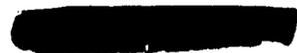


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SMALL RUMINANT
COLLABORATIVE RESEARCH SUPPORT PROGRAM
(SR-CRSP)

BUDGETS AND WORKPLANS
1987-1990

Submitted by the Management Entity
October 1985

BUDGET

Explanatory Notes

The Final Budget Summary on page is the total requested from the Agency for International Development for fiscal years 1988, '89, and '90. In addition, U.S. institutions will contribute at least an additional 33 1/3% (25% of the total) as matching contributions. The Host Countries also make major contributions - largely "in-kind" as personnel times, facilities, animals, utilities, and other infrastructure.

International travel is defined as travel involving the crossing of an international boundary. Travel within a work-site country or the U.S. is listed as "domestic travel" or as "supplies and expenses".

Host Country Research Funds are allotted to the various host countries to support in-country research and administrative costs. The allocation of these funds are recommended by Program Advisory Committees (PACs) consisting of Host Country personnel and Principal Investigators working at that site.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: FINAL BUDGET SUMMARY

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	613.5	813.0	1426.5	667.6	892.4	1560.0	736.5	979.5	1716.0
Fringe benefits	134.7	146.6	281.3	148.4	160.2	308.6	160.7	176.2	336.9
Supplies & expenses	179.5	337.5	517.0	190.5	380.0	570.5	202.2	417.4	619.6
Equipment	15.0	43.0	58.0	9.4	41.2	50.6	6.8	39.9	46.7
International travel	2.0	280.0	282.0	2.2	300.4	302.6	2.4	340.2	342.6
Domestic travel	80.0	20.5	100.5	84.5	23.0	107.5	89.2	25.8	115.0
Other direct costs	35.5	41.0	76.5	37.1	44.6	81.7	39.9	48.6	88.5
Indirect costs	256.5	276.7	533.2	279.8	303.0	582.8	303.0	333.6	636.6
Outreach*	56.0	159.0	215.0	61.6	174.9	236.5	67.8	193.4	260.2
SubTotal	1372.7	2117.3	3490.0	1481.1	2319.7	3800.8	1608.5	2553.6	4162.1
Host Country Research Funds			750.0			775.0			800.0
Contingency Funds			200.0			225.0			250.0
TOTAL			4440.0			4800.8			5212.1

* Development of packages, manuals and facilitation of collaboration with extension.

TOTAL BUDGETS FOR YEARS 10, 11, AND 12. . . . \$14,452,000

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Host Country Research Funds and Contingency Funds

	Year 10	Year 11	Year 12
Host Country Research Funds	750	775	00
Contingency Funds	200	225	50
Total	950	1000	1,050

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(S in thousands)

SR-CRSP BUDGET CATEGORY: Management Entity

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	190	-	190	200	-	200	210	-	210
Fringe benefits	52	-	52	55	-	55	58	-	58
Supplies & expenses	59	-	59	62	-	62	65	-	65
Equipment	5	-	5	5	-	5	-	0	0
International travel	-	78	78	-	76	76	-	84	84
Domestic travel	53	-	53	54	-	54	58	-	58
Other direct costs	23	-	23	24	-	24	26	-	26
Indirect costs	74	16	90	78	16	94	82	17	99
Total	456	94	550	478	92	570	499	101	600

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Outreach

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	50	-	25	60	-	60	70	-	70
Fringe benefits	17	-	17	20	-	20	23	-	23
Supplies and expenses	7	86	118	1	100	101	-	106	106
Equipment	1	-	1	2	-	2	3	-	3
International travel	-	6	6	-	7	7	-	8	8
Domestic travel	3	-	3	4	4	-	5	-	5
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	22	23	45	23	24	47	24	25	49
Total	100	115	215	110	135	237	125	139	264

GENETIC IMPROVEMENT OF SHEEP AND GOATS
FOR SMALLHOLDER PRODUCTION

Eric G. Bradford, Principal Investigator

University of California, Davis

Work Plan for Years 10, 11, 12

Work Sites: Indonesia and Morocco

Introduction

The UCD Breeding Project has established sound research programs in Indonesia and Morocco beginning in 1980 and 1982 respectively. With the return home of host country scientists with training in the U.S. and, in Morocco, with the development of facilities for sheep research at Tadla Farm, these projects have reached a very productive stage in 1984-85. However, breeding research is by nature long term, and much of the work will need to continue well beyond 1987 to realize the potential benefits for small ruminant production in the regions represented by these countries.

Features of the work proposed for 1987-90 include:

1. Support to help the young scientists trained under auspices of the CRSP to establish long term research programs for genetic improvement of small ruminants relevant to the needs of their countries. These programs will include new research projects as well as continuation of projects initiated by the CRSP in earlier years.
2. Field testing of improved genetic stocks developed in the breeding project, as part of improved production packages which will include also nutrition, economics, animal health and sociology components. Improved linkages with other CRSP projects and with non-CRSP research programs in the participating countries is a goal of this portion of the work.
3. Continued training of host country and third country scientists in the U.S., with emphasis on training relevant to the needs of the participants' countries.

Indonesia

The principal research projects currently active in Indonesia are:

1. Determination of the mode of inheritance of prolificacy in Javanese sheep, and development of strains expected to differ consistently in level of prolificacy. (Cicadas).
2. Evaluation of the potential of St. Croix Hair Sheep to improve productivity of sheep for Indonesian conditions. (Sei Putih, North Sumatra).
3. Evaluation of the milk production and growth potential of crossbred

goats produced by use of U.S. dairy breed semen on Etawah and Kacang does. (Cilebut; collaborative with RMI).

Projects 2 and 3 are just being initiated in 1985 with the importation to Indonesia from California of St. Croix sheep and of Alpine and Nubian goat semen. In addition to these station-based research projects, the breeding project is continuing the monitoring of small ruminant performance in 3 West Java villages.

All of these activities will continue through 1990. The projected work and schedules are outlined below.

1. Development and testing of strains of sheep differing in genetic potential for prolificacy. The basis of the exceptionally high level of variability in prolificacy of both Thin Tail and Fat Tail breeds of sheep in Java appears to be segregation of a gene with large effect on ovulation rate. On this basis a breeding program to produce strains with mean litter size in adult ewes of either:
 - a) approximately 1.5 (practically all singles and twins)
 - b) 2.5 - 3.0 (range of 1 to 5 with many litters of 3 and 4).

The first of these would be appropriate for more moderate levels of management, while the second would require a very good level of feeding and management to realize its potential. The advantage of distinct strains is that efficient feeding and management programs could be developed for each. At present, the flocks of Indonesian sheep are a mixture of the two types, and a feeding and management program suitable for an "average" ewe is not ideal for either of the two types making up this average.

The schedule for this project is as follows:

Cicadas

- | | |
|---------|--|
| 1983-85 | Determination of the genetics of prolificacy in Javanese sheep, and identification of ewes of the two types. |
| 1984-87 | Progeny testing rams in Cicadas flock to identify males carrying the postulated high ovulation rate gene. |
| 1987-88 | Mating of known carrier rams to carrier (and homozygous?) ewes |
| 1988-90 | Measure reproduction of ewes produced from 1987-88 matings, to identify heterozygous and homozygous ewes and to compare their performance. |

Field tests

- | | |
|---------|--|
| 1986-87 | Place rams from "high" and "low" matings in village flocks where records can be obtained on their daughters. Work with sheep owners to implement improved feeding and management practices (collaborative with other CRSP projects). |
| 1987/88 | Progeny of these test sires born |

- 1987-90 Evaluate progeny of test rams in village flocks; correlate performance of daughters with predictions from parent performance at Cicadas.
Compare costs and returns for "high" and "low" ewes, assuming both are produced from the test matings in village flocks.

2. Evaluation of St. Croix sheep

The research program on sheep at the Sub-Balai at Sungai Putih is just getting underway, with no long term investment as yet in the breeding program of the sheep there. The climate throughout Indonesia appears more suited to woolless than to woolled sheep, and this seems an appropriate time and place to evaluate hair sheep for the country. The proposed schedule for the project is as follows:

- 1985 Import ten each St. Croix rams and ewes. Mate to produce St. Croix lambs and lambs from St. Croix sires and Thin Tail dams.
- 1986 Compare St. Croix, F_1 and Thin Tail lambs for viability and growth. Place F_1 and Thin Tail rams with producers
- 1987-89 Compare reproduction of ewes of the three groups at Sungai Putih - compare viability and growth of lambs sired by F_1 and Thin Tail rams in local producer flocks.
- 1988-90 If preliminary indications are that St. Croix crossbred lambs are superior in performance to local breed sheep, add pure St. Croix rams to the field testing program in North Sumatra, and possibly also in Java.

3. Evaluation of dairy goat crosses at Cilebut.

It has recently been decided to evaluate progeny of improved dairy goat breed sires for milk production at the Cilebut Station. Dr. Hobart Peters of RMI is acting as a consultant to BPT on the project. Semen from 4 each Alpine and Nubian bucks is being shipped (June, 1985) from UCD for this trial. Plans are to compare progeny of Alpine and Nubian sires mated to Etawah and Kacang does with pure Etawah and Kacang goats for viability, growth and milk production.

- 1985 Import semen and make first inseminations
- 1986 First dairy crossbreds born. Measure viability and growth.
- 1977-88 Evaluation of milk production of F_1 's.
- 1987-90 Production and evaluation of backcrosses (1/4 and 3/4 dairy breeding).

Results from Cilebut should permit a decision by 1988 as to whether or not to field test the dairy crosses.

Linkages with other projects.

The experiment station work will continue to involve collaboration with the CRSP Nutrition Project, and the field testing will continue to involve work with all three other CRSP projects - Nutrition, Economics and Sociology. We also plan to continue close collaboration with the RMI scientists, on evaluation of the crossbred goats and on housing and management studies for sheep and goats in the villages, and with CSIRO scientists on reproduction work at Cicadas and in the villages. The last will include (but will not be limited to) work on management of males and mating to reduce parturition intervals in village flocks.

Morocco

Goals of the breeding project in Morocco are to determine the mode of inheritance of the exceptional prolificacy of the D'Man breed of sheep, and to estimate the value of crosses carrying various percentages of D'Man and non-prolific breed inheritance in mixed crop - livestock farming areas of Morocco.

Performance of pure D'Man and pure Sardi breeds was characterized at Tadla Farm in 1982-84, and a large number of F_1 crossbreds was produced. Two lamb crops from mating D'Man, Sardi and F_1 rams and ewes in all possible combinations are being produced in 1985. Thus we will have comparisons of contemporary purebred, F_1 , F_2 and backcross animals in phase II of the project, scheduled to last through 1989. These will be evaluated at Tadla for viability, growth and age at puberty of both sexes, and ovulation rate, embryo survival, litter size and total lamb production of ewes. The Project will provide research data for at least three doctoral dissertations of IAV faculty members. A fourth IAV faculty member will be evaluating quantity and quality of wool produced by sheep of the different groups.

Comparison of progeny of F_1 and Sardi rams in farmer flocks is also a major goal of the next phase. Planning for such trials, to begin in 1986 if possible, has been initiated. These rams would be placed in cooperating flocks whose owners would be provided with information on recording system to be followed, materials and instructions for prevention of selenium deficiency, and recommendations for feeding and management.

Phase III of the breeding experimentation at Tadla Farm will be initiation of development a new strain carrying 25, 38 or 50% D'Man inheritance, depending on results from the phase II research and the field tests. The crossbred group judged to be most nearly optimum in terms of reproduction potential will be chosen as the base for the new strain, with selection within the group for growth, wool and color characteristics to optimize their productivity and acceptability.

The anticipated schedule is as follows:

Tadla

- | | |
|---------|---|
| 1985 | (March and November) - Birth of total of 700 to 800 purebred, F_1 , F_2 and backcross lambs |
| 1985/86 | measurement of viability, growth, age at puberty and early |

fertility of rams and ewes born 1985.

- 1986-89 measurement of ovulation rate, litter size, lambing interval and total lamb production through 4 parturitions of the 350 to 400 ewes born 1985.
- 1989/90 decision on the base population for development of a new strain of intermediate prolificacy, and initiation of selections to produce the strain.

Field tests

- 1986-87 F₁ and Sardi rams placed in field tests
- 1987-89 Progeny of test rams born
- 1987-90+ Progeny of test rams evaluated for viability, growth, reproduction and net returns.
- 1988+ (depending on results from Tadla and initial field tests) - 1/4 and/or 3/4 D'Man rams placed in field tests in comparison with Sardi rams.

Linkages with other projects.

Breeding Project participants are interested in collaboration with the Nutrition Project in genotype x environment interaction studies involving comparison of different groups, e.g. D'Man, F₁ and Sardi, under different levels of nutrition or different feeding systems. These will become feasible in 1986, with the completion of phase I and consequent availability of mature ewes of the three groups. The ultimate goal is development of sound, feasible recommendations for feeding and management of those groups potentially suited to production systems of the area (which might include, for example, Sardi., 1/4 D'Man, 3/4 Sardi; 1/2 D'Man, 1/2 Sardi, but not pure D'Man). We are also interested in collaborating with the Sociology Project, and with economists and veterinarians from IAV (since the Morocco CRSP does not include these projects) in development of the needed production packages.

