 ± .14
Summer Lambing			
Age of Ewe:			
1	28	75.68 ± 7.00	1.57 ± .10
2	20	76.92 ± 8.35	2.15 ± .15
3	9	56.25 ± 10.64	2.00 ± .24
4	6	75.00 ± 15.05	2.50 ± .43
5	3	75.00 ± 21.28	2.33 ± .33
Combined	66	68.12 ± 5.12	1.92 ± .09

Table 8. Weight of lamb born and weaned per ewe and ewe body weight in straightbred St. Croix ewes in twice-a-year lambing (4 yrs combined).

Classification	n	Kg lamb born/ewe	Kg lamb weaned/ewe[1]	Ewe body wt (kg)
Winter Lambing				
Age of ewe:				
1	16	3.52 ± .34	38.43 ± 5.33	35.33 ± 1.42
2	14	5.29 ± .36	48.63 ± 5.70	48.21 ± 1.52
3	11	5.14 ± .41	38.14 ± 6.43	52.59 ± 1.72
4	5	5.98 ± .60	34.10 ± 9.54	55.28 ± 2.55
5	2	---	---	---
Combined	48	4.80 ± .19	41.70 ± 3.08	46.10 ± .82
Summer Lambing				
Age of ewe:				
1	28	4.00 ± .29	27.51 ± 4.93	31.74 ± 1.13
2	20	5.84 ± .34	46.00 ± 5.83	42.80 ± 1.34
3	9	5.80 ± .51	42.88 ± 8.69	49.70 ± 2.00
4	6	6.62 ± .62	50.98 ± 10.65	51.40 ± 2.45
5	3	6.23 ± .88	25.38 ± 15.06	53.70 ± 3.47
Combined	66	5.14 ± .19	37.24 ± 3.21	40.33 ± .74

[1] Adjusted to 120 days.

Table 9. Overall reproductive and production comparisons of SxS, RxR, and SxR ewes (USU, preliminary data)[1]

Trait	Mean ± SE		
	SxS (n=101)	RxR (n=71)	SxR (n=9)
Age at first lambing (days)	---	---	369.44 ± 1.1
Fertility (%)	93.07 ± 6.02	88.73 ± 6.7	100.00 ± .00
Prolificacy	2.23 ± .12	1.49 ± .09	1.11 ± .19
Weaning Rate	1.40 ± 0.9	1.35 ± .10	1.00 ± .24
Wt. of lamb born/ewe (kg)	6.07 ± .23	6.76 ± .18	4.04 ± .31
Wt. of lamb born/EBW (%)	13.82 ± .74	11.33 ± .32	9.88 ± .52
Wt. of lamb weaned/ewe (kg)	47.53 ± 2.57	55.65 ± .68	36.58 ± 1.34
Wt. of lamb weaned/EBW (%)	118.83 ± 7.47	99.50 ± 1.20	86.80 ± 2.16
Ewe body wt.	40.10 ± .82	62.14 ± .56	41.18 ± .55

[1] Data for 4, 2 and 1 year respectively for straightbred St. Croix (SxS), straightbred Rambouillet (RxR) and their cross (SxR).

ANNUAL REPORT 1 June 80 - 31 March 1981 - BRAZIL

1. Institution: California State Polytechnic University, Pomona

2. Principal Investigator: Edward A. Nelson

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $100,000
   Matching Contributions from 1980/81 subgrant. $90,456

4. Project Title: Improving Reproductive Capability of Small Ruminants in LDC's with Emphasis on Male Reproductive Physiology

5. Project Goals:

   I. To develop methods to improve the capability of collecting, processing, storing and transporting viable sheep and goat semen to selected LDC locations.

   II. To measure the reproductive potential of selected small ruminant male genotypes in the United States and Brazil. To coordinate the relative influence of males as compared to females in solving reproductive problems in developing countries.

   III. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.

   IV. 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 previous accomplishments.

   Objective I - Accomplishments to May 30, 1980.

   a. Facility development at Cal Poly from non-Title XII funds. These include buck housing facility and the development of a moderately equipped semen research laboratory (only two major pieces of equipment were purchased using Title XII funds).

   b. Literature was reviewed.

   c. Research was initiated to evaluate various extenders, the use of washing semen, different freezing times and evaluation techniques for determining the effects of treatments. Abstracts of papers presented at the Western Section of ASAS, 1980, indicating the results obtained from these initial studies, are available upon request from the Mangement Entity Office.

Objectives II and III - Accomplishments to May 30, 1980.

a. Research was initiated during this period at Cal Poly in the following areas to satisfy this objective.
   (1) Seasonal variations in both sheep and goat semen.
   (2) Body measurements relating to puberty in sheep. The breeds included Rambouillet, Suffolk, St. Croix hair sheep.

   No results were available for the previous report.

b. Cooperative work at Laurelwood Acres, Ripon, Calif. was initiated. Semen from bucks of various breeds was collected, evaluated and frozen. These included bucks being used on a modified light treatment. No results were available at the time of the first annual report.

c. Two visits were made to EMBRAPA, Sobral, Brazil. Male physiology of reproduction studies were initiated. In addition, all ongoing projects at the CNPCOT station were reviewed and discussed with cooperating scientists.

Objectives IV - Accomplishments to May 30, 1980

a. A short course outline was developed in cooperation with W. C. Foote to be used to conduct short courses on reproductive physiology at CNPCOT, Sobral, Brazil.

7. Statement of specific 1980/81 objectives

I. To conduct a two year study on measuring the reproductive characteristics of Somali rams.

II. To participate in the development of additional laboratory facilities for reproductive physiology work as needed.

III. To participate in a cooperative owner based management study as it addresses male reproductive problems.

IV. To assist in the development and conduct of a short course on reproduction.

V. To cooperate with other components of the SR-CRSP in measuring reproductive characteristics of males being used in their research projects.

VI. To measure the characteristics relating to sexual development and aging of 3 breeds of sheep and 3 breeds of goats.

VII. To continue to develop techniques and procedures for extended time storage of goats and sheep semen.

8. Description of work undertaken.

I. A five day short course dealing with reproductive physiology and problems associated with reproduction of sheep and goats was held Sept. 15-19, 1980. Nineteen participants attended representing 9 states of Northeastern Brazil. Brazilian counterpart scientists (Aurino Simplicio and G. Simon Riera) in addition to W. C. Foote and E. A. Nelson presented discussions. Materials were prepared, translated into Portuguese and distributed to participants. Techniques involved with reproductive research as well as research data were also presented. Certificates of completion were presented indicating the sponsorship of CNPCOT/EMBRAPA and SR-CRSP reproduction. The evaluations indicate that this course was a success.

II. A study measuring the reproductive characterisics of Somali rams was initiated January, 1980. Body measurements including weight, scrotal volume, length and circumference and length of epididymis, were recorded. Semen has been evaluated by volume, concentration, motility, color and abnormal spermatozoa.

III. The physiology laboratory was analyzed and remodeling suggested. Remodeling has been completed and equipped in the following ways:

Bausch and Lomb Spectrophotometer 20, electroejaculator, pH meter and semen counting chambers along with miscellaneous semen processing glassware supplies.

IV. Ongoing projects dealing with male reproduction at CNPCOT were reviewed and recommendations relative to their conduct and analysis were made.

V. One trip was made to Brazil during this reporting period, side trips were made to Quixada, Paraiba and Belo Horizonte. The possibility of cooperative research activities was investigated at each location.