Collaboration with the USAID-funded Range Extension and Dryland Farming Systems projects is also a possibility, particularly in the field tests of crosses or new strains.

In general, linkage of the Morocco CRSP breeding project with other CRSP projects and other programs will depend on the success of the new structure for coordination of the CRSP instituted by IAV in 1985.

U.S.

Project activities in the U.S. will continue in two major categories:

1. Training at the M.S. and Ph.D. levels, in the fields of animal breeding and sheep production.
2. Supporting research on sheep, in the areas of genetics of ovulation rate

and embryo survival and of genetic and management factors controlling breeding season.

The University of California, Davis has strong graduate programs in the Animal Sciences and related disciplines, and the presence of faculty members with international experience and students from many countries adds to the relevance of the training received by participating country students. Both Moroccan and Indonesian students are using SR-CRSP data from their home countries for their dissertations, but they also need research opportunities during the time they are in California. The sheep research programs at Davis and at the Hopland Station, which address problems similar, in general, to those being researched in the overseas worksites, provide such opportunities, as well as providing backup information for the overseas work.

General

Linkages of the CRSP Breeding Project activities with work in other countries and extension of results to other countries should be possible during the 1987-1990 period. For example, contacts were made with animal breeding researchers from Syria and other Arab countries at the Agricultural Networks Workshop in Jordan in March 1985. There is interest in the Morocco results on work related to partial intensification of sheep production in North Africa and the Middle East, and good opportunities for exchange of research results and possibly for joint training efforts.

Another area of possible support for work in other areas is in artificial insemination of goats. The UCD Breeding Project developed the capability for providing U.S. dairy goat sire semen to other countries, and also initiated genetic evaluation of dairy goat sires in the U.S. We have shipped semen to Kenya, Mexico and Indonesia, and can make it available to other countries as well.

The UCD Breeding Project research and training activities are going well, with the work in progress promising a very productive period if funding is continued 1987-1990.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: UCD Breeding

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	35	50	85	38.5	55	93.5	42.35	60.5	102.85
Fringe benefits	10.5	12	22.5	11.55	13.2	24.75	12.705	14.52	27.225
Supplies & expenses	10	43	53	10.1	47.3	57.4	11.11	52.03	63.14
Equipment									
International travel	-	20	20	-	22	22	-	24.2	24.2
Domestic travel	2	-	2	2.2		2.2	2.42		2.42
Other direct costs									
Indirect costs	11.5	21	32.5	12.65	23.1	35.75	13.915	25.41	39.325
Total	69	146	215	75	160.6	235.6	82.5	176.66	259.16

SMALL RUMINANT FLOCK/HERD HEALTH PROGRAM IN SMALLHOLDER SYSTEMS

Harvey Olander, Principal Investigator

University of California-Davis

Workplan Years 10, 11 and 12

Work Site: Brazil

Overall Goals

The Brazil project offers a unique opportunity to continue research on caseous lymphadenitis, hopefully to a significant conclusion - that is, until methods of control and management or eradication of the disease are developed. Because this disease is insidious and produces rather undramatic chronic clinical signs it has not received the sustained research effort which will be necessary to reach a successful conclusion. The disease has been a continual economic burden to the sheep and goat producers throughout the world, but it has been largely ignored in better developed countries because of the relative unimportance of the sheep and goat industries in those countries. However, it can be a critical factor in the survival of people in lesser developed tropical countries where individuals may depend on small numbers of sheep or goats to sustain them through periods of drought and depression. The Brazilian project provides access to large numbers of such small holders who can benefit immediately from the research as paid cooperators and ultimately from the development of methods of control of the disease. For these reasons the U.C.-Animal Health project foresees the continuation of both laboratory and field research aimed at methods of controlling caseous lymphadenitis.

The past 2 years of heavy rainfall have demonstrated that animal health management in the tropics requires the development of a flexible system to cope with the radical extremes of climate and their effects on animal sanitation. During the recent drought years animal scientists in northeast Brazil, including those in EMBRAPA and the CRSP, saw little need for clinical veterinary service. Lack of energy and water were the major constraints of livestock production. With the onset of the wet season sanitation has become a major constraint, and the cry now is for more veterinary care and treatment. A more reasonable approach would be to alter methods of management to provide better sanitation. It is clear that alternate methods of management exist, in temperate climates and in wet tropical areas, which are better suited to disease control under those conditions than are the systems normally used in arid lands. The challenge is to provide education and a flexible system, that will allow small holders to adapt. To answer immediate needs for veterinary care and to develop an ongoing system of care and management to meet the changing needs, the Animal Health Project will provide a clinical veterinary epidemiologist. He will not only establish a health care system, but he will help to train Brazilian veterinarians to maintain such a system.

Specific Objectives

1. The major thrust will be to continue research on the natural history of caseous lymphadenitis to determine the best means for control. Studies on pathogenesis and attempts to control the disease will be carried on within the laboratory in the field. They will include assessments of means of persistence and spread of infection, natural routes of inoculation and effectiveness of altered management and various vaccination procedures on control of the disease.
2. Similar studies will be made on diseases associated with wet season environments. Foot rot and intestinal parasitism are of particular concern in this regard. The comparison of different types of housing, such as the raised slatted platforms which were considered to be without effect in the dry years should be continued during the wet season. The effect of humid or wet environments on the persistence, prevalence and spread of "dry environment diseases", such as, caseous lymphadenitis will also be examined and monitored.
3. The neonatal infectious diseases also increase in incidence in wet seasons, and the importance of enteric infections and mycoplasmosis in northeast Brazil will be assessed by serologic, cultural and pathologic studies. Methods of control will be instituted as needed.
4. With the establishment of a good microbiologic diagnostic capability, specific etiologies of pneumonias will be established and methods of control will be researched and instituted.
5. Mastitis studies will continue in support of the development of the dairy goat facility at CNPC.
6. The project will continue to support work on mineral deficiencies and imbalance and plant intoxications.

Equipment

A major need at the CNPC is for good infectious disease isolation and quarantine facilities. Such facilities will facilitate and encourage research in infectious diseases and make the Center a more attractive place to work for scientists interested in animal health research.

Much of the equipment currently in use will need updating through the years 1988-1990.

Training.

- 1) Advanced research training for Dr. Selmo Alves and for Dr. Janete Santa Rosa will be in progress through 1988 and 1989. The training will attempt to incorporate radioisotopic methods in the study of infectious diseases to further utilize the radioisotope laboratory being developed at CNPC.
- 2) A CRSP clinical veterinary epidemiologist will be in place in 1986 and will provide training for clinical veterinarians at the CNPC. Extension of such training to Brazilian communities will be attempted.

- 3) At the CNPC the project will continue to emphasize on the job training of local people as technicians.

Lessons Learned

- 1) It is important to train host country people who have family or other personal ties to the area in which you wish to develop an institution. (This may be especially true in Brazil where local and family allegiance is of much greater importance than job or professional responsibilities. Most of the Brazilian animal health people initially attached to CNPC have left Sobral to go to jobs in or near their family homes).
- 2) It is important to work within the tempo of the local population. Very little can be accomplished until host country counterparts recognize the need for change as their own.
- 3) In Brazil it is especially important to attempt to work in Portuguese. Even rudimentary attempts are appreciated and do as much for collaboration as scientific results. It is apparently recognized by the Brazilians that it requires an interest in them to learn their language.

Global Plans for FY '88, '89 and '90

- 1) Assuming success with toxoid vaccines for caseous lymphadenitis, field testing in other AID countries would be promoted.
- 2) Since other CRSP projects are located in humid tropical areas transference of health management procedures, or adaptations, from those sites to the Brazilian northeast for the management of wet season problems will be investigated.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Animal Health - UCD

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	35	42	77	38.5	46.2	84.7	42.35	50.82	93.17
Fringe benefits	4	3	7	4.4	3.3	7.7	4.84	3.63	8.47
Supplies & expenses	23	16	39	25.3	17.6	42.9	27.83	19.36	47.19
Equipment	2	5	7	2.2	5.5	7.7	2.42	6.05	8.47
International travel	--	14	14	--	15.4	15.4	--	16.94	16.94
Domestic travel	2	1	3	2.2	1.1	3.3	2.42	1.21	3.63
Other direct costs	2	--	2	2.2	--	2.2	2.42	--	2.42
Indirect costs	14	12	26	15.4	13.2	28.6	16.94	14.52	31.46
Total	82	93	175	90.2	102.3	192.5	99.22	112.53	211.75

AN INVESTIGATION OF SMALL RUMINANT HEALTH PROBLEMS

James C. DeMartini, Principal Investigator

Colorado State University

Work Plans Years 10, 11 and 12

Work Site: Peru

Overall Goals

The long range goal of the Colorado State University (CSU) Animal Health Project is to increase the efficiency of production of sheep, goats and alpaca in Peru by application of appropriate disease control strategies. Past work at IVITA and San Marcos University (SMU) as well as our own preliminary studies have identified chronic respiratory disease of sheep, reproductive diseases, neonatal lamb mortality and neonatal mortality of alpaca as major problems that constrain production in smallholder flocks. We plan to apply current biomedical research techniques to increase knowledge of the causes, diagnosis, and mechanisms of spread of these entities. Application of research results in disease control or prevention will be through pilot studies in smallholder "community" flocks and demonstrations of control techniques on large enterprises. Results of these studies will be made available to agricultural extension agencies of the Peruvian Government who will be responsible for their widespread dissemination. We also plan to prepare handbooks on techniques of disease identification and control for use of field veterinarians in Peru.

Training is viewed as an important goal of the CSU project since, ultimately, future progress in livestock disease control in Peru will be largely dependent upon experienced, highly motivated Peruvian veterinarians. Training opportunities will consist of graduate studies at Colorado State University, short term training in the U.S. and short courses and seminars in Peru.

Specific Objectives

The major effort to develop a control strategy for sheep pulmonary adenomatosis and other causes of respiratory diseases will be continued. It is anticipated that we will soon be in a position to apply results of recent research to these problems. Early efforts to control sheep pulmonary adenomatosis, some already underway, will by necessity be tested on large livestock enterprises before being applied to smallholder flocks. The control methods will be based on management changes, serologic tests, and perhaps eventually, vaccines.

Studies on causes of infectious causes of reproductive failure in sheep in the Central Sierra, will be continued and expanded. Chlamydia and mycoplasma will be added to the entities under investigation. Control programs for ram epididymitis based on Rev-1 vaccine, culling, and semen evaluation will be extended to communities; these programs have been very successful in large cooperative farms. Efficacy of anthelmintics in control

of internal parasites will also be evaluated in such flocks as will hygienic procedures in limiting neonatal lamb mortality.

Evidence suggests that neonatal enteritis of alpaca crias is the most significant health problem of a livestock species that is growing in importance in the high Andean region. New knowledge about the role of colostral immunoglobulin in protective immunity in alpaca and mechanisms of colostral transfer from dam to cria will be applied to assist in prevention of neonatal mortality. New tests for identification of the causative bacteria and their toxins will also soon be available.

Approach

Basic research on causes and serodiagnosis of sheep pulmonary adenomatosis will be continued at CSU. Now that the disease can be experimentally reproduced we are in a better position to isolate the causative virus and develop a serologic test. Serologic tests and other practical means of controlling this and other respiratory diseases will be evaluated in Peru by SMU investigators. Development of a suitable immunization product would be a relevant, if ambitious, goal in this research area.

Serological surveys for significant infectious agents in geographically diverse areas of Peru will serve as a base for future recommendations of disease control. Test and slaughter, immunoprophylaxis, and interruption of transmission cycles are control strategies for diseases such as brucellosis, leptospirosis, chlamydiosis, mycoplasmosis, bluetongue and caprine arthritis-encephalitis.

Failure of passive transfer of maternal immunoglobulin through colostrum at birth in alpacas has been shown to be a predisposing factor in neonatal enteritis. Tests for determination of immunoglobulin levels developed at Washington State University will be applied to increase knowledge about the prevalence of failure of colostral immunoglobulin transfer, particularly in smallholder flocks. In parallel, studies of antigenic characteristics of causative agents such as *E. coli* and *C. perfringens* will be continued at CSU. with a long range goal of development of new vaccines for these agents of disease.

Equipment

There is a major need for continued repair and replacement of scientific equipment in IVITA and SMU research laboratories in Peru. In particular, such items as microscopes and centrifuges are in great need.

Training

Graduate training in pathology, virology, bacteriology, immunology, and epidemiology will be continued for peruvian veterinarians. Dr. Ramirez and Dr. Rosadio should complete requirements for the PhD degree by 1987 and will return to Peru by that time. Continued support for their research will be provided through the CRSP. Other short term training sessions in the U.S. and in Peru will be provided as needed and possible.

CSU staff collaborating on the project will include J.C. DeMartini, DVM,

PhD, Principal Investigator and Pathologist; R.P. Ellis, PhD, Bacteriologist; and C.V. Kimberling, DVM, Clinical Veterinarian; and M. Salman, DVM, PhD, Epidemiologist.

SMU staff and IVITA personnel primarily involved with the project include: E. Ameghino, DVM, Clinical Veterinarian; G. Calderone, DVM, PhD, Immunologist; D. Huaman, BS, Bacteriologist; H. Rivera, DMV, Virologist; and C. Morales, DVM, Pathologist. Drs. Rosadio and Ramirez will return to Peru by 1987 and will be involved in virology and bacteriology diagnostic work and research.

Contribution to Overall SR-CRSP Program

Animal health care is often cited by smallholders in Peru as their primary concern. It is the intent of the CSU project to develop new knowledge and apply existing knowledge to control disease losses in livestock in Peru. In the process, liaison will be maintained with large cooperative farms which often have a major influence on surrounding communities of smallholders. Collaborative research arrangements and services provided to other SR-CRSP projects in Peru and other SR-CRSP animal health projects will be necessary in order to maximize utilization of CRSP resources. The work of the CSU Animal Health Project will be extended to Puno Department of Peru through a contract between CSU, Universidad Nacional del Altiplano, and CORPUNO, a development project funded by the World Bank. It is anticipated that this project will be extended beyond its current December 1985 expiration date.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Animal Health - Colorado

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	36	44	80	39.6	48.4	88	43.56	53.24	96.8
Fringe benefits	5	2	7	5.5	2.2	7.7	6.05	2.42	8.47
Supplies & expenses	16	18	34	17.6	19.8	37.4	19.36	21.78	41.14
Equipment	0	3	3	0	3.3	3.3	0	3.63	3.63
International travel	-	6	6	-	6.6	6.6	-	7.26	7.26
Domestic travel	2	3	5	2.2	3.3	5.5	2.42	3.63	6.05
Other direct costs	1	-	1	1.1	-	1.1	1.21	-	1.21
Indirect costs	20	19	39	22	20.9	42.9	24.2	22.99	47.19
Total	80	95	175	88	104.5	192.5	96.8	114.95	211.75

SOCIOLOGICAL ANALYSIS OF SMALL RUMINANT PRODUCTION SYSTEMS

Michael F. Nolan, Principal Investigator

University of Missouri-Columbia

Work Plan for Years 10, 11, 12

Work Sites: Indonesia, Kenya, Morocco, Brazil, and Peru

Overall Goals

The University of Missouri-Columbia Sociology Project has been active in all five of the SR-CRSP overseas work sites. While specific projects have differed from site to site, the overall objective of the project has been to provide support to the biological science projects in the SR-CRSP in the form of information and data so that they might better plan and implement their research program. In a general sense, the Sociology Project has worked to develop an understanding of the human elements of the small ruminant production system in the overseas sites as well as to gather information on the place that small ruminants occupy within the overall farming system strategies of the limited resource farmers to whom the SR-CRSP is directing its efforts.

During years 10, 11 and 12 of the SR-CRSP, the Sociology Project will begin to gradually deemphasize the collection of basic information on small ruminant production systems and turn its attention increasingly to implementing, monitoring and evaluating field trials proposed by the biological projects. This transition will occur at different times in the different overseas sites as there has been considerable variation in the amount of baseline data collected to date.

The Project will also continue to emphasize the training of counterparts at each of our overseas collaborating institutions. It is anticipated that during the three years covered by this workplan that two or three graduate level trainees will be in residence at the University of Missouri at any given time. An additional one or two individuals will be supported for degree training at an institution in their home country. All this is part of a major effort to develop effective socio-economic research units within the counterpart organizations with which the SR-CRSP is collaborating.

Specific Objectives

Peru

Plans for Peru during years 10, 11 and 12 include the initiation of graduate degree training for additional Peruvians and continued collaboration in the integrated interdisciplinary Andean community studies now underway. It is felt that the continued involvement of a long-term resident scientist in Peru will be essential in order to insure continuity of coverage. The level of sociological expertise and commitment of the Peruvian institutions with whom we are working is not sufficient to allow for the "Peruvianization" of the Sociology Project to the same degree as the other SR-CRSP projects active in the country. However, INIPA has made a major commitment to the development

of a socio-economic research unit and we will support that development through technical assistance and training. Our principal INIPA counterpart will begin her M.S. studies in 1986 (year 8) and would take two years to complete her program (year 10).

It is anticipated that all activities will be focused on central and southern Andean communities. Collaboration with the Range, Breeding, Health and Economics Projects in the integrated community activities, particularly as they relate to the monitoring and evaluation of specific technological interventions, will be emphasized.

Indonesia

The collection of baseline information for Indonesia has lagged behind the other SR-CRSP sites due to the lack of a full-time scientific presence on site. That situation was partially ameliorated during year 5 with the return of an M.S. trained rural sociologist to BPT/Bogor. However, this individual returned to the U.S. for Ph.D. studies during program year 6 which again created a program leadership void in Indonesia. His program of study is not expected to be completed until 1988 (year 10).

This led to the placement of a long-term scientist in Indonesia at the beginning of program year seven so that the research initiatives now underway on the role of women, comparing producers and non-producers of small ruminants, and the role of the village trader could be continued. In addition, it is hoped that new studies in the area of communication flows, animal sharing arrangements and the role of SR in estate crop production can be undertaken. All research will be done at the village level and close collaboration with the nutrition, breeding and economics projects is anticipated. With the collaboration of the Economics Project, it has been determined that it is in the best interests of the entire Indonesia program to keep one social and one biological scientists in Indonesia until program year 11.

Brazil

Budget constraints will not permit extensive activities in Brazil during program years 10, 11 and 12. However, it is hoped that through some form of joint funding arrangements with the Utah State Range Project, that a cooperative effort in the sociology of range management might be initiated. This will parallel similar projects undertaken in Morocco and Peru, although the land tenure situation in Brazil, as it affects range is markedly different from the other two locations. To date, nearly all Sociology Project activities have focused on developing an understanding of the interrelationships that exist between crops, livestock and climate. Studies dealing with the specific issues involved in managing the range resource have not been undertaken to date and yet this may constitute the single most viable approach to increasing the production of sheep and goats at modest cost to the producers.

In addition there is an informal agreement for the Sociology Project to collaborate with EMBRAPA/CNPC in the development of a socio-economic research unit in the CNPC. If a sociologist is hired by the CNPC, the Sociology Project is prepared to provide technical assistance to the development of that

person's research program.

Kenya

Project activities in Kenya in years 10, 11 and 12 will be concentrated on helping evaluate the dual purpose goat package, scheduled for on-farm testing in year 10, and enhancing the capabilities of the sociological researchers in the MALD. One Kenyan student began Ph.D. training at the end of program year 6 which would continue until program year 10. No full-time expatriate scientists input will be put into Kenya during years 8 and 9 but may be necessary in years 10 and 11 as the on-farm trials are initiated.

Morocco

Activities in Morocco will undergo a major change in years 10, 11 and 12 if the SR-CRSP continues to have a full program at that site. Baseline studies of production systems in the Rheraya Valley should be completed in year 7 and the overall study of agdals should be completed by early in year 8. Beginning in year 9, a shift of location will be made in order to provide support for the biological work being done at Tadla and Meknes. In years 10, 11 and 12, a major thrust of the program shall be to develop joint projects with production scientists -- particularly those in range management and animal nutrition. In years 10 and 11 we envision collaborative arrangements involving Missouri, NCSU and TTU students working in the Moyen Atlas and Tadla regions where, respectively, range management and animal nutrition work are centered. Funding graduate training for Moroccan nationals will not be a high priority for the sociology project in years 10, 11 and 12. A large number of Moroccans are being funded by at least three USAID projects so training is not a Moroccan priority. We have and will continue to help finance field research expenses of Moroccans trained by other programs whenever it is desirable. It is not expected that an expatriate scientist will need to be placed in Morocco during years 10, 11 and 12. However, it is possible the project might provide partial support for a sabbatical leave during that period.

United States

To date the only activities carried on at the U.S. site, in addition to graduate training, have been the development of a biogeographic reference center and providing administrative and logistic support for the overseas work sites.

By the end of program year nine, numerous reports and a large amount of data will have been accumulated for the 5 overseas sites and it is hoped to allocate some funds during year 10, 11 and 12 to integrate and further disseminate this wealth of information. To date, most of the output of the sociology project has been confined to the SR-CRSP "family." Yet, there is a great deal that would be of interest to the international agriculture scientific community in general and to the sociology/anthropology disciplines in particular. It is planned that during years 10, 11 and 12 that funds will continue to be allocated to this effort which was began in program year 8.

Approach

For the most part, the collection of baseline data, as well as the

monitoring and evaluation of technological interventions, requires the full-time presence of trained personnel in the overseas sites. Relatively little equipment is needed to support these individuals. However, such activities are extremely labor intensive. There is little substitute for having someone working in a community or village and actually observing from day to day the consequences of a new animal management regime or system to produce forages. In that sense, while there has been some reliance on survey methodologies in the past and while they will continue to provide some information in the future, much of the "data" that are collected by the sociology project are done via intensive field observations by trained, knowledgeable observers. To the greatest extent possible, the use of students in such undertakings is often desirable as well as being cost effective. They are, however, not a complete substitute for a fully trained on-site professional.

Thus, the workplan assumes that activities will again be staggered at the various overseas sites. Available funds allow for the placement of two professionals overseas at any given time and first priority for those individuals during years 10, 11 and 12 will probably be Peru and Indonesia.

Equipment

The sociology project has purchased relatively little equipment during years 1 to 9 and it is not anticipated this will change during years 10, 11 and 12. However, it is anticipated that additional support for the upgrading of microcomputer facilities at our overseas work sites will continue to be a high priority.

Training

Present plans call for the sociology project to support graduate training at the University of Missouri for: a Kenya MLD rural sociologist (Ph.D. level); a Peruvian rural sociologist (M.S. level); and, an Indonesian BPT rural sociologist (M.S. or Ph.D.). Some of these will have begun before year 10 but will require support beyond year 9.

In addition, the sociology project will continue to support, whenever possible, the direct cost of selected American graduate research projects conducted at the overseas sites.

The following overseas scientists are currently collaborating with the sociology project:

Kenya	A. Mbabu, M.A., Ministry of Agriculture and Livestock Development
Peru	Cristina Espinoza, B.A. (INIPA); Jose Portugal, B.A. (Direccion de Comunidades Campesinas)
Indonesia	K. Suradisastra, M.S., BPT/Bogor; Sri Wahyuni, B.A., BPT/Bogor; S. Mawi, B.A., BPT/Bogor, J. Ihalauw, Ph.D., Satya Wacana University
Morocco	A. Hammoudi, Ph.D., IAV; M. Mahdi, M.A., IAV

University of Missouri faculty and staff collaborating on this project besides the Principal Investigator are: Jere Gilles, Constance McCorkle, Keith Jamtgaard, Eric Reynolds, and Mark Gaylord.

Contribution to Overall SR-CRSP Program

The ultimate litmus test for the University of Missouri sociology project is whether the information it obtains and disseminates on the social organization of small ruminant production systems impacts, in any substantial way, the direction taken by the biological science disciplines in the SR-CRSP. Through its efforts alone, the sociology project will not produce one more sheep or goat for a protein deficient world. Yet hopefully, the information provided to date in nearly all of the overseas sites will allow the collaborating projects in the SR-CRSP to view their research program in the context of the overall system in which small ruminants are produced on the small farms which are our target group. It is anticipated that even closer interaction with the biological projects will be essential as they begin to develop specific technological interventions which will require careful monitoring and evaluation by biological and social scientists alike. In those sites where the sociology project is able to have a full-time scientific presence, the sociology project will have very close working relationships with the other SR-CRSP projects, particularly as the program moves into the stage of field testing and trials. Through the cooperative efforts of social and biological scientists, there is an increased likelihood that the research results which are obtained will be both useful and used by the limited resource farmers we are trying to help.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Sociology - Missouri

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	22	118	140	24.2	129.8	154	26.62	142.78	169.4
Fringe benefits	5	30	35	5.5	33	38.5	6.05	36.3	42.35
Supplies & expenses	10	17	27	11	18.7	29.7	12.1	20.57	32.67
Equipment	-	3	3	-	3.3	3.3	-	3.63	3.63
International travel	-	25	25	-	27.5	27.5	-	30.25	30.25
Domestic travel	5	-	5	5.5	-	5.5	6.05	-	6.05
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	-	-	-	-	-	-	-	-	-
Total	42	193	235	46.2	212.3	258.5	50.82	233.53	284.35

EVALUATION AND GENETIC IMPROVEMENT OF SHEEP AND GOATS IN EXTENSIVE MANAGEMENT SYSTEMS

R.L. Blackwell, Principal Investigator

Montana State University

Work Plans Years 10, 11 and 12

Work Site: Peru

Overall Goals

The principal goal of the Montana State University breeding project is to provide information needed to develop genetic improvement programs for efficient production of meat and fiber from the small ruminant populations of the Andean region. This includes collaborative research with Universidad Nacional Agraria, Universidad Nacional Tecnica del Altiplano and IVITA of San Marcos University. Sheep are the species of primary interest although the alpaca will be included in the research. The activities to accomplish the principal goal are genetic resource evaluation, investigation of selection criteria and selection responses, introduction of genetic material, further development of the nucleus herd concept and distribution of improved genetic material to the limited resource farmer. Increased emphasis will be given to animal improvement methodology appropriate for indigeneous communities within the context of the farming systems research approach. The traits of greatest importance include measures of growth, reproduction, maternal ability and fiber production. Genetic change that results in improvement of these economic traits requires identification of animals that transmit genes associated with the superior phenotypes. A basic consideration is the training and development of personnel who can provide research leadership in scientific animal breeding technology and who can aid in the application and transfer of this technology to the limited resource farmer.