VI. Semen processing and freezing techniques for both sheep and goats is being studied. This is to satisfy the original charge given to Cal Poly to develop a semen bank as a possible source of germ plasm for distribution at overseas locations. The use of various extenders, freezing rates and evaluation methods have been studied. (Refer to abstracts of papers given at Western Section ASAS).

9. Technical Acomplishments.

I. The papers that were presented at the Western Section ASAS indicate results on specific facets of sheep and goat semen dilution, processing and evaluation.

II. Male goats of the five common dairy breeds are being collected twice each week, year around to gain information relative to age, breed and seasonal variations in semen production. The data for the first period is in the preliminary stages of analysis.

III. Results of Somali male reproductive measurement year one. Data collected by Aurino Simplico and Simon Riera

Five Somali rams approximately 8 months of age January, 1980 were identified and placed on a schedule for body measurements and semen collection. These rams were trained to work on the artificial vagina prior to the start of the project. Specific measurements reported here include: body weight, volume and diameter of testis and volume, concentration and motility of semen. Semen was collected and evaluated each week. Data from year one of this study are presented in Figure 1 and Tables 1 and 2. These data indicate that Somali rams are capable of reproducing successfully in Northeastern Brazil during all months of the year. There were some variations in the characteristics measured as shown in Figure 1. Some of the variation shown in Figure 1 may be explained as being the result of some body growth due to age as shown by the increase in body weight from February - August. Semen motility estimates reached a high of 85 percent in July. This may be related more to the environmental temperature and level of nutrition than any so called seasonal variation in reproductive capability.

Table 1. Characteristics of Semen and Body Measurements of Somali Rams for a 12 Month Period

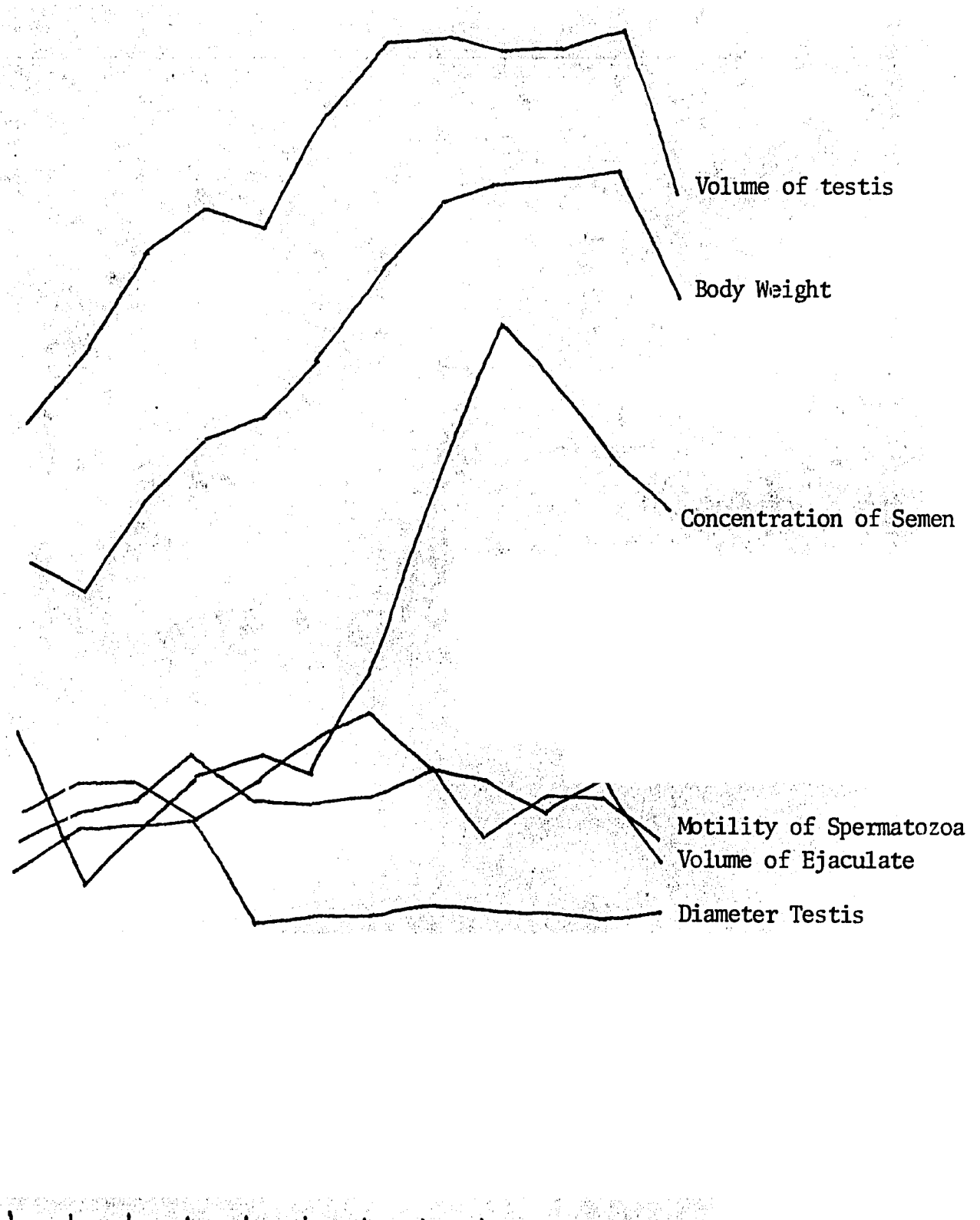
Months	Weight Kg.	Ejaculate Volume ml.	Semen Concentration N X 10^9	Total Sperm/Ejac n X 10^9	Sperm Motility percent	Testis Volume ml.	Testis Diameter cm.
Jan.	22.0	.6	1.62	1.05	68.7	264.6	5.9
Feb.	21.2	.7	1.11	.84	73.5	290	6.5
March	24.7	.7	1.32	.92	74.5	322.4	6.6
April	26.8	.8	1.51	1.20	68.3	339.8	6.9
May	27.7	.7	1.58	1.11	74.	333.9	5.0
June	29.3	.7	1.50	1.08	82.1	370.5	5.2
July	32.0	.7	1.83	1.39	86.	395.5	5.2
Aug.	34.4	.8	2.56	2.02	77.8	398.2	5.3
Sept.	34.6	.8	3.05	2.36	65.2	393	5.3
Oct.	35.	.7	2.80	1.93	72.7	395.6	5.4
Nov.	35.6	.7	2.56	1.99	72.1	400.3	5.2
Dec.	31.1	.6	2.42	1.48	66.3	399.8	5.4
Average	29.5	.71	1.99	1.45	73.4	358.6	5.7

Table 2. Simple Correlations Between Semen Characteristics and Body Measurements

	Body Weight	Ejaculate Volume	Sperm Motility	Semen Concentration	Testis Volume	Testis Diameter	Total Sperm/Ejac.
Body Weight	-	+ *	+ **	+ **	+ **	- **	+ **
Ejaculate Volume		-	+ **	+ **	+ **	+ **	+ **
Sperm Motility				Ns	Ns	*	Ns
Semen Concentration				-	+ **	- **	+ **
Testis Volume					-	Ns	+ **
Testis Diameter						-	- **
Total Sperm/ejac.							-

1. Signs indicate positive (+) or negative (-) correlations.
2. Significance of correlations are represented by Ns, $P<.05$ (*) and $P<.01$ (**)
3. Correlations calculated and interpreted by Aurino Simplico

Figure 1. Averages of Measurements on Somali Rams



ANNUAL REPORT 1 June 80 - 31 March 1981

Cooperative Effort Sites Other than Brazil and Peru

1. Institution: California State Polytechnic University, Pomona

2. Principal Investigator: Edward A. Nelson

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $100,000
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5. Project Goals:

   I. To develop methods to improve the capability of collecting, processing, storing and transporting viable sheep and goat semen to selected LDC locations.