Specific Objectives

1. Determine the relative magnitude of genetic differences in growth, reproduction, maternal ability and fiber production of populations of animals and individual animals and the interrelationships among these traits.
2. Investigate methodology for the transfer of animal breeding technology to indigeneous communities in conjunction with the farming systems research project.
3. Train and develop personnel for research and extension in scientific animal breeding.
4. Assist in the development of nucleus sub-populations that are genetically superior and from which breeding stock can be distributed to farmers to effect genetic improvement in the small ruminant populations of the region.

5. Monitor the effect of prolific sheep in the Andean environment.

Approach

Breeding comparisons in sheep will include breeds, breeding groups within breeds and individual rams. Performance testing of large numbers of rams, intensive selection and progeny testing selected rams for maternal ability of their daughters will be continued to generate research data and to produce sub-populations of superior animals. Evaluation of breeding methods of some large enterprises will be continued. Improvement in their use of technology and breeding procedures will be effected where possible to develop nucleus herds that are truly superior genetically and which will be a major source of breeding stock for the small farmer.

Attention will be given to the Criollo, or native sheep, to ascertain their production potential under better management conditions. Grading-up procedures and selection within the Criollo will be studied. Since the Criollo constitutes about 75% of the 15 million sheep in Peru, small increments in productivity through genetic improvement will result in large increases in animal products produced.

In the alpaca breeding research selection experiments will be continued to evaluate the response of single trait selection for fleece weight and for growth rate. Control populations are included to measure genetic progress. Direct response to selection and correlated response in other traits will be studied. Breeding research with alpaca will continue at IVITA's La Raya Station if appropriate resources and infrastructure requirements are provided.

Equipment

Field equipment for the breeding project is generally available. Additional or replacement livestock scales, animal handling equipment and vehicles for travel to the experimental areas makes up the major field equipment needs. The Computing Center at UNA provides the basic equipment needs for computing. However, additional memory and storage capacity and software are needed to more effectively handle the large volume of data processing and the statistical analyses required in animal breeding research. Analyses that cannot be done there will be accomplished at MSU.

Training

A continuing training program will include graduate work at the M.S. level for highly selected students at UNA. Some support for post-B.S. training and research for the Ingeniero Zootecnista title will be provided on a continuing basis at UNA or at other cooperating universities. These students will work on the project as technicians. Training emphasis will be placed on field experience in animal husbandry and in applications of breeding and statistical theory to animal improvement.

Training of M.S. level students at MSU will include U.S. graduate students supported by the sheep breeding project of Montana Agricultural Experiment Station and Peruvian or other international students supported by SR-CRSP and other funding sources.

The principal Peruvian personnel collaborating with the project are Manuel Carpio, UNA, and Rolando Alancastre and Ruben Chavez from UNTA. Dr. Benjamin Quijandria, Site Coordinator in Peru is shared by the breeding project with ME.

The MSU personnel collaborating on the project are R. L. Blackwell, Principal Investigator, P. J. Burfenig and D. D. Kress.

Contribution to overall SR-CRSP Program

The MSU breeding project will cooperate with every other SR-CRSP projects in Peru to effect comprehensive research coverage of major production problems and socio-economic studies. Increased emphasis will be given to contribution to the farming systems research project in the indigeneous communities. Our greatest interaction with sociology will occur in this activity. Cooperation with the Utah reproductive physiology project and the Colorado Animal Health project will continue. Breeding project animals and data will be made available to these projects and other projects. The breeding project will contribute to validation research with the Texas Tech range project and TAMU's systems project. Cooperative studies on the economic aspects of animal breeding technology, such as the relative economics value of various traits, that will guide the development of breeding objectives will be undertaken.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Animal Breeding - Montana

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	22.5	60	82.5	25.3	67.65	92.95	28.435	76.23	104.665
Fringe benefits	4.8	4	8.8	5.5	4.4	9.9	6.05	4.84	10.89
Supplies & expenses	3.5	15.5	19	3.3	15.95	19.25	3.63	18.15	21.78
Equipment	-	4	4	-	4.4	4.4	-	-	-
International travel	-	14	14	-	15.4	15.4	-	18.15	18.15
Domestic travel	1	-	1	1.1	-	1.1	1.815	-	1.815
Other direct costs	3	10	13	2.64	10.45	13.09	2.42	11.132	13.552
Indirect costs	13.7	9	22.7	14.96	10.45	25.41	16.698	12.1	28.798
Total	48.5	116.5	165	52.8	128.7	181.5	59.048	140.602	199.65

GOAT AND SHEEP NUTRITION AND FEEDING
SYSTEMS RESEARCH

William L. Johnson, Principal Investigator

North Carolina State University

Work Plan for Years 10, 11, 12

Work Sites: Brazil, Indonesia and Morocco

INTRODUCTION

The North Carolina State University small ruminant nutrition and feeding systems project is currently collaborating with other small ruminant research programs in Brazil, Indonesia and Morocco as part of the Small Ruminant CRSP. The research plan summarized below envisions work in all three of these countries continuing until 1990.

Overall goals of the project reflect the fact that at each of the three locations, present feeding practices limit small ruminant productivity at least part of the year. Also, much remains to be learned about locally available feed resources. The overall goals can be summarized as follows:

- to characterize the nutritional value of locally available feed resources, including native and cultivated forages, crop residues, and byproducts; and
- to develop improved guidelines for feeding sheep and goats, including when and how to provide supplemental nutrients.

Training will continue to be an important aspect of the project. This includes support of candidates for advanced degrees, particularly for their thesis research; in-service training of young, relatively inexperienced personnel; and support of post M.S. and post-doctoral scientists during the crucial reentry phase after completing their degree program.

The pages that follow outline specific objectives and approach for continued work in Brazil, Indonesia, and Morocco, and supporting research activities in Raleigh. Proposals for interaction with other AID-sponsored projects and with international centers are outlined, and a projected budget is shown.

Northeast Brazil

The major emphasis of research in the 1987-1990 period will be the testing of supplementation strategies for goats and hair sheep that obtain most of their year-round nutrition from grazing the native caatinga vegetation. The objective is to optimize productivity of local meat-producing breeds at various critical points in their lifetime production cycle:

- conception (to optimize conception rates)
- gestation (to optimize fertility rates and birth weights)

- lactation (to optimize weaning weights and dam health)
- post-weaning growth (to optimize market age and weight for males, or age and weight at puberty for replacement females).

Meeting this objective will require carefully coordinated work in collaboration with range scientists and reproductive physiologists.

Other research objectives are also important, but may have to take a secondary priority--depending on personnel and budgetary resources available. Work in this category includes:

- further evaluation of byproduct feedstuffs available in the region.
- further characterization of the mineral status of soils, vegetation, and animals in the region.
- further evaluation of irrigated forages such as napier grass, forage sorghum and cultivated legumes.
- further development of feeding systems for lactating does of dairy goat breeds.

NCSU welcomes the interest recently shown by EMBRAPA to increase the available pool of trained personnel by sponsoring thesis research by Brazilian graduate students. It is hoped that the NCSU SR-CRSP budget, expected to be limited, will be adequate to support two or three such student projects at any one time. The continued presence of a PH.D. animal nutritionist at the CNPC will be necessary to give proper supervision to these student projects; however, such a position is not budgeted in the current projection.

Similar research training might be offered for sponsored third-country students, most likely from Portuguese speaking African countries or from Spanish speaking areas

A final objective will be to seek a meaningful involvement with a network of extension agents who are willing to initiate pilot on-farm tests of new feeding and management ideas.

Indonesia: West Java and North Sumatra

By 1987 a good cadre of Indonesian scientists will have completed M.S. and Ph.D. studies in the United States, Australia, or at home in Indonesia. This will make possible a transfer of leadership for the research program in West Java (Bogor) to these newly trained nutritionists. They will need continued financial and technical support, however, through until 1990.

At the same time, resources will be released which can be reallocated to the new research projects in North Sumatra. The need for technical and advisory support will be more acute in North Sumatra than at Bogor, due to the expected continued lack of senior scientists at that location.

Specific objectives for the work at Bogor (West Java):

- continue on-farm testing of economically viable alternative feeding practices for village sheep and goat herds.
- continue the intensive evaluation of locally available feed resources, with attention to anti-quality factors and nutrient

availability.

- intensify collaborative work with the animal breeding project, to develop appropriate feeding recommendations for high and low prolificacy lines of West Java sheep.

At the Sungei Putih substation in North Sumatra, work will focus on the following objectives:

- evaluate systems for pasture or green-chop forage for small ruminants in rubber or oil palm plantations.
- evaluate locally available feed supplement materials.
- determine the growth and reproduction response of local small ruminant breeds to varying levels of nutrient intake (energy, soluble and bypass protein, minerals).

Whenever possible, assistance will be given to Indonesian Ph.D. candidates to conduct thesis research at Bogor (or Ciawi) or at Sungei Putih. Such projects should address one or more of the above listed objectives.

Advisory and budgetary support will also be extended to Indonesian scientists recently returned from study leave, and to newly appointed junior research personnel.

Morocco

Nutrition and feeding systems research in Morocco will continue to focus on the mixed crop-livestock production system in the rainfed cereal producing zones. Specific objectives include:

- continue on-farm monitoring of current production practices; initiate on-farm testing of economically viable alternative feeding practices.
- continue evaluation of forage and byproduct feed resources for small ruminant.
- intensify evaluation of cereal stubble grazing by bred ewes, including the response to strategic supplementation with soluble or bypass protein, energy and minerals.
- collaborate with the animal breeding group in developing efficient feeding programs for sheep of improved genetic potential.

Collaborative research with the range science group, expected to be underway before 1987, will intensify during the 1987-1990 period. This work will be focussed on the extensive systems of sheep and goat production in the mountainous regions with moderate rainfall, and eventually may be extended to lower rainfall regions further to the east and south. The objective will be:

- to provide timely supplementation for ranged small ruminants, in order to optimize reproductive performance, weaning weights, and growth.

Three research centers are involved in these projects:

- the Tadla research farm of IAV Hassan II, for wheat stubble grazing work, feed resource evaluation, and part of the work of developing

- improved feeding systems for ewes and lambs.
- laboratories at IAV Hassan II in Rabat, for feed and diet analysis.
- the research farm and laboratories at ENA, Meknes, for corollary studies on comparative breed responses and appropriate feeding systems for existing and improved genotypes.

It is hoped that collaboration can be initiated before 1987, and continued through the 1987-1990 period, with two other major USAID-supported programs in Morocco: particularly the dryland farming systems project at Settat in which MIAC is collaborating, but also the range extension project in which Utah State University is involved.

A post-doctoral nutrition research position is included in the projected budget. Given the expected excellent research facilities and flocks, the presence of such a person is deemed necessary to optimize the rate and quality of research output. Also, this person will be able to help supervise 2nd and 3rd cycle student projects, as well as participate in a limited way in the teaching and seminar program, especially while IAV Hassan II and ENA faculty members are engaged in their own Ph.D. programs.

In terms of training, major emphasis will continue in supporting thesis research projects at several levels: Moroccan faculty who are candidates for the Ph.D.; IAV Hassan II 3rd cycle students; and ENA (Meknes) 2nd cycle students. Also, with the pending expiration of the University of Minnesota training grant program, the need will be assessed for possible addition of one or two training grants for Ph.D. studies from the SR-CRSP.

Supporting Research At The Raleigh Campus

Research to be supported at the Raleigh campus falls into two main categories: work of a more basic nature, designed to discover principles of ruminant feed utilization which can help solve problems general to one or more overseas research sites; and student projects which have a major training objective, for student participants from collaborating overseas institution.

Work in the 1987-1990 period is expected to continue along lines currently underway:

- basic studies on fiber degradation and passage, and how fiber intake and digestion is controlled.
- studies on low levels of protein supplementation of high fiber diets, and effect on animal performance and physiology.
- basic studies on mineral requirements and interactions.

Collaboration With International Agricultural Research Centers

Two activities are now in the exploratory stage for major interaction with international centers:

- with ICARDA (Aleppo), a project to investigate use of legume cover crops on fallow land and their nutritive value for sheep, with special attention to tannins and their effect on diet utilization.
- with CIAT (Cali), a project to investigate the utilization of tropical forages by tropical hair sheep, with emphasis on possible

problems encountered as hair sheep are moved into humid tropical areas.

Both activities will hopefully include a training component, with provision for graduate student thesis or post-doctoral research at the international centers, and scientist training grants for research to be conducted at Raleigh. Facilities at Raleigh which can contribute to these activities include the forage metabolism research complex, the plant growth chambers (phytotron) and the electron microscopy center.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: North Carolina State University - Forage/By-Products

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	63	102	165	70	113	183	77	124	201
Fringe benefits									
Supplies & expenses	13	37	50	15	45	60	16	48	64
Equipment	5	5	10	-	6	6	2	6	8
International travel	-	30	30	-	33	33	-	35	36
Domestic travel	3	6	9	3	7	10	4	7	11
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	19	42	61	21	47	68	23	52	75
Total	103	222	325	109	251	360	122	273	395

SYSTEMS ANALYSIS AND SYNTHESIS OF LIVESTOCK HERDS

T. C. Cartwright, Principal Investigator

Texas A&M University

Work Plans Year 10, 11 and 12

Work Sites: Kenya, Peru, Brazil and Indonesia

Overall Goals

The Systems Analysis Project of Texas A&M has had two broad goals; the first was developmental, and the second was designed as an integrated part or link among other projects, utilizing SR-CRSP data to examine small holder production systems practices. The first was to develop general sheep and goat production systems simulation models that are adjusted or fine tuned by parameters specific to given locations, management practices, type of sheep/goat, etc. This goal is viewed as that of summarizing world literature into a manageable, consistent form in a manner suitable for transferring existing scientific knowledge from developed countries for application to solving production problems in LDCs. These models have been developed, validated and utilized in Kenya, Peru, Brazil and Indonesia (SR-CRSP host countries) as well as the U.S. and other countries. The second goal is to apply systems analysis to simulate and analyze small holder sheep and goat production systems (or subsystems) in the SR-CRSP host countries.

The second goal examines various practices of small holder production systems (or subsystems) in the host countries for use in analysis of both efficiency and effectiveness of the alternatives. These simulations have two main features: (1) they substitute for much research where facilities, funds and scientific personnel are scarce and (2) they simultaneously account for the various interacting forces on all components of the production system, i.e. they emulate the complex interaction of real life and replace reliance on simplistic projections. Optimal sets of production practices (feeding, breeding, health, forage production, economic, sociology) can thus be sorted out that are appropriate for a given location and objective functions. The goal of this project is an interactive one recognizing that the SR-CRSP was designed and structured not as a set of ad hoc projects. The model depends on CRSP projects for input data (e.g. forage and breed characteristics) and then performs simulations for these projects as feed back to aid their decision making and also supplies the simulated biological production input/output data to economics and other projects.

Since the systems analysis models are designed to simulate the response of small holder flocks to sets of production conditions similar to the manner in which real flocks respond to those conditions, the simulation of alternatives not only substitutes for many experiments, but also provides guidance in determining the key experiments to perform. These models have been especially useful in extending SR-CRSP results from larger units to practical application for the small holder.

Specific Objectives

The specific objectives of the systems analysis project for years 10, 11, and 12 utilize data collected on the CRSP and associated host country projects in order to simulate sheep/goat production in specific locations for various sets of production practices; i.e. to transform forage and animal data into small holder sheep/goat production data in order to examine the effects on total production efficiency of various interventions. The simulated input/output data are in convenient form for economic analysis and for analyzing the key points of biological constraints to productivity to determine optimal practices under given input resources and constraints. In addition to biological and economic efficiency of production systems, effectiveness of optimal sets of practices should be evaluated in the context of sociological viability.

Since the simulation models have been developed, programmed, validated, and tested in application over wide areas, the specific objectives are:

1. To obtain and organize forage, feed, management, animal and health data for use in simulations; these data are those collected (and hopefully published) by other SR-CRSP projects, host countries agencies and international livestock centers on projects.
2. To fine tune and adjust the appropriate model for the specific locations, set of practices, production unit sizes, etc.
3. To simulate existing production system and various selected alternates (interventions) as determined in consultation with other projects' PIs and host country collaborators.
4. To simulate designed experiments.
5. To analyze the simulated data and provide "feed back" data to forage/range nutrition, health and breeding projects and provide "feed up" simulations for economic analysis.
6. To simulate combinations of alternatives chosen by successive approximations to obtain sets of practices (packages) that are optimal and lead to maximal efficiency (economic) and effectiveness (sociological) as defined by the objective functions of the host country program. Emphasis to be placed on small holder production including conversion of large holder (e.g. SAIS and COOP) application to small holder application.

Approach

The approach is to utilize existing data and information to transfer and/or extend it, via simulation, to small holder sheep/goat production data in order to examine the effects of various alternative practices ("improvements") on the total inputs/outputs of the small holder production system. The systems analysis project furnishes the results of the simulations to the project (e.g., forage project) for use in pinpointing constraints (e.g., determine major stress points for nutrition, such as lactating first does, and the effect on the does and total production offtake of providing

them access to preferential grazing). The Systems Analysis Project will cooperatively examine overall biological efficiency of various practices and by successive approximations, determine optimal sets of practices. The simulation data will be output in a form convenient for economic analysis. The simulated practices most viable from biological (including health) and economic points of view should be examined for social costs/benefits and viability.

Sufficient data, experience and training have been gained in the SR-CRSP host countries so that projects can both supply data and experienced judgement on the one hand and benefit from specific objective analysis on the other hand. For example, the forage projects must translate forage data into sheep/goat production and experiments can only examine a limited number of practices. The systems analysis project can examine many intuitively chosen alternatives to suggest the most promising experiments but also, more importantly, project results to examine optimal sets of small holder practices. The economics project, after initial economic analyses will want to examine the effect of alternative production practices suggested from the analyses. The set of PIs and Co-PIs in host countries must collaborate to determine recommendations to be taken to small holders. First, the recommendations can be examined for viability in the total production context and, second, the simulated data can be used for "selling" or demonstrating the extension recommendations.

Equipment

Little equipment other than that for transportation and computer facilities that are in place are required. All SR-CRSP countries have computers in place and available to SR-CRSP that are capable of simulations with limited versions of the sheep and goat models. Also, these countries are increasing and upgrading their computer hardware so that by year 10 no computer limitations are anticipated.

Training

The Systems Analysis project is now in position to emphasize direct training in systems analysis at the M.S. and Ph.D. level. However, a workshop program of 3 months for range/forage, nutrition, production, breeding and economics trainees and scientists is proposed and will be emphasized.

Contribution To Overall SR-CRSP Program

After original development, the Systems Analysis project was designed as collaborative with all other projects in a host country. The overall approach of Systems Analysis is that of examining the array of inputs and outputs of sheep/goat production systems in order to sort out optimal combinations and avoid recommending practices that may enhance one phase of production but are counterproductive either from total productivity of an individual producer or of a country. Also, the key constraints to enhancement of net productivity often are not apparent until examined in the total production context.

The value of examining livestock production problems as a total system in biological, economic and social context has come to be recognized by major international organizations (e.g., ILCA and Winrock) and many departments of

animal science at agricultural universities. The SR-CRSP was designed to include sets of projects at each location to cover the major areas of constraints including the vital, but sometimes overlooked, economic and social factors. All of these are vital to Systems Analysis and vice versa. Translations and interpretations of Systems Analysis in the total production context is vital for the social science as well as the biological science projects.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Systems Analysis - Texas A&M

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	8	10	18	9.9	11	20.9	10.89	14.52	25.41
Fringe benefits	2	2	4	2.2	2.2	4.4	2.42	2.42	4.84
Supplies & expenses	9	2	11	6.6	5.5	12.1	3.63	6.05	9.68
42 Equipment	1	1	2	-	-	-	-	-	-
International travel	2	5	7	2.2	5.5	7.7	2.42	10.89	13.31
Domestic travel	1	-	1	2.2	-	2.2	-	-	-
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	5	2	7	5.5	2.2	7.7	4.84	2.42	7.26
Total	28	22	50	28.6	26.4	55	24.2	36.3	60.5

DEVELOPMENT AND BREEDING OF GENETICALLY IMPROVED GOATS

T. C. Cartwright, Principal Investigator

Texas A&M University

Work Plans Years 10, 11 and 12

Work Site: Kenya

Overall Goals

The Texas A&M University Breeding Project goals are integrated with the major thrust of the SR-CRSP program in Kenya. They are to develop, in collaboration with Kenyan scientists and agencies, the research projects and results that will provide the basis for establishing and continuing viable dual purpose goat production for small holders in the more intensive agricultural areas of Kenya.

The first goal was to characterize the milk and meat production potential of native, exotic and native/exotic crossbred goats under Kenyan production conditions and management. This characterization, which included estimating genetic and environmental parameters, was done in the context of total utility or productivity and therefore includes viability, fertility, resistance/susceptibility to parasites and diseases and other practical considerations. Development of breeds or crosses capable of thriving and producing under small holder dual purpose production conditions (a type of goat that does not traditionally exist in Kenya) will be completed (the Kenya DPG). A multiplication and genetic improvement phase will be established giving increasingly greater emphasis to the role of Kenyan scientists and agencies.

A complementary goal is to supply goats to and conduct collaborative research with MALD projects. The base data and genetic and environmental parameter estimates obtained from this project are essential for logical development of a dual purpose production system. Graduate level training at Texas A&M, utilizing the Kenya CRSP projects as a source of data for theses, and collaborative training in Kenya will continue, with greater emphasis on Ph.D. level training.

The developmental generations of the synthetic, composite Kenya DPG of the Breeding Project has been well accepted and interest has been expressed by MALD of Kenya to develop the DPG further to include adaptation to semi-arid areas.

The research is now directed toward more intense selection of the indigenous breeds to incorporate into the synthetic breed and to develop and implement breeding and selection programs to retain maximal heterosis, increase milk production and retain the hardiness to thrive under small holder husbandry.

Specific Objectives

Indigenous goats formed the base population for developing a dual purpose goat for the small holder of western Kenya. Early research characterized the two very different indigenous breeds. Based on these results, a new composite synthetic breed was computer designed (with the Systems Analysis model) that included optimal characteristics of indigenous and exotic breeds. The new objectives are:

1. To measure production, reproduction and survival characters of various developmental generations in order to characterize variability and estimate heritability, repeatability and other appropriate genetic parameters.
2. To establish and retain selected improved strains of indigenous and exotic breeds to use in altering the Kenya DPG via infusions for adaptation to semi-arid and other areas of Kenya.
3. To develop practical methods for maintenance and improvement of the synthetic Kenya DPG that meet the criteria required for viable small holder production: milk and meat production, reproduction, and survival.
4. To supply, or collaboratively use, goats for the production systems projects, the veterinary project and other uses as required.
5. To maintain a breeding flock of Kenya DPG for genetic improvement and to supply goats for multiplication and distribution by MALD.
6. To design a breeding program for producing goats, semen and/or embryos for export to other LDCs.

Approach

Originally, project emphasis was to introduce "improved" exotic breeds to increase the milk production potential through crossbreeding and establishment of pure breeds. Research and surveys from the project have demonstrated that there is wide variability among the native East African and Galla in milk production potential and that in fact pockets of milking strains of each do exist. Earlier results indicated that survival increased as the fraction of indigenous breeding increased, especially that of the East African which is kept in the more humid areas. Since fairly high levels (1/2 to 3/4) of indigenous breeding is required for acceptable levels of survival under Kenya conditions, the Project shifted toward emphasizing screening and utilizing the indigenous breeds and minimizing the exotic breeding. Crossbreeding was utilized initially to obtain the desired blend of milk, growth, reproductive and survival potential plus heterosis. Systematic crossbreeding is not feasible outside of a multiplication center, therefore genetic development of a composite synthetic was pursued. The approach was designed to produce a practical, improved (synthetic) breed to form the basis of MALD multiplication flocks. Earlier research demonstrated that it is feasible to create a stable breed that will be a real contribution to the small holder of Kenya and enhance morale and confidence of Kenya scientists as well as provide a model and gene pool for development of strains or breeds for other areas of Kenya and for potential export.

Equipment

The breeding project is carried out at the MALD 01 Magogo (Naivasha) location where adequate facilities either existed or were developed collaboratively by MALD and SR-CRSP Breeding project. As for any breeding project, animals, pastures, pens, scales and measuring devices, milking facilities and equipment, semen collection and AI equipment, and data recording/analysis equipment are primary. These facilities and basic equipment are now in place. Relatively minor additions of scientific equipment will be needed for collaboration with other projects. The need for imported semen and indigenous breeding goats will have diminished or vanished.

Training

Present plans for training include students at the M.S. and Ph.D. level; only one student at a time can be funded by this project. Other sources of funds have been vigorously sought for outside student funding. In Kenya, emphasis is placed on training via collaboration at the Co-PI and other levels; e.g., management of a research breeding flock is demanding and must (and should) be done directly by Kenyans and several managers have collaborated in either formal or informal training. Training emphasis will be placed on training at the Ph.D. level in order to assure the capability to carry on the selection and breeding program required for the multiplication flock to mature into a truly productive, distinctive breed.