   II. To measure the reproductive potential of selected small ruminant male genotypes in the United States and other locations.

   III. To measure and examine seasonality and other related responses to the environment as they affect the reproductive ability of male sheep and goats.

6. Summary of previous accomplishments.

   Objective I - Accomplishments to May 30, 1980.

   a. Facility development at Cal Poly from Non Title XII funds. These include buck housing facility and the development of a moderately equipped semen research laboratory (only two major pieces of equipment were purchased using Title XII funds).

   b. Literature was reviewed.

   c. Research was initiated to evaluate various extenders, the use of washing semen, different freezing times and evaluation techniques for determining the effects of treatments. Abstracts of papers to be presented at the Western Section of ASAS, 1980, indicating the results obtained from these initial studies, may be obtained from the Management Entity Office upon request.

   Objectives II and III - Accomplishments to May 30, 1980.

   a. Research was initiated during this period at Cal Poly in the following areas to satisfy this objective.

(1) Seasonal variations in both sheep and goat semen.
(2) Body measurements leading to puberty in sheep. The breeds included Rambouillet, Suffolk, St. Croix hair sheep.

No results were available for the previous report.

b. Cooperative work with University of California Davis Breeding component to freeze semen of selected outstanding buck goats was initiated (one buck was identified and attempts were made to freeze his semen - were only partially successful due to his age and state of health).

c. Cooperative work at Laurelwood Acres, Ripon, Calif. was initiated. Bucks of various breeds were collected, their semen evaluated and frozen. These included bucks being used on a modified light treatment. No results were available at the time of the first annual report.

7. Statement of specific 1980/81 objectives

I. To measure the characteristics relating to sexual development and aging of 3 breeds of sheep and 3 breeds of goats.

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

III. 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.

I. Forms have been developed to coordinate and standardize the collection of reproduction information within the SR-CRSP as suggested by the EEP. These forms have been distributed and inputs solicited from other SR-CRSP components. Positive responses to the use of these forms have been received from other projects.

II. Semen processing and freezing techniques for both sheep and goats is being studied. This is to satisfy the original charge given to Cal Poly to develop a semen bank as a possible source of germ plasm for distribution at overseas locations. The use of various extenders ,freezing rates and evaluation methods have been studied. (Refer to abstracts of papers given at Western Section ASAS).

III. Cooperative research involving male goats at Laurelwood Acres, Ripon, California and the University of California, Davis, Breeding component have been conducted. Each cooperating organization participated in providing financial support in these cooperative efforts.

9. Technical Acomplishments.

I. The papers that were presented at the Western Section ASAS indiciate results on specific facets of sheep and goat semen dilution, processing and evaluation.

II. A cooperative project for collecting, processing and freezing semen on selected dairy goat males was conducted at the University of California, Davis, in connection with their Breeding component of the SR-CRSP. Eleven bucks representing four breeds were collected with 116 straws of semen frozen for use in AI. In addition, artificial insemination was attempted on does treated for syncronization by UC Davis personnel.

ANNUAL REPORT FORM FOR 1980/81

1. Institution: University of California, Davis

2. Principal Investigator: Blaine McGowan

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant: $266,666
   Matching Contributions from 1980/81 subgrant: $88,938

4. Project Title: Animal Health

5. 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 northeast 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 usable, 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 previous accomplishments.

Brazil: Field necropsies (dry season, 79-80) on many dead or dying sheep and goats at CNPC and two private farms visited on a regular basis indicated starvation as a very common cause of death (East). Computer analysis of EMBRAPA CNPC individual animal records relating to death loss is currently processed (East).

California: Preliminary screening on animal health data (accumulating on a continuous basis) gathered from 120 aborting does and 147 aborted kids from a large goat dairy indicates chlamydia as a major cause of abortion. Neonatal necropsies are showing mycoplasma as a serious cause of kid mortality followed by coliform enteritis and Pasteurella pneumonia (East, Brooks). Evaluation of a serologic diagnostic test for Corynebacterium pseudotuberculosis is continuing but was severely set back when Dr. Humphrey Knight was killed.

7. Statement of specific 1980/81 objectives.

a. To provide skilled personnel to work with CNPC professionals in order to develop a diagnostic capability in the areas of pathology, bacteriology, virology, and clinical pathology.

b. To identify promising young professionals for advanced training in US.

c. To recruit a long-term diagnostic pathologist for assignment in Sobral.

d. To provide a long-term clinical or field veterinarian to provide diagnostic material in the laboratories and work with the smallholders to develop herd health plans.

8. Description of work undertaken.

Dr. McGowan, in Brazil for 2 weeks in Fall, 1980, to determine equipment needed for work to begin in the pathology, microbiology, and clinical microbiology laboratory. Necessary equipment ordered - should be in Sobral by June, 1981. Discussed diagnostic and research plans with CNPC collaborators.

Hired Dr. Donald Hansen (and family) for a long-term commitment in Brazil. His responsibilities will primarily be as a clinician and will develop the disease survey and surveillance projects. Currently taking intensive language training. The Hansen family will go to Sobral May 1, 1981.

Negotiations are nearly final to hire a diagnostic pathologist for a long-term commitment in Sobral. Should be in Brazil by August, 1981. Have received commitment from two Brazilian DVM's for graduate training veterinary parasitology (Padilha, 1981; Costa, 1982).

Dr. Nancy East continues her studies on causes of abortion and neonatal death at a large goat dairy.

Dr. Dale Brooks is pursuing his work regarding the significance of mycoplasma infections in kid mortality. He will soon begin investigations directed at developing a mycoplasma vaccine.

9. Technical Accomplishments.

The laboratories essential to an Animal Health Program should be equipped and operating before the end of FY 80-81. When these are in place the animal health program at Sobral should accelerate greatly.

Dr. East's work on causes of abortion on a goat dairy in California has incriminated chlamydia as a serious cause. During the next kidding season vaccine trials will be initiated.

Dr. Brook's determinations that Mycoplasma is transmitted in colostrum and is an important cause of baby kid mortality, is very significant.

Dr. Knight (deceased) was able to greatly increase our capability to detect Corynebacterium pseudotuberculosis infection by serologic testing.

Annual Report Form for 1980/81

(Brazil)

1. Institution: Tuskegee Institute

2. Principal Investigator: Nancy M. Stott

3. Funds from:

Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $133,000
Matching Contributions from 1980/81 subgrant. $66,400

4. Project Title: Intensive Management of Goats

5. Project Goals:

The objectives stated in the original subgrant agreement are modified and broadly encompass the following:

1. To study the effects of management regimes on milk production, growth and reproduction in goats.

2. To assist in development of a nutrition laboratory at CNPC, Sobral, Brazil.

3. To evaluate management systems for raising young kid for meat production.

These changes were adopted because of changes made in Principal Investigator, collaborating Brazilian counterpart and Brazil project site.