Contribution to Overall SR-CRSP Program

The Texas A&M Breeding Project has integrated with the other SR-CRSP projects in Kenya. The primary goal has been to determine the criteria for a viable dual purpose goat for small holders, to establish a breeding program to produce a base flock for continued breeding and improvement. The criteria were determined from feedback information from the production systems, veterinary and economics projects. The Systems Analysis Project synthesized these data and data from the Breeding Project in order to establish the basis for logical simultaneous consideration of the myriad of input and output demands. The breeding flock provides ideal experimental animals for evaluating veterinary treatment, as genotype x treatment interactions yield information of much wider application. Data are provided to the Economics Project for biological outputs and inputs. The extensive data collected on the large goat flocks of this project are analyzed and are available to projects and are especially useful to Production Systems Project and for M.S. and Ph.D. students. The popular and scientific publication coming from this project have value to all SR-CRSP activities related to goat breeding and production; e.g., estimates of genetic parameters for milk and meat production, differential response to anthelmintics and heterosis (all of these have been virtually nonexistent). The dual purpose synthetic composite breed will serve as a model for utilizing and improving indigenous breeds and will be a germ plasm resource via semen and embryos for other countries.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Animal Breeding-Kenya - Texas A&M

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	20	20	40	22	22	44	24.2	24.2	48.4
Fringe benefits	4	5	9	4.4	5.5	9.9	4.84	6.05	10.89
Supplies & expenses	5	66	71	5.5	72.6	78.1	6.05	79.86	85.91
Equipment	1	2	3	1.1	2.2	3.3	1.21	2.42	3.63
International travel	-	12	12	-	13.2	13.2	-	14.52	14.52
Domestic travel	1	-	1	1.1	-	1.1	-	1.21	1.21
Other direct costs	2	-	2	2.2	-	2.2	2.42	-	2.42
Indirect costs	7	10	17	7.7	11	18.7	8.47	12.1	20.57
Total	40	115	155	44	126.5	170.5	47.19	140.36	187.55

BREEDING AND MANAGEMENT OF SHEEP AND GOATS

Maurice Shelton, Principal Investigator

Texas A&M University-College Station

Workplan for Years 10, 11 and 12

Work Site: Brazil

Overall Goals

The management and breeding components of the Texas A&M University project in the U.S. and in Brazil has a number of distinct as well as complementary goals. In respect to breeding, the long-term goals may be stated as follows:

- (a) Design and place in motion long term genetic improvement programs for hair sheep and meat goats in both the U.S. and Brazil. This includes selection within existing and important breeds or strains, and the creation of synthetic populations based on crossbred foundations.
- (b) Collect a body of data which can later be analyzed to answer basic questions relative to breeding sheep and goats for unfavorable environments and with high transferability (of information) to other areas or other environments.
- (c) Explore the possibilities of evaluating exotic genotypes for meat and milk production in the U.S. and Brazil.
- (d) To provide data for use in thesis projects for graduate students pursuing advanced degrees in the U.S. and Brazil.

In Brazil, exotic dairy breeds used alone or in crosses with native types are being explored for milk production under small holder conditions. In the U.S., hair sheep (Barbados Blackbelly) and highly prolific types (Booroola Merino and Finnish Landrace) are being studied as to the suitability of prolific types of sheep under extensive and adverse conditions. At present, three locations in Brazil (Sobral and Quixada in Ceara and Fazenda Pendencia in Paraiba) are involved in these efforts.

These efforts are collaborative with and/or supportive of the work of the CNPC and the respective research agencies of the states of Ceara and Paraiba. All of these are by nature long term studies and should be evaluated and supported in this light. The possibility of continuing collaboration with returning scientists who have received training at U.S. institutions as a part of the SR-CRSP effort may well yield the greatest return of transferable information per unit of cost. This is particularly true of those projects which require long term effort such as animal breeding.

In respect to management, a major current activity is located at Fazenda Pendencia near Soledade in Paraiba, and to date these activities have consisted in part of supporting EMEPA initiatives in respect to dairy goat

production. To some extent, this program has a role of (a) supporting dairy production from goats throughout the Northeast, (b) attempting to determine the feasibility and to provide technological support for a commercial dairy goat program in this region of Paraiba, and (c) provide technical support for increased use of the goat for the production of a domestic (home) milk supply in Northeast Brazil and other similar regions. This latter aspect may well be the most important contribution which the goat makes in developing countries or stressing environments. By or before the 10th year of this program is underway, it is expected that economic survey data will have been reported and that a large number of experiments will have been completed and analyzed. Therefore, the major activity in respect to milk production will be to develop a test package of a proposed dairy or dual purpose goat production systems for small holders in the region. It is envisioned that this should be tested under producer conditions in the region. However, it is envisioned that this testing would be primarily the responsibility of local agencies and that this project would serve only an advisory role. Also, a more intense, commercial scale dairy project is being planned for the CNPC at Sobral. The present project would expect to be involved in the latter only in an advisory or supporting role.

The above comments are directed primarily at the use of goats for milk production. However, only a small part of the goats, and none of the sheep, in Brazil or in much of the rest of the world are routinely utilized for milk production. Thus, in order to have a significant impact on the primary industries, i.e. maintaining sheep and goats for meat production, management in a broader context must be addressed. Management in the broad context is the only avenue whereby any discipline must eventually impact the industries that the SR-CRSP is to serve. Thus, research work which has been completed needs to be reviewed and summarized. In addition to this, specific studies need to be conducted to identify solutions to major constraints. Thirdly, information from various sources (including pre SR-CRSP and non SR-CRSP research) and various disciplines need to be brought together to develop proposed production systems. This will not be accomplished with each worker concentrating on individual disciplines. Proposed production systems or technology packages need to be developed and tested either at an institutional or village site. Ideally, they should first be tested, as compared to conventional practice, at an institutional site followed by a movement to producer conditions. However, doing this in series would require more time than is likely to be available. Thus, the time scale needs to be compressed by simultaneous testing at the two levels or by leap-frogging to field conditions.

More importantly, improvement programs in developing countries which are initiated or supported by international agencies and having to do with sheep and goat production generally take the form of recommending individual practices or production systems. In order for the SR-CRSP to have a positive impact, this process must be made to function more efficiently than in the past. Thus, it seems logical that after nine years work at five sites under 14 different projects by 10 different institutions at a cost of approximately 30 million dollars, any extension of the project should include or consist of validation, demonstration and implementation of the contributions which have been made. An extension should be made only if this is a salient part of the plan. This should not consist or should not only consist of working within the five sites. It is critical that the information generated be transferable

to other areas or environments. Since the number of countries or regions which might benefit from such efforts could run as high as 100, the prospect of replicating the current approach in any or all of these is unrealistic. Thus, the SR-CRSP should provide a role for assistance to USAID (or other international agencies) sponsored projects or programs dealing with sheep and goats. These need to be screened to those who genuinely desire assistance as contrasted to financial inputs. However, some financial inputs should be provided in this approach to cover the costs of the testing phase or testing elements and to insure that support is available to insure an adequate test. This approach should not necessarily be limited to requests from countries affiliated with international development agencies.

Equipment

No major purchases of scientific equipment to be used specifically for this project are envisioned or can be projected this far in advance.

Training

Brazilian students in U.S.:

Two graduate students from Brazil and who have some involvement with the SR-CRSP are currently attending Texas A&M University. These are:

Elsio Antonio P. de Figueiredo
Eneas Reis Leite

Two, and possibly three, are in the process of making application at the present time. The graduate programs for some of these students are expected to extend into the years 10, 11 and 12. It is important that Texas A&M University retain some involvement with the Brazil project in order to provide thesis data, preferably collected in Brazil, and to partially cover staff time for working with these students. Some of these require more assistance than is the case with U.S. students.

Brazilian students in Brazil:

At the present time, two students are associated with the TAMU Project, pursuing graduate degrees at Brazilian universities and have been provided some support.

In the future, it is expected that Brazilian students working with the SR-CRSP and CNPC staff will become an important means of accomplishing collaborative studies and that a means will be available to provide support for these endeavors.

U.S. graduate students in Brazil:

No U.S. graduate students who are associated with this project are currently working in Brazil or at other overseas sites. It is not envisioned that U.S. graduate students will be placed in Brazil. If work is initiated at alternative overseas sites, the possibility of placing graduate students at these sites should be reconsidered in light of the language and other adjustments required for short term residency in a

foreign environment.

U.S. graduate students working in the U.S. in projects supportive of SR-CRSP goals:

At the present time, two U.S. graduate students are receiving some support from the SR-CRSP funds and are working on projects of mutual interest to U.S. and to overseas sites.

It is anticipated that this type of effort will continue and that an assistantship for at least one graduate student should be provided from SR-CRSP funds.

Contribution to Overall SR-CRSP Program

The Texas A&M University Project is currently collaborating with other SR-CRSP projects (Health, Nutrition, Sociology, etc.) at Fazenda Pendencia. Also, the management component of the SR-CRSP in Brazil would appear to be a likely medium to test practices deriving from any of the projects which hold the potential for implementation under field conditions. This approach should be pursued in collaboration with other projects.

Collaboration or Interaction with Other CRSPs, International Centers and Other AID Supported or Development Projects

No specific plans have been made for collaboration with other CRSPs or International Centers. However, this PI envisions that providing technical assistance to AID supported development projects or to developing countries which request assistance with sheep and goat production systems should represent a high priority goal of the SR-CRSP.

This model should consist of either or both of the following approaches:

1. Continue collaborative research with trained scientists at existing sites. This should be based on technical and financial support and should be designed to maximize the harvest of transferable information which should evolve from the investments already made. All projects should, after 9 years, have a cadre of trained host country scientists in place, and working through these offers a much more economical approach to data collection.
2. Develop "technology packages" which describe recommended production systems in a given environment. This may consist of three phases as follows:
 - a. Develop information.
 - b. Test at demonstration or institutional site.
 - c. Test at village or community level.

The logical place for this to start is at the current sites in which one or more institutions assist host country personnel in the development and testing of production systems indicated by the work accomplished to date. If

no more than two institutions or projects are active in this testing process at each current site, this should leave the overall SR-CRSP project some latitude to undertake similar initiatives at additional sites. New sites may well provide more efficient and more valid test situations since they can be initiated free of existing constraints and expectations. These additional or new sites may also be chosen to represent more critical needs for development, whereby current sites were often chosen with a view of an existing institution infra-structure for research.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Animal Management & Breeding - Texas A&M

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	35	15	50	38.5	16.5	55	42.35	18.15	60.5
Fringe benefits	8.4	3.6	12	9.24	3.96	13.2	10.164	4.356	14.52
Supplies & expenses	10	15	25	11	16.5	27.5	12.1	18.15	30.25
Equipment	-	-	-	-	-	-	-	-	-
International travel	-	6	6	-	6.6	6.6	-	7.26	7.26
Domestic travel	1	.5	1.5	1.1	.55	1.65	1.21	.605	1.815
Other direct costs	2.5	2	4.5	2.75	2.2	4.95	3.025	2.42	5.445
Indirect costs	24.3	1.7	26	26.73	1.87	28.6	29.403	2.057	31.46
Total	81.2	43.8	125	89.32	48.18	137.5	98.252	52.998	151.25

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MANAGEMENT OF NATIVE RANGE AND IMPROVED FORAGES

Fred C. Bryant, Principal Investigator

Texas Tech University

Work Plan for Years 10, 11, 12

Work Site: Peru

Overall Goals

Texas Tech University, the leader in Range/Forages research and training in Peru, has established several goals, all of which will benefit the pastoralists who graze their animals on the vast acreages of native range in the high Andes. Years 1-5 allowed us to achieve our initial goal of launching collaborative research on grazing management, nutrition of small ruminants, and integration of cultivated pastures into the range/grazing ecosystem. Years 6-9 were devoted to maintaining long-term grazing research, training Peruvians for advanced degrees, writing research publications and bulletins, and establishing joint research projects with Winrock Economics, Montana Breeding, Utah State Reproductive Physiology, and Texas A&M Systems Analysis. Also during Years 6-9, range research was launched in Morocco when Texas Tech assumed responsibilities there. Future goals for years 10, 11, and 12 are (1) to continue research activities by providing adequate financial and technical support, (2) to distribute research findings to the Andean region (3) to continue our strong training emphasis through workshops, shortcourses, and opportunities for Peruvian students to obtain advanced degrees, (4) to integrate research findings with other components of the SR-CRSP, particularly the community projects, and other USAID programs in Peru and (5) to provide technical assistance to INIPA to assist in their effort to build a strong National Livestock Program.

Specific Objectives

Research objectives will continue to focus on evaluating the response of range improvement practices (i.e. proper stocking rates, improved grazing strategies, proper use of prescribed burning, efficient mixed species grazing) through increases in animal performance and improved vegetal conditions. How best to use cultivated forages to enhance the nutrition of small ruminants also will continue to be evaluated. On the north coast of Peru, research will focus on problems in the range-goat livestock industry to assist small holders there.

Approach

Long term studies will be conducted at 3 sites in the Andes. Research data will be collected in the central (SAIS Pachacutec) and southern Sierra (IVITA/La Raya and UNTA/Chuquibambilla), and on the north coast of Peru. Research will be published in scientific journals and then translated to Spanish for distribution in all countries of the Andean region. At least 2 to 3 Peruvians will be brought to the U.S. for advanced degree training. If funding is sufficient, a long-term range scientist will be placed in Peru to

provide technical assistance.

Training

Future plans for U.S. trained students from developing nations include 3 M.S. and 2 Ph.D. students. One student will be trained in Forages and 4 in Range Science. Potential candidates include Juan Astorga (Ph.D.-Peru), Ramiro Farfan (Ph.D.-Peru), Francis Villena (M.S.-Peru), Jose Otto (M.S.-Peru), and Jorge Gammara (M.S.-Peru). Students also will be funded for thesis projects for the Ingeniero Degree at Univ. Nacional Agraria, Univ. Nacional Technica del Altiplano, Univ. del Cuzco, or San Marcos Univ. Workshops, shortcourses, and technical bulletins (in Spanish) will be presented on Range/Forages topics.