6. Summary of previous accomplishments.

7. Statement of specific 1980/81 objectives.

Objectives at Tuskegee Institute:

1. To evaluate nutritional management systems for the production of goats for meat and milk.

2. To collect data relative to the reproductive performance of goats under various management systems.

Objectives in Brazil:

1. To assist in establishing a nutrition laboratory at CNPC, Sobral.

2. To begin construction of a facility for the housing and milking of dairy-type goats at CNPC.

3. To secure animals and begin collecting data concerning milk production in four breeds of goats.

4. To initiate the research effort, submitted to Ederlon Oliveira (Not Attachment). Comments are expected shortly and efforts should be initiated during the Summer of 1981.

8. Description of work undertaken.

Travel Activities (International)

Visit to Tuskegee Institute by Dr. Pompeu Memoria and Elsio Figueiredo, June, 1980.

Visit to Sobral and EMBRAPA Headquarters, Brasilia by Drs. George E. Cooper and Nancy M. Stott, October, 1980.

Visit to Tuskegee Institute by Dr. Ederlon Oliveira, February, 1981.

Improvement to Facilities - Tuskegee Institute

Improvement of facility for housing goats during feeding or digestion trials.

Procurement of additional land for use as pasture.

Construction of new fences, sheds and utility outlets in new pasture area.

Renovation of pastures - discing, liming, reseeding.

Research Projects

1. The effect of monensin on growth rate and carcass traits of male goats. J. E. Correa-Gumbe and N. M. Stott. MS Degree Thesis in progress.

2. The effects of supplementing grass hay with a concentrate containing dried cattle manure - A. W. Elliott and G. E. Cooper. MS Degree Thesis (May 1980).

3. Evaluation of sweet potato vines and leaves as an energy source for small ruminants. A. Ashley and D. W. Libby MS Degree Thesis (May 1980).

4. Effect of replacing dietary protein with dried poultry litter in a ration for growing goats. A. J. Nianogo and N. M. Stott (*).

(*) A preliminary study is process.

9. Technical Accomplishments.

Research Results

1. Effect of monensin on growth rate and carcass traits of bucks.

Monensin (20mg/kg diet) was found to have a significant ($P<.05$) effect on feed intake and feed conversion in rapidly growing bucks. No significant differences were demonstrated in Longissimus muscle area, fat over Longissimus muscle, or dressing percentage. There was a tendency for the fat thickness over the Longissimus muscle to be less in animals receiving monensin. Treatment means are shown in Table 1.

2. Effect of supplementing hay with concentrate containing dried cattle manure.

A corn, oat, soybean meal concentrate containing 1, 12.2, 23.2 or 32.5% dried cattle manure was fed to lactating dairy goats at a rate of 227 grams/454 grams milk produced as a supplement to an ad libitum intake of coastal bermudagrass hay. Milk yield was significantly ($P.<05$) higher for animals receiving the concentrate without the dried cattle manure. Feed intake was depressed in does consuming the two higher levels of dried cattle manure. Composition of the diet however, did not affect the composition of the milk during the trial.

3. Evaluation of dried sweet potato vines as an energy source for ruminants (goats).

Digestion trials were conducted to compare the nutritive value of sweet potato vines with coastal bermudagrass hay. Results showed that dry matter, cell wall components, and protein digestibilities were significantly higher for coastal bermudagrass hay than for the sweet potato vines.

Table 1 Treatment Means of Parameters Measured

Parameter	Monensin	Control
Initial weight (kg)	26.8	26.9
Final weight (kg)	39.6	38.9
Total feed intake (kg)	81.4	90.1
Total weight gain (kg)	12.8	11.9
Feed: Gain ratio	6.4	7.6
Average daily gain (kg)	.21	.19
Dressing percent	48.6	48.4
Area Longissimus (cm^2)	26.3	27.0
Fat over Longissimus (cm)	.58	.65

SR-CRSP
Annual Report Form for 1980-81
Brazil

1. Institution: University of Missouri-Columbia

2. Principal Investigator: Michael F. Nolan

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $253,333
   Matching Contributions from 1980/81 subgrant. $91,727

4. Project Title: Sociological Analysis of Small Ruminant Production Systems.

5. Project Goals:

   The goals for the Sociology project in Brazil are:

   1. To gain an understanding of the inter-relationships that exist among animals, land, people and climate.

   2. To understand the role sheep and goats play in the overall system of agricultural production and to learn what non-economic importance they serve for the people of the Northeast region.

   The ultimate goal of the project is to be able to:

   1. Understand the economic calculus (the source of rationality) of small producers and the constraints under which they operate.

   2. Understand who among the overall population of livestock producers will benefit from technological change.

   3. Anticipate the problems which will emerge with the implementation of new technology on a large scale.

6. Summary of previous accomplishments.

   The 1981-82 year represents the first year of activity for the Sociology project in Brazil. The only accomplishment in previous years was to collect a small amount of literature related to Northeast Brazil agriculture and to begin the process of developing a program plan for Brazil.

7. Statement of specific 1980/81 objectives.

   The objective specified in this year's work plan for Brazil is to make one visit to Brazil to provide the basis for preparing a program plan.

8. Description of work undertaken.

1. The Principal Investigator visited Brazil in October-November, 1980 and prepared a program plan as a result of that trip.

2. A Brazilian student has been identified for graduate training and will start graduate studies at the University of Missouri in June, 1981.

3. Staffing for the Brazil site has been arranged and Dr. George Primov of the Department of Sociology at the University of Missouri, will be spending eight months in Brazil during the 81-82 year to begin the initial sociological studies.

4. Literature review continues and is being compiled into a computerized data base.

9. Technical Accomplishments.

Since on-site work will not begin in Brazil until the Summer of 1981, there are no accomplishments to report as yet.

Annual Report Form for 1980/81
(Brazil)

1. Institution: Winrock International Livestock Research and Training Center

2. Principal Investigator: A. J. DeBoer

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $233,333
   Matching Contributions from 1980/81 subgrant. $82,295

4. Project Title: Economic Analyses of Small Ruminant Production and Marketing Systems in Brazil

5. Project Goals:

   (i) Provide a well trained group of professional agriculture economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multidisciplinary research on small ruminants and their producers.

   (ii) Provide an improved data base for guiding research and providing policy guidelines for improving small ruminant productivity and farmer incomes.

   (iii) 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.

   (iv) 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 previous accomplishments.
   Program Year 1 (October 1, 1978 - April 1, 1980)

   (i) A long-term scientist, Mr. Nestor Gutierrez, was hired in August, 1979 for assignment to National Sheep and Goat Center, Sobral. Initial trip to Sobral by DeBoer and Gutierrez led to formulation of short-term and 5 year work plans and proposal for collaborative research with Federal University of Ceara, and EMBRAPA Center for the Semi-Arid Tropics in Petrolina.

   (ii) Phase III Work Plans and Research Protocol approved.

   (iii) Gutierrez in residence in Sobral beginning March, 1980.

(iv) Baseline survey planning started and survey instrument designed.

(v) Two graduate student (MS) projects started at Federal University of Ceara with SR-CRSP funds.

(vi) Paper on supply/demand methodology to be used in Brazil marketing studies developed and submitted as: Nestor F. Gutierrez and A. John DeBoer. "An Econometric Model of the Colombian Beef Sector: 1950-1970", submitted to Canadian Journal of Agricultural Economics, January, 1980.

7. Statement of specific 1980/81 objectives.

(i) Establish long-term collaborative staffing arrangement with National Sheep and Goat Center, Sobral.

(ii) Initiate regular farm survey work with sheep and goat producers in Northeast Brazil.

(iii) Initiate inter-institutional research programs with other Brazilian institutes.

(iv) Integrate agricultural economics into the National Sheep and Goat Center's regular activities.

(v) Prepare long-term plans for agricultural economics research on sheep and goats in Brazil with an emphasis on the assessment of technological programs on sheep and goat producers.

(vi) Establish a long-term counterpart arrangement with the Center agricultural economist.

8. Description of work undertaken.
(April 1, 1980 - March 31, 1981)

(i) International Travel - John DeBoer to Brazil November 10-21, 1980. Nestor Gutierrez to USA February 18-March 19, 1981. Ederlon de Oliveira to Winrock International March 1-3, 1981.

(ii) Participation in meetings, workshops, conferences

(a) Gutierrez- Attended Brazilian Society of Agricultural Economics meetings, Rio de Janeiro, June, 1980.

Presented seminar at National Sheep and Goat Center, Sobral, July 8, 1980, entitled "Preliminary Results of Socio-Economic Baseline Survey".

Presented paper at Denver, Colorado meeting of SR-CRSP Principal Investigators, February 19-20, 1981.

Invited to act as Chairman, Socio-Economics Section, First National Symposium on Tropical Sheep and Goats, EMBRAPA/CNPq, Fortaleza, May 4-8, 1981.

(b) Gutierrez and DeBoer - Attended workshop meeting of EMBRAPA agricultural economists on World Bank program for NE Brazil, Petrolina, November 12, 1980.

(iii) Research work - Carried out baseline sample survey of 127 sheep and goat producers in 10 counties of Ceara State, April 28-June 17, 1980. All data computer coded and processed using computer at Federal University of Ceara.

Initiated year-long monitoring survey of 32 farms in July, 1980. Ear tagged 4000 sheep and goats and initiated weighing, condition scoring and reproduction data recording on tagged animals.

(iv) Two MS candidates at Federal University of Ceara supported on sheep and goat research. Preliminary analysis of aggregate producer supply response of sheep and goat production in Ceara State completed by Mr. Jose de Souza Neto. Sheep and goat hide/skin export study by Mr. Odorico de Costa started.

9. Technical Accomplishments.

(i) Baseline survey of 127 farmers completed April-June, 1980. Data processed and analyzed in Brazil. Some results reported in preface to Brazil Annual Report.

(ii) Baseline survey results are summarized in three papers:

(a) Nestor Gutierrez A., A. John DeBoer and Jose Ubiraci, "Some Resource Interactions and Economic Characteristics of Sheep and Goat Producers in the Sertao of Ceara State, Northeast Brazil; Some Preliminary Survey Results", paper presented to First National Symposium on Tropical Sheep and Goats, EMBRAPA/CNPq, Fortaleza, Brazil, May 4-8, 1981, pp. 42.

"A Socio-Economic Survey of Sheep and Goat Producers in the Sertao of Ceara, State, Northeast Brazil", EMBRAPA/CNPC Technical Bulletin (English version in press, Portuguese version in preparation).

(iii) Initiated year long monitoring survey of 32 farms with 4 visits per farm. Tagged 4000 sheep and goats and, in conjunction with Center extension agent and veterinarian, keeping records of

weights, condition and reproduction. Data being coded and analyzed at Fortaleza.

(iv) Ordered and installed two computer software packages at Federal University of Ceara computer and we are using these regularly for survey analysis and MS thesis projects.

(v) Completed preliminary analysis of Jose de Souza Neto, MS thesis project entitled, "A Simultaneous Equation Model of Sheep and Goat Supply and Inventory Response in Ceara State, Brazil: 1950-1970." Results are summarized below:

Goat Response Equations

$$IG_t = 611.6 + 7.7\ PG_t + 0.73\ W_t + 0.44\ IG_t - 1$$
$$(1.57) \quad (4.15)^{***} \quad (2.60)^{**}$$
$$R^2 = 0.85 \quad F = 29.92^{***} \quad DW = 2.10$$

$$SG_t = 111.1 + 0.14\ IG_{t-1} - 0.09\ IG_t + 1.72\ T$$
$$(3.14)^{***} \quad (1.73) \quad (1.49)$$
$$R^2 = 0.68 \quad F = 11.26^{***} \quad DW = 0.85$$

Sheep Response Equations

$$IS_t = 489.9 + 10.86\ PS_t + 0.72\ W_t + 0.45\ I\ S$$
$$(2.11)^{**} \quad (4.62)^{***} \quad (2.62)^{**}$$
$$R^2 = 0.91 \quad F = 53.83^{***} \quad DW = 2.19$$

$$SS_t = 67.7 + 0.13\ I\ S_{t-1} - 0.07\ I\ S_t + 1.58\ T$$
$$(3.39)^{**} \quad (1.47) \quad (1.25)$$
$$R^2 = 0.77 \quad F = 18.01^{***} \quad DW = 0.77$$

Where

IG_t and $I\ S_t$ are, respectively, goat and sheep inventories in time t,
IG_{t-1} and S_{t-1} are goat and sheep inventories logged one year,
SG, and SS_t are, respectively, goat and sheep slaughter in time t,
PG_t and PS_t are, respectively, goat and sheep prices (in Cr/head) in time t,
W_t = rainfall in period t (millimeters) and
T = time (T=1,....21) trend variable.
All inventories and slaughterings are in million heads.
The numbers in parentheses are t statistics where *** represents statistical significance at 1% level, ** at 5% level and * at 10% level. DW represents the calculated Durbin-Watson statistics.

All variables had coefficients with the expected signs. In the inventory equations the weather and logged inventory variables were highly significant in explaining sheep and goat inventories while current price was significant in the sheep inventory equation but not for goat inventories. Current slaughter equations had only inventories logged one-year as significant explanatory variables. Current inventories and time trend were not significant. Improved specifications of the weather variable are currently being constructed and are being tried with the model.

(vi) Re-drafted paper for re-submission to Canadian Journal of Agricultural Economics entitled: Nestor F. Gutierrez, A. John DeBoer and Enrique Ospina, "An Econometric Model of the Colombian Beef Sector: 1950-1970." Submitted for publication March 30, 1981.

(vii) Technical consultation with Gutierrez PhD thesis committee at Purdue University and Washington DC, March, 1981.

Annual Report Form for 1980/81
(BRAZIL)

1. Institution: Texas A&M University

2. Principal Investigator: T. C. Cartwright

3. Funds allocated from:

   Grant No. AID/DSAN/XII-G-0049 from 1980/81 subgrant. $190,000
   Matching Contributions from 1980/81 subgrant. $63,333

4. Project Title: Systems Analysis and Synthesis of Small Ruminant Production

5. Project Goals:

The broad objective is to increase productivity of small ruminant production systems in Northeast Brazil and in LDC's to improve the standard of living and increase human nutritional levels, especially of the smallholder, in these countries. This objective will be addressed by providing a method for increasing the effectiveness of research by establishing research priorities and by providing a method of effectively evaluating application of research results and recommended practices in Brazil as well as the US. The specific goals are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems and a separate model for goat production.

2. To obtain parameters needed to characterize sheep and goat production systems in low and moderate rainfall areas in Northeast Brazil; to validate the model and input parameters for each of these specific zones; and to use these validated simulations as baseline simulations.