Contribution to the Overall SR-CRSP Program

Range/Forages research will continue to play an important role in the SR-CRSP because proper management of the food or forage base (range and pastures) is vital to the well-being and production of most, if not all, of the small ruminants that graze the high Andes. When integrated with findings from the other SR-CRSP components in Peru, research results on range/pasture management will provide a well-balanced, technological package to be used by the pastoralists and small holders of the high Andes.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Range/Forages - Texas Tech

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	45	60	105	49.5	66	115.5	60.5	66.55	127.05
Fringe benefits	10	6	16	11	6.6	17.6	12.1	7.26	19.36
Supplies & expenses	8	26	34	8.8	28.6	37.4	9.68	31.46	41.14
Equipment	-	5	5	-	5.5	5.5	-	6.05	6.05
International travel	-	14	14	-	15.4	15.4	-	16.94	16.94
Domestic travel	4	1	5	4.4	1.1	5.5	4.84	1.21	6.05
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	24	12	36	26.4	13.2	39.6	29.04	14.52	43.56
Total	91	124	215	100.1	136.4	236.5	116.16	143.99	260.15

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RANGE RESEARCH FOR INCREASING
SMALL RUMINANT PRODUCTION

John C. Malechek, Principal Investigator

Utah State University

Work Plans Years 10, 11 and 12

Work Site: Brazil

Overall Goals

A large proportion of the world's poor live on lands classified as arid or semi-arid, where scarce or erratic precipitation and marginal soils make crop production a risky venture, or entirely preclude it. These people depend largely on animal agriculture for their sustenance, and the type of husbandry practiced is, almost without exception, extensive grazing of native rangelands.

Such is the case for a large region of tropical northeastern Brazil, known locally as the Sertao. Characteristic of many arid or semi-arid regions, precipitation of the Sertao is extremely variable, both seasonally and from year-to-year. The monsoonal-type of precipitation distribution pattern results in an extended annual dry season when even well-adapted animals like sheep and goats lose much of the body weight gains they produced during the rainy season. Often, the annual dry season extends into a prolonged drought lasting several years. Major economic losses in herds are common at such times.

Thus, the crux of the problem for animal production in the Sertao, like so many range areas, is providing adequate nutrition, or, stated in other terms, providing a more favorable balance between nutritional demands of livestock herds and the supply of nutrients available from rangelands.

Improvement of the forage resource (nutrient supply) is the obvious short-term rationale for our research in the Sertao. This includes two directions: achieving a better balance between the wet season surplus and the dry-season deficit on an annual basis, and minimizing the impacts of recurrent drought on the long-term basis.

There is yet another dimension to the problem that deals with the long-term consequences: the effect of land and animal management (or mismanagement) on the inherent stability and productive capacity of the land. In their attempt to face current demands of growing human populations and withering economics, agriculturalists in developing countries often feel compelled to over-graze or over-exploit the land. On a world-basis, this has led to an unprecedented degradation of the land resource over the past two decades. The special term "desertification" has been coined to describe the phenomenon.

The Sertao is not exempt from this problem. However, before steps can be taken to change the trend of events, the ecological characteristics of the system must be understood. This includes not only knowing about the nutritional specifics of sheep and goats, but also about the climatic,

edaphic, vegetational, and sociological aspects of the region and its people. It is these additional components that separate range science as a discipline from the more traditional animal science disciplines.

Given this perspective, we have approached the problem of sheep and goat production in the Sertao region of northeastern Brazil with four general objectives or problem areas in mind. These will continue to serve as our broad objectives through years 10, 11 and 12.

1. Ecological analysis of the range forage production system. Soils, vegetation, and climate of the Sertao are highly diverse on a geographic scale and climate varies profoundly from season-to-season and from year-to-year. To understand how these factors affect forage and animal production and to enable extension of local experiment station results to the broader region, ecological studies are necessary. Also, before we can recommend ways to manipulate the native plant communities to achieve improved forage production, we must better understand the environmental forces that determine production.
2. Plant-animal relationships. Typical of all tropical ecosystems, the vegetation of the Sertao, known as caatinga, contains a wide variety of plant species. These species vary widely in their palatability and nutritional value to sheep and goats, and any particular species may vary markedly over the year and, indeed, from one part of the plant to another at any given time. These studies are aimed at understanding the nutritional relationships of animals to their erratic and highly differentiated environments. Through this understanding, we hope to be better able to manipulate both the plant and animal components of the production system to achieve a more effective level of animal off-take.
3. Rangeland improvement and woody plant management. One of the few so-called "management" alternatives available to smallholders of the Sertao (and elsewhere in the developing world) is manipulation of the woody vegetation. Local wisdom in Brazil holds that clearing improves forage conditions. While this may be true in the near-term, the long-range consequences of land clearing are not well known and may be highly undesirable, both from the standpoint of animal production and land stability. An advancing point of view is that through a better understanding of woody plant ecology, some species have high potential for providing valuable forage, once we know how to manipulate them to suit our purposes.
4. Grazing management. With information in-hand from the first three objectives, we will ideally be able to design and recommend grazing management practices and land treatments that will optimize the relationship between animal forage demand and sustained forage production.

Approach

Our general approach to the research outlined above will continue to depend heavily on the use of advanced Ph.D. graduate students (both US and

Brazilian nationals) who live in northeastern Brazil for at least one year while collecting relevant research data. They are closely directed by participating resident faculty of Utah State University and collaborating EMBRAPA scientists from the CNPC. When possible, faculty, and students from the Federal University of Ceara' in Fortaleza, and researchers from the Ceara' state research organization EPACE are also involved in the project.

Ecological analysis. The ecological analysis work will focus on gaining a better understanding the dynamics of the caatinga ecosystem, both in its natural state and when manipulated. We know from anecdotal sources and from the few published works available that year-to-year variations in plant (forage) responses to climate are great, but we have little information on the dimensions of these fluctuations and what they might mean to livestock production. In a highly stochastic region like the Sertao where much of the producer's management activity is aimed at risk minimization (instead of production maximization), it is crucial to understand more about these annual variations.

Manipulation (clearing, thinning) of the caatinga woodland superimposes yet another layer of complexity on the above situation. The wide variety of plant types present offer many options for constructive manipulation to benefit animal production. This is especially true for goats who seem particularly well adapted at exploiting the highly diverse plant community for a livelihood. However, we must better understand the effects of manipulation on the various plant species present before we can prescribe management practices. A promising line of research with many potential applications involves questions of soil fertility and how this affects palatability and nutritional value of forage species (particularly woody species).

Plant-animal relationships. This area will continue to cover a broad range of investigations centered around the plant-animal interface. Included will be such studies as seasonal nutrition and feeding behavior of sheep and goats as affected by climate and by manipulations of caatinga vegetation. We will continue to define which plants are palatable and unpalatable, how this varies seasonally and how we might alter the unpalatable ones to make them better forage. We will better isolate and define nutritional deficiencies and test supplementation programs to correct these deficiencies. Additionally, we will be collaborating with Brazilian researchers on integration of native and improved tropical legumes into the forage program.

Woody plant management. The so-called "brush-bias" (i.e. most woody plants are weeds to be eliminated) remains strong amongst land managers in Brazil (and the US), but we feel that better alternatives are available. Elimination of existing woody vegetation and replacement by so-called "improved" species is economically impractical and probably ecologically undesirable. We will therefore focus studies on ways to selectively manipulate woody plants using local methods (hand cutting) to achieve the timing, combination of species, and kinds of regrowth (coppice) that best meet the needs of sheep and goat production. Our present research shows, for example, that the period of green feed can be extended for almost 5 months each year by strategic cutting of certain tree and shrub species. The nutritional value and palatability of this coppice material must be evaluated, both in the laboratory and through whole-animal studies.

Grazing management. Research in this area will focus in-part on assisting Brazilian scientists in analyzing and interpreting data from long-term trials they have been conducting. In another part, information from the first 3 objectives above will be integrated into testable management packages that will be applied on suitable farmscale experiments. This will be done with combinations and levels of technology from other SR-CRSP projects. EMBRAPA has recently secured a new, large experimental area appropriate for such tests.

Additional to the work in Brazil, studies on various aspects of nutrition and feeding behavior of sheep and goats are being supported in Utah. These studies provide valuable training grounds for Brazilian and other third-country graduate students who are working on graduate degrees at Utah State University.

Equipment

Purchases have been made of basic equipment needed to bring the nutrition laboratory at CNPC up to operable conditions. Such support will continue as needed. Additionally, minor purchases of equipment have been made to support the Utah component of the research.

Training

Education of US, Brazilian, and other LDC students is viewed as a primary goal in the Utah Range Project. Consequently, we will continue to support a strong graduate program. Currently six Ph.D. students and one M.S. student are in active programs under direct CRSP support. Three of these are Brazilian, one is Ethiopian, and the remainder are US students.

Interaction with other USAID programs

As the reputation of our research reaches managers and scientists in other developing countries, we anticipate frequent interaction on an advisory level. As an example, P.I. Malechek has recently been asked to consult with an AID project in the Dominican Republic that is dealing with goat production in a semi-arid tropical environment similar to that of northeastern Brazil. We anticipate more such requests and are prepared to use part of our SR-CRSP research funds to respond where appropriate.

Another major route of outreach from our project to other AID programs (and programs sponsored by other world development agencies) will be through our former students. Already, our first two completed Ph.D. students have become involved in AID-affiliated programs, one in Peru and one with a private firm in New Mexico that is dealing with fodder shrub development on a world-wide basis. They were recruited to these positions largely on the basis of their training through the SR-CRSP.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Range Management - Utah State University

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	48	30	78	57.2	28.6	85.8	62.92	31.46	94.38
Fringe benefits	14	9	23	17.6	8.8	26.4	19.36	9.68	29.04
Supplies & expenses	5	25	30	5.5	27.5	33	6.05	30.25	36.3
Equipment	1	7	8	1.1	6.6	7.7	1.21	7.26	8.47
International travel	-	20	20	-	22	22	-	24.2	24.2
Domestic travel	2	5	7	2.2	5.5	7.7	2.42	6.05	8.47
Other direct costs	2	5	7	2.2	5.5	7.7	2.42	6.05	8.47
Indirect costs	22	30	52	25.3	31.9	57.2	27.83	35.09	62.92
Total	94	131	225	111.1	136.4	247.5	122.21	150.04	272.25

ANIMAL HEALTH CONSTRAINTS ON SMALL RUMINANT PERFORMANCE

Travis C. McGuire, Principal Investigator

Washington State University

Work Plan for Years 10, 11, 12

Work Site: Kenya

Overall Goals

The role of the animal health component is to identify disease problems that are a constraint to goat production and then determine solutions. Some disease problems have well known solutions that can be readily applied while others, especially some that occur in Kenya and adjacent countries, require specific research to find a solution

In order to improve the production of goat meat and milk in the areas of Kenya under study, it is necessary to introduce other breeds. The introduction of animals presents a major disease problem in that goats new to an area lack immunity to diseases that native goats have developed. In addition to finding solutions to problems of intestinal parasites in introduced goats, it will also be necessary to develop strategies for the protection of goats from such diseases as pleuropneumonia, heartwater and trypanosomiasis. The nature and scope of disease problems faced in countries such as Kenya makes it necessary to have effective solutions to these problems before the overall program objectives can be achieved.

To accomplish the animal health component objectives, it is clear that the research and training must be done within the framework of the Ministry of Agriculture and Livestock Development (MALD) of the Government of Kenya. This approach will allow the work to continue after SR-CRSP ends and will provide the collaboration SR-CRSP needs during the project period.

Specific Objectives:

Research objectives for animal health have been established collaboratively between the MALD and Washington State University (WSU) based on the following considerations: Published information of health problems of goats, results from SR-CRSP health surveys; research and manpower needs of the MALD, WSU capabilities and interests in small ruminant diseases and, finally, a common goal for the research and training to have a long term impact on the goat industry at the production level.

1. Control of haemonchosis and other intestinal parasites. Previous work and results from SR-CRSP surveys show that internal parasites are wide-spread in goats and the Haemonchus is the most important. When crossbred goats are introduced, the extent of the disease is increased, requiring expensive interventions, such as drenching.
2. Immunoprophylaxis for contagious caprine pleuropneumonia (CCPP). CCPP is currently the most serious disease of goats in Kenya causing

high mortality and great economic loss. The disease occurs in epidemics in all areas of the country including western Kenya. MALD and SR-CRSP scientists have developed a successful experimental vaccine. Continued development of this vaccine for broad application could be the most significant contribution that animal health research can make to goat production in Kenya.