3. To examine, by simulation, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objectives of the CRSP in Brazil.

4. To supply input/output data of sheep and goat production systems for use in economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of sheep and goat production systems to alterations or interventions as requested by the staff of the CNPC.

6. Summary of previous accomplishments.

An initial visit was made to Brazil during which (1) a Co-Principal Investigator was tentatively identified, (2) arrangements were made to use CNPC data to verify the sheep and goat models, (3) increased understanding of small ruminant production in Brazil was gained, and (4) the sheep and goats models were conceptually outlined and communicated with the research workers at the CNPC.

Mr. Elsio Figueiredo visited Texas A&M to become familiar with Systems Analysis and Animal Breeding research that is being conducted at this institution.

The sheep and goat models were conceptually outlined and communicated to US members of the CRSP. Their inputs were incorporated into model design. Development of structural and biological components of the models was begun.

7. Statement of specific 1980/81 objectives.

1. Complete development of a sheep production systems model.

2. Gain additional understanding of small ruminant production systems in Brazil.

8. Description of work undertaken:

In May and June, 1980, Elsio Figueiredo visited Texas A&M to become familiar with the research in systems analysis and animal breeding that is being conducted here, and discussed enrolling in graduate school at a later date.

In February, 1981, Ederlon Oliveira made a brief visit to Texas A&M. During this visit, discussions regarding an appropriate Brazilian Co-Principal Investigator and Mike Boyd's plans for moving to Brazil were held.

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

9. Technical Accomplishments.

A sheep model has been developed and programmed but is not yet operational. A number of biological parameters must yet be specified. A number of literature reviews have been completed.

1. Growth Rates for Various Breeds of Sheep* (HDB, 3/80).

2. Effect of Type of Birth and Rearing on Growth* (HDB, 3/80).

3. Effects of Ewe Age on Lamb Birth Weights and Weaning Weights* (HDB, 3/80).

4. Birth Rate Comparisons for Various Breeds of Sheep* (HDB, 5/80).

5. Postpartum Interval and the Correction Factor for Time (HDB, 3/80).

6. Puberty in Ewe Lambs (HDB, 4/80).

7. The Effects of Ad Lib and Restricted Water Intakes on Sheep (HDB, 5/80).

8. Embryonic Mortality in Sheep (HDB, 9/80).

9. Summary of Some Phenotypic Characteristics of East African Indigenous Breeds of Sheep (GH, 9/80).

10. Milk Production in Sheep (HDB, 11/80).

11. Nursing Lamb Intake (JM, 12/80).

12. Mineral Requirements (GLB, 3/81).

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*Tabular reviews

PART V

BUDGET - PAST, PRESENT, FUTURE

TITLE XII

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

V. 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
August 25, 1980	$ 615,000
Total	$11,167,000

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. The following points need to be made with respect to Table 1.

1. The first year was a 20 month period.

2. The second year was a 16 month period.

3. The Management Entity budget includes all of the following costs:

   a. Cost of the External Evaluation Panel.

   b. Cost of the Board of Institutional Representatives.

   c. Cost of all the Overseas Site Visits.

   d. Cost of the AID mandated Audit.

   e. Cost of the ME Office including ME travel.

   f. Cost of the Technical Committee.

4. There was substantial carryover of Program Year One funds into Program Year Two. None of the carryover funds were returned to "life of project funds".

5. The cumulative total sub-granted over the first 3 calendar years of the SR-CRSP was $7,746,427, which compares with $9,346,224 actually available. (ie, [$15,577,043 ÷ 5 = $3,115,408] x 3 = $9,346,224).

6. The budgets submitted for the fourth calendar year, if approved, will mean that $4.25 million remains for the fifth and final year of the SR-CRSP.

7. The SR-CRSP has never received any adjustments for inflation and continues to operate upon fixed 1978 dollars, even though some costs (travel, for example) have already doubled. Bearing in mind that we project a need in the fourth year of $3.6 million and in year 5 of $4.25 million, we shall exactly consume the SR-CRSP funds by October 1983 without need of augmentation. However, AID should be aware that subsequent funding of the CRSP will annually require about 2x the 1978 level.

2. US Institution Funds

Table 2 documents the matching contributions of US Institutions toward the work of the SR-CRSP. Column 1 are actual figures recently verified by the audit report on first year expenditures, which we have just received. Column 2 represents the commitment made by Institutions upon receipt of the second year subgrants, and Column 3 represents the projected commitment in the year ahead starting October 1, 1981. US Institutions have more than met their obligation to the SR-CRSP.

3. Overseas Counterpart Contributions

The implementation of the SR-CRSP overseas is in its very early stages, less than 18 months old. However, the SR-CRSP has benefited in every country from substantial matching contributions.

In Indonesia, BAPPENAS, the National Planning Body, immediately set aside funds which were to match SR-CRSP funds entering Indonesia on a dollar for dollar basis, an amount of approximately $160,000 per annum.

In Brazil, the calculated contribution of EMBRAPA was sent to us recently by Dr. Memoria and is in the order of $240,000 per annum.

In Kenya, a contribution amounting to approximately $140,000 per annum has been approved.

In Peru, the matching contribution has not been estimated.

4. Site Coordinator Expenditures

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 the the first three program years has been as follows:

Program Year One	10/1/78 - 5/31/80	8%
Program Year Two	6/1/80 - 10/1/81	5%
Program Year Three	10/1/81 - 9/30/82	8%

These funds are equally distributed among the four sites, and Table 3 documents the status of these funds in support of Site Coordinators only up to February 28, 1981.

In addition, some $200,000 for "site development" was set aside in the first year and this was distributed by decision of the Technical Committee and approval of the Board in the following manner:

Brazil	$30,000
Kenya	$56,666
Peru	$56,666
Indonesia	$56,666

The disbursement of all these funds has been determined by the Regional Sub-Committee of the Technical Committee with approval of the Board, and copies of the Tables with projected expenditure figures in them have been distributed to all PIs following each of the regional Technical Committee Meetings. Table 4 documents the exact current status of expenditures to date from site development funds.

5. Management Entity Expenditures

The Management Entity has closed its ledgers on the first two fiscal years of operation and the details are available in Tables 5 and 6. In the first year, there was substantial carryover. In the second year, there were cost overruns which are completely covered by the carryover. It is anticipated that with the small carryover and approval of the current estimate, the ME budget will balance in the third fiscal year.

6. The Third Program Year Subgrants (October 1981 - September 1982)

In the final columns of Table 1 are listed the subgrant requests made to the ME by each of the participating institutions. These requests have been through the following review process.

- Submission to ME.
- Thorough review in the ME including:
  - -- Personal discussion with each PI.
  - -- Amendment as necessary.
  - -- Complete re-typing in the ME into standard format.
- Submission and review by the Technical Committee (TC). (Every member of the TC received every subgrant)
- Submission and review by the External Evaluation Panel (EEP) (Every subgrant and annual report went to the EEP in May)
- Presentation to the Board of Institutional Representatives (BIR) and subsequent approval.

7. Review of the Basic Funding Pattern

Several participating institutions have questioned the basis of their funding pattern. In particular, Dr. Hank Fitzhugh has questioned this classification of his work as "socio-economic" as opposed to "biological" in letters that have been previously circulated. Dr. Tom Cartwright, Dr. Nolan and Dr. DeBoer in a joint statement, requested a ceiling funding of $200,000 with the option to restrict to two overseas sites at any one time. These changes were approved by the Board.

8. Contingency Funds

The Management Entity received 12 (see Table 7) applications for contingency funds. Three of these (number 1,2 and 3) were received prior to the last Board Meeting and were submitted for consideration there. Two of these were approved by the Board (numbers 1 and 2) in February and a further two were approved by the Board (numbers 11 and 12) in June 1981

Summary and Conclusions

In the 1983/84 fiscal year, the SR-CRSP will be in very seious financial difficulty unless augmentation of the 1978 funding level is provided by USAID. On two occasions in the past, the Management Entity has requested augmentation of the ME budget for the purpose of picking up costs of all the administrative units in the CRSP and thus sparing research funds. USAID, while granting permission to augment ME for these costs out of "life of project" funds, has indicated there can be no additional augmentation in real terms. The cost of maintaining the same activity level in 1983/84 as in 1978 will have almost doubled without taking into account the need for growth or extension of research activities.

In July 1980, a detailed budget plan was submitted to AID projecting expenditures until the end of the first five years of the SR-CRSP and developing a budget for the continuation of SR-CRSP into year 6. To date, more than one year later, no reply has been received from AID, and so the future of the CRSP appears to be tenuous indeed.

TABLE 1

THE SR-CRSP PROGRAM BUDGET

Institution	Discipline	COLUMN 1 BOARD Approved Year One 10/78-5/80	2 PROGRAM Year One Carry Over	3 BOARD Approved Year Two 6/80-10/81	4 TECH COMM Budget Submitted 10/81-9/82	5[1] PROPOSED BUDGET Before The Board 6/81
California	Breeding	206,786	111,965	266,666	200,000	200,000
California	Health	196,145	126,691	300,000	175,000	175,000
Cal Poly	Physiology	60,000	16,434	80,000	76,000	76,000
Colorado	Health	150,000	74,499	233,333	175,000	175,000
Missouri	Sociology	174,992	48,973	253,333	190,000	200,000
Montana	Breeding	200,000	61,669	200,000	149,999	149,999
N. Carolina	Nutrition	109,435	10,741	266,666	200,000	200,000
Ohio State	Forages	166,016	46,254	266,666	150,000	150,000
Texas A&M	Breeding	160,000	60,995	200,000	150,000	150,000
Texas A&M	Systems	184,000	12,815	253,333	190,000	200,000
Texas Tech	Range	200,000	69,111	266,666	200,000	200,000
Tuskegee	Management	100,000	7,801	153,333	115,000	115,000
Utah State	Range	196,081	82,493	266,666	200,000	200,000
Utah State	Physiology	99,800	16,520	186,666	124,000	124,000
Washington	Health	200,000	115,924	233,333	175,000	175,000
Winrock	Economics	175,000	53,564	253,333	190,000	200,000
Winrock	Management	100,000	26,528	153,333	115,000	150,000
Program Subtotals		2,678,255	942,977	3,833,327	2,774,999	(2,839,999)
Management Entity		516,691	161,568	468,154	515,429	515,429
Near East Contingency			-0-	50,000	50,000	100,000
General Contingency Funds			-0-	200,000	200,000	200,000
GRAND TOTAL		3,194,946	1,104,545	4,551,481	3,540,428	(3,655,428)

[1] Funding levels approved by Board 6/81.

TABLE 2

MATCHING CONTRIBUTIONS FROM US INSTITUTIONS

Institution	Discipline	Inception To June 1980	June 1980 To Sept 1981	Oct 1981 To Sept 1982
California	Breeding	35,828	105,926	79,063
California	Health	87,872	88,938	76,904
Cal Poly	Physiology	110,765	90,456	64,365
Colorado	Health	42,976	66,667	58,333
Missouri	Sociology	65,889	91,727	68,342
Montana	Breeding	76,721	70,323	54,759
N. Carolina	Nutrition	44,083	68,584	84,737
Ohio State	Forages	77,752	138,677	91,221
Texas A&M	Breeding	65,780	70,974	50,000
Texas A&M	Systems	43,110	82,172	63,333
Texas Tech	Range	64,274	66,674	66,667
Tuskegee	Management	33,271	66,400	35,515
Utah State	Range	79,029	88,903	66,982
Utah State	Physiology	109,310	73,648	61,875
Washington	Health	65,961	88,906	80,923
Winrock	Economics	46,666	92,965	78,310
Winrock	Management	35,076	57,005	48,845
Total		1,084,363	1,408,945	1,130,174

TABLE 3

ACTUAL SITE COORDINATOR EXPENSES

As of February 28, 1981

	KENYA	PERU	INDONESIA	BRAZIL	TOTAL
SALARIES	15,890.00*	15,890.00*	23,087.73[1]	19,619.06[2]	74,486.79
BENEFITS	6,060.02*	5,383.22*	8,132.76[1]	8,020.30[2]	27,596.30
TRANSPORT GOODS	2,090.55	14,588.71	598.32	--	17,277.58
TRAVEL	9,535.07	5,425.60	8,080.93	6,137.01	29,178.61
HOUSING	15,060.60	2,416.65	10,095.18	1,544.72	29,117.15
SCHOOLING	--	155.56	10,002.38	--	10,157.94
VEHICLE	21,676.07	12,790.10	18,513.20	28,419.48	81,398.85
OTHER	502.87	317.79	3,369.35	1,174.49	5,364.50
OFFICE COSTS	4,622.79	16,283.13	1,996.52	2,149.12	25,051.56
TOTAL	75,437.97	73,250.76	83,876.37	67,064.18	299,629.28

*Starting dates for Salaries and Benefits - August 1, 1980.
[1]Starting dates for Salaries and Benefits - May 12, 1980.
[2]Starting dates for Salaries and Benefits - May 10, 1980.

TABLE 4

SITE DEVELOPMENT FUNDS
595035

	BRAZIL	PERU	KENYA	INDONESIA	TOTAL
Appropriation	30,000.00	56,666.00	56,667.00	56,667.00	200,000.00
S.C. Advance	79.50	79.50	79.50	79.50	318.00
INIA	--	27,275.85	--	--	27,275.85
Modern Chevrolet	--	8,100.66	--	--	8,100.66
To Tuskegee	4,000.00	--	--	--	4,000.00
Overhead	--	5,373.34	--	--	5,373.34
Transit Risk Insurance	--	--	--	.73	.73
Vehicle Shipping	--	2,876.49	--	--	2,876.49
Bookstore	--	--	--	72.00	72.00
Importation Expenses	--	864.82	--	--	864.82
Olympic Sales Co.	--	--	--	618.35	618.35
Overhead - Nov	--	737.04	--	14.18	751.22
Lucas Brothers Publ.	11.71	--	--	--	11.71
Geron-X Inc.	140.00	--	--	--	140.00
Indo Pasture Dev	--	--	--	320.00	320.00
Overhead - Nov	29.89	--	--	63.04	92.93
Society-Study-Repro	82.00	--	--	--	82.00
IGSR	25.00	25.00	25.00	25.00	100.00
Overhead Jan	21.06	4.93	4.93	4.93	35.85
Boxwood Press	10.71	--	--	--	10.71
Cambridge U Press	574.20	--	--	--	574.20
To be reversed	--	--	--	--	33.99
Peru Labor/Material	--	1,267.37	--	--	1,267.37
Overhead - Feb	115.23	249.67			364.90
Balance remaining as of March 31	24,910.70	9,811.33	56,557.57	55,469.27	146,708.18