3. Diagnosis and control of heartwater. This disease is caused by Cowdria ruminantium and is transmitted by Amblyoma ticks. It is a severe and fatal disease in goats, especially those introduced into an enzootic area. Heartwater is difficult to diagnose and there is no vaccine.
4. Development of strategies to introduce exotic crossbred goats into trypanosomiasis areas. If the introduction of improved goats is successful in the current work sites of western Kenya they will be tried in the Busia, South Nyanza and coastal areas where there are tsetse flies and trypanosomiasis. Trypanosomiasis can be devastating to goats and a strategy for introduction of crossbred goats to areas with the disease is needed.
5. Monitoring of caprine arthritis encephalitis virus (CAEV) in Kenya. No new infections of goats with CAEV were found in Kenya.
6. Determining the cause of any disease and deaths of the crossbred goats introduced to SR-CRSP study sites in Kenya.

Approach:

1. The first control strategy for haemonchosis will involve evaluating a slow release drug given in bolus form that may protect the goat for several months. Treatments will be evaluated by fecal egg counts, weight gains, and clinical appearance. The second method will be to collaborate with the SR-CRSP Breeding Project to evaluate genetic resistance to haemonchosis. Our preliminary data indicate there are large breed differences and we may be able to exploit these differences to develop a goat that produces acceptable levels of meat and milk, yet is relatively resistant to haemonchosis.
2. We have tested an inactivated vaccine of mycoplasma (F-38) that induces protection against contact challenge. Vaccine dose, injection intervals and duration of protection need further evaluation. Commercialization of the vaccine also needs to be pursued.
3. Attempts to determine if trypanotolerance has a genetic or environmental basis will be continued. Different breeds of goats will be evaluated in a trypanosomiasis area in conjunction with the SR-CRSP Breeding Project. Preliminary data indicate there may be significant breed differences. Also, the effect of passive antibody on the disease in young goats will be evaluated.
4. A diagnostic test for heartwater will be made using antigen purified from infected ticks which will be reacted with serum from infected

animals. Using surface labeling techniques, antigens on the organism will be identified, isolated and tested for immunization.

5. Goats will be continuously monitored for CAEV infection.
6. All goats put on farms in Kenya study areas will be closely followed and the cause of any disease and death will be determined. This information will be used to determine animal health care interventions that will be economically viable and then these intervention protocols will be tested.

Training

The major emphasis in training will be continuing the current program for educating Kenyan students at the master's and Ph.D. levels through WSU. Most of these students are veterinarians who take coursework at WSU, then conduct research and write a thesis in Kenya under the close supervision of WSU's on site coordinator, Fred Rurangirwa, BVS, Ph.D., and the Director of Research in the MALD, S. Chema, DVM, Ph.D. Three students--Johnson Bari, Stanley Mbwiria, and James Njanja--have completed their MS degrees. A fourth student in this program, Derrick Mwamachi, has completed course work at WSU and is doing thesis research in Kenya.

Elizabeth Oluoch, on leave from the University of Nairobi, is currently studying toward an advanced degree at WSU under the auspices of SR-CRSP. In February 1984, Suryakant Waghela temporarily left his position with the MALD and is at WSU to work on a Ph.D. He has been actively involved with SR-CRSP as an adviser to students in Kenya conducting research.

Antonio Garmendia, a veterinarian from Peru, is studying toward a Ph.D. degree at WSU in collaboration with the SR-CRSP animal health component at Colorado State University. He has completed his coursework and preliminary exams. A part of his thesis research has been done in Peru on an SR-CRSP sponsored project.

WSU faculty members, in addition to the Principal Investigator, actively involved in teaching or advising Kenya students, include Richard Wescott, DVM, Ph.D.; John O. Dickinson, DVM, Ph.D.; A. F. Barbet, Ph.D. and Mack I. Johnson, DVM, Ph.D.

Contributions to overall SR-CRSP

WSU's contribution to SR-CRSP falls into two categories. First, research conducted through this university is improving the chances for increased milk and meat production in goats in Kenya. Since the specific area under study is relatively deficient in goats, it seems reasonable to try to increase the number and quality of goats owned by small farmers. Controlling disease is a part of such a strategy and WSU is a major contributor to this effort.

The second contribution is the training of Kenyan graduate students. As Kenyan students with active SR-CRSP projects receive advanced training at WSU and return to their countries to work on a research problem, they take with them a lasting knowledge of the most advanced research techniques. This training will result in trained researchers in Kenya to carry on the work when SR-CRSP is gone.

In addition, WSU's component is conducting an increasing amount of research in Kenya. This continuing policy of transferring research efforts to Kenya as it becomes possible also helps significantly in building an infrastructure of well trained veterinary scientists in Kenya.

Equipment

A small amount of laboratory research equipment will be needed for the work in Kenya. Since we intend to use current techniques, equipment such as that required for monoclonal antibody production and other procedures will be purchased.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Health - Washington State University

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	19	61	80	20.9	67.1	88	22.99	73.81	96.8
Fringe benefits	5	9	14	5.5	9.9	15.4	6.05	10.89	16.94
Supplies & expenses	6	24	30	6.6	26.4	33	7.26	29.04	36.3
Equipment	-	1	1	-	1.1	1.1	-	1.21	1.21
International travel	-	11	11	-	12.1	12.1	--	13.31	13.31
Domestic travel	-	3	3	-	3.3	3.3	-	3.63	3.63
Other direct costs	-	-	-	-	-	-	-	-	-
Indirect costs	13	23	36	14.3	25.3	39.6	15.73	27.83	43.56
Total	43	132	175	47.3	145.2	192.5	52.03	159.72	211.75

ECONOMIC ANALYSIS OF SMALL RUMINANT PRODUCTION
AND MARKETING SYSTEMS

A. John De Boer, Principal Investigator

Winrock International

Work Plans Years 10, 11 and 12

Work Sites: Brazil, Peru, Indonesia, and Kenya

Overall Goals

The broad goals of the Economics project are all related to the central theme of increasing the capacity of collaborators in developing countries to carry out research on economic problems that limit small ruminant populations and productivity on limited resource farms. The first goal is to establish reliable baseline data on small ruminants and their producers that can be used by national planners, research agencies, and extension agents in the formulation of realistic programs to improve farmers welfare through small ruminants.

The second goal is to assist in the establishment and institutionalization of the Farming Systems Research (FSR) approach to help generate research appropriate to the needs of small farmers and to help in the transfer of technology to a diverse range of production situations.

The third goal is to foster interdisciplinary research within the SR-CRSP work teams. This includes assistance with experimental designs to render them more suitable for economic analysis, interpretation of biological research results for the economic implications of the findings and development of ex ante models of small farms to assist in the screening of potential technologies.

The final goal is the formal training of collaborating scientists to enhance their research skills to a level where they can assume leadership in the formulation and execution of economic research projects dealing with a range of problems related to small ruminant production, marketing, and policy needs.

SPECIFIC OBJECTIVES

1. Carry out descriptive (diagnostic) studies to define existing small ruminant production systems, constraints operating against higher animal numbers and higher animal productivity, construct agro-economic profiles, define farmer goals and objectives related to small ruminant production, and quantify interactions between small ruminants and other livestock species as well as between livestock and crop production.

This objective has largely been met within the limited environments in the proximity of the major experiment stations with which we collaborate. There is still considerable scope for descriptive type

of work in other regions within the respective countries.

2. Develop a set of bio-economic models incorporating the major components of the farming systems under which small ruminants are produced and the interactions between components. These can be used to evaluate research results generated by experiment station trials on an ex ante basis as well as the evaluation of field trials.

This phase is in full swing and will continue during years 10-12 as a major activity.

3. Conduct research on marketing procedures and pricing mechanisms to ascertain if current input or output marketing systems impose serious constraints on the economic benefits provided by small ruminants and on the potential adoption of new technology.

This objective will receive more emphasis in years 10-12 as off-farm constraints become more evident. A better balance between economic studies supporting production programs and studies supporting pricing, marketing, policy and infrastructure issues will be sought.

4. Sponsor training activities encompassing both formal long-term training of collaborating researchers as well as a variety of short-term training activities related to all stages in the research program described above. By year 10, the project will be providing full or partial support for 5 Ph.D. students at U.S. universities.

Approach

The research approach follows the general steps of the Farming Systems Research, the key elements of which include 1) client participation in setting research needs and priorities, 2) feedback between farmers, researchers, and extension personnel, 3) incorporation of farm household goals and objectives into planning of research strategies, and 4) onfarm trials to evaluate and modify experiment station technologies. This approach has been used primarily in crop improvement programs and the Economics project of the SR-CRSP is making a major effort to adopt this approach to make it useful for animal improvement programs. There are four major steps used in the research approach:

1. Descriptive or diagnostic stage -- In each overseas worksite, general surveys are conducted to determine the role and relative importance of small ruminants, linkages within farming systems, resource utilization, agro-economic zones, and constraints to increased income from small ruminants.
2. Research design stage -- Results of the diagnostic stage are used by the research teams to design research and farm-level testing programs that will have the maximum impact upon the constraining factors. Research design thus incorporates information on relative prices, physical production environment, available infrastructure and levels of government support, seasonality of the production system, labor availability and use patterns, consumer tastes and preferences, plus market performance. Next, bio-economic models are constructed for

use in the setting of research priorities, on-farm testing, and technology evaluation. These range in degree of complexity from simple enterprise budgets to dynamic simulation models.

3. Testing stage -- The economists now collaborate in the design of field trials that will provide realistic answers to how well SR-CRSP research will perform under actual farm conditions, which are capable of rapid analysis, and are easily understood by farmers. The field trial results are to be quickly evaluated using the models described above, the results discussed with collaborating researchers and participating farmers, and, if needed, further testing can then be conducted.

Equipment

Major needs are vehicles for transport of personnel and field equipment, portable scales for on-farm monitoring work, and computers plus related software and peripherals for analysis of data at every level. If the policy of replacing vehicles with Host Country funds continues, the only vehicle needed on the Economics project fund will be in Brazil. A microcomputer may be needed to support the project in Brazil.

Training

Current training includes support for local M.S. students in Kenya, one Kenyan for Ph.D. degree in the United States, one Indonesian for Ph.D. training in the United States (primary support from World Bank, two Peruvians for Ph.D.s in the United States during years 7-9, one @Indonesia (partial support from SR-CRSP) for local Ph.D. during years 6-8 and one Indonesian for Ph.D. studies starting year 9.

Collaborating personnel include the following:

1. Brazil -Jose de Souza Neto, M.S., Co-Investigator
- Peru -Domingo Martinez, M.S., Co-Investigator
-Nestor Gutierrez, Ph.D., Research Associate
-Corinne Valdivia, M.S., Co-Investigator
-Rubén Velarde, B.S., Research Assistant
-Aldo Cruz-Technician
-Mauricio Jaramillo, M.S., Research Assistant
- Indonesia -M. Sabrani, M.S., Co-Investigator
-Tjeppy Soedjano, M.S., Collaborator
-Agus Muljadi, M.S., Collaborator
-Uka Kusnadi, M.S., Collaborator
-Syahrir Mawi, B.S., Collaborator
-Setel Karo Karo, B.S. Collaborator
-Joel Levine, Ph.D., Visiting Scientist
-H. C. Knipscheer, Ph.D., Co-Investigator
-Pervaiz Amir, Ph.D., Research Associate (Arkansas-based)
- Kenya -Fanny Nyaribo, M.S., Co-Investigator
-Adrian Mukhebi, Ph.D., Research Associate

- L. Oyugi, M.S., Collaborator
- H. Ogada, B.S., Collaborator
- H. C. Knipscheer, Ph.D., Co-Investigator

Contribution To Overall SR-CRSP Program

The Economics component of the SR-CRSP has provided research inputs that have influenced program priorities, the design of research projects, the focus on small farmer problems and priorities, and the support function in terms of evaluation of specific experimental results. The project has tried, where possible, to integrate information from both the biological and social sciences programs and to participate in the conduct of interdisciplinary research projects. The project is now assuming leadership in the design and monitoring of field testing programs and in the economic analysis of the results. The goals of this project are complementary to those of the other SR-CRSP products and to current AID thrusts to extend the Farming System Research and Extension approach to assist national research programs in reaching small farmers more effectively.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Winrock - Economics

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	20	95	115	22	104.5	126.5	24.2	114.95	139.15
Fringe benefits	6	30	36	6.6	33	39.6	7.26	36.3	43.56
Supplies & expenses	1	5	6	1.1	7.7	8.8	1.21	8.47	9.68
Equipment	-	7	7	-	3.3	3.3	3.63	-	3.63
International travel	-	13	13	-	16.5	16.5	-	21.78	21.78
Domestic travel	2	-	2	2.2	-	2.2	2.42	-	2.42
Other direct costs	-	18	18	-	19.8	19.8	-	21.78	21.78
Indirect costs	9	44	53	9.9	48.4	58.3	10.89	53.24	64.13
Total	38	212	250	41.8	233.2	275	49.61	256.52	306.13

DUAL PURPOSE GOAT PRODUCTION SYSTEMS FOR
SMALLHOLDER AGRICULTURALISTS

H. A. Fitzhugh, Principal Investigator

Winrock International

Work Plans Years 10, 11 and 12

Work Site: Kenya

Overall Goals

The goal of the dual-purpose goat production systems project is to improve the welfare of families on small farms in medium to high-potential tropical regions of developing countries. This goal will be attained by improving the nutritional status of family members and generating additional income from sales of animals

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

Project Objectives

Develop and evaluate goat production systems