TABLE 5

MANAGEMENT ENTITY BUDGET AND EXPENSES FOR SEPTEMBER 1978 TO SEPTEMBER 1979

	BUDGET	EXPENDED	BALANCE
SALARIES			
PROGRAM OFFICE			
Program Director (Robinson)	34,700	27,633.37	7,066.63
Stipend (Robinson)	3,000	3,666.63	<666.63>
Special Assistant (Waters)	24,100	4,894.00	19,206.00
Benefits (Robinson/Waters)	14,214	7,267.40	6,946.60
Adm Asst II (O'Connor)	11,388	6,642.00	4,746.00
Principal Clerk Typist	9,972	0.00	9,972.00
Benefits	4,700	1,681.16	3,018.84
UCD INTERNATIONAL PROGRAMS OFFICE			
Coordinator (Hill)	4,480	4,795.02	<315.02>
Benefits for Coordinator	1,030	1,012.09	17.91
TOTAL SALARIES/BENEFITS	107,584	57,591.67	49,992.33
MOVING EXPENSES			
Transportation	7,400	0.00	7,400.00
Shipping Household Goods	10,000	0.00	10,000.00
RENTAL OFFICE SPACE/JANITORIAL	10,500	8,030.53	2,469.47
EQUIPMENT			

TABLE 5 cont. 2	BUDGET	EXPENDED	BALANCE
Office Furniture	3,580	5,053.41	<1,473.41>
2 Typewriters	1,500	0.00	1,500.00
1 Mag Card II Typewriter	10,592	13,992.00	<3,400.00>
1 Photocopier	5,200	0.00	5,200.00
Dictation/Transcribing Units	2,500	884.43	1,615.57
Calculator	-0-	529.18	<529.18>
TOTAL EQUIPMENT	23,372	20,459.02	2,912.98
SUPPLIES AND EXPENSE			
4 Telephones	1,500	439.94	1,060.06
Tolls & Cables	1,000	1,768.85	<768.85>
Office Supplies	2,500	7,090.45	<4,590.45>
Equipment Maintenance	1,185	28.60	1,156.40
Postage	500	92.39	407.61
TOTAL SUPPLIES & EXPENSE	6,685	9,420.23	<2,735.23>
TRAVEL - PROGRAM AND ME STAFF			
FOREIGN	48,192	29,177.61	19,014.39
DOMESTIC	11,600	5,943.27	5,656.73
MEETINGS			
BUSINESS MANAGERS	6,000	0.00	6,000.00

TABLE 5 cont. 3	BUDGET	EXPENDED	BALANCE
BOARD MEETINGS	6,000	5,770.03	229.97
EEP MEETINGS			
Domestic Travel	8,000	0.00	8,000.00
Foreign Travel	-0-	0.00	0.00
Consultant Fees	10,500	0.00	10,500.00
TECHNICAL COMMITTEE	-0-	17,976.94	<17,976.94>
MEETING ROOMS	360	1,022.44	<662.44>
TOTAL MEETINGS	30,860	24,769.41	6,090.59
TOTAL DIRECT COSTS	256,193	155,391.74	100,801.26
INDIRECT COSTS	45,866	26,650.57	19,215.43
TOTAL COSTS	302,059	182,042.31	120,016.69

TABLE 6

MANAGEMENT ENTITY BUDGET AND EXPENSES FOR OCTOBER 1979 TO SEPTEMBER 1980

	BUDGET	EXPENDED	BALANCE
SALARIES			
PROGRAM OFFICE			
Program Director (Robinson)	36,435	32,908.14	3,526.86
Stipend (Robinson)	3,000	3,999.96	<999.96>
Special Assistant (Waters)	25,305	15,429.16	9,875.84
Benefits (Robinson/Waters)	14,890	13,133.49	1,756.51
Adm Asst II (O'Connor)	12,527	4,215.11	8,311.89
Principal Clerk Typist	10,970	0.00	10,970.00
Staff Research Associate (Burstein)	0	15,140.11	<15,140.11>
Adm Asst I (Lipner)	0	4,595.65	<4,595.65>
Senior Clerk Typist (Ferguson)	0	5,672.49	<5,672.49>
Technical Translator (Penz)	0	213.12	<213.12>
Benefits	5,170	10,043.89	<4,873.89>
UCD INTERNATIONAL PROGRAMS OFFICE			
Coordinator (Hill)	4,684	0.00	4,684.00
Benefits for Coordinator	1,077	9.84	1,067.16
TOTAL SALARIES/BENEFITS	114,058	105,360.96	8,697.04
RENTAL OFFICE SPACE/JANITORIAL	11,025	9,399.13	1,625.87

TABLE 6 cont.	BUDGET	EXPENDED	BALANCE
SUPPLIES AND EXPENSE	7,019	22,417.44	<15,398.44>
TRAVEL - PROGRAM AND ME STAFF			
FOREIGN	12,871	24,917.03	<12,046.03>
DOMESTIC	12,200	11,090.81	1,109.19
MEETINGS			
BOARD MEETINGS	6,300	12,479.80	<6,179.80>
EEP MEETINGS			
Domestic Travel	8,000	10,132.60	<2,132.60>
Foreign Travel	8,000	0.00	8,000.00
Consultant Fees	10,500	12,750.00	<2,250.00>
TECHNICAL COMMITTEE			
Domestic Travel	0	20,094.55	<20,094.55>
Foreign Travel	0	6,829.43	<6,829.43>
MEETING ROOMS	381	303.51	77.49
TOTAL MEETINGS	33,181	62,589.89	<29,408.89>
TOTAL DIRECT COSTS	190,354	235,775.26	<45,421.26>
INDIRECT COSTS	37,500	46,914.77	<9,414.77>
TOTAL COSTS	227,854	282,690.03	<54,836.03>

TABLE 7

CONTINGENCY FUND PROPOSALS

No.	Submitted by:	Date	Purpose	Amount	APPROVED/NOT APPROVED TC	ME	BIR
1.	Peru PIs	12/30/80	La Raya Upgrading	$17,000	YES	YES	YES
2.	Dr. Foote	2/17/81	Int'l Goat Conference	$10,000	YES	YES	YES
3.	Dr. Nolan	11/25/80	Goat Research	$27,000	NO	NO	NO
4.	Dr. DeMartini	2/24/81	Smelting Toxicity	$52,000	NO	NO	NO
5.	Dr. DeBoer	2/21/81	Sri Lanka/Thailand	$40,000	NO	NO	NO
6.	Dr. Cartwright	6/23/81	Wool Quality	$24,000	NO	--	--*
7.	Dr. Foote	4/17/81	Physiologist	$40,000	NO	NO	NO
8.	Mr. Miller	4/20/81	Pastures	$50,000	NO	NO	NO
9.	Brazil PIs	4/27/81	Goat in Tropics	$50,000	NO	NO	NO
10.	Mr. Quijandria	4/27/81	Goats in Peru	$120,000	YES	YES	YES[1]
11.	Dr. Johnson	5/01/81	Pasture Work	$1,200	YES	YES	YES
12.	Dr. VanKeuren	6/23/81	Forage Work in Jungle	$50,000	--	--	--[2]

*
[1]Revised proposal returned to Technical Committee for recommendation to Board.
[1]Revised proposal for $106,000 approved by Board 6/81.
[2]Pending recommendation of Technical Committee and Board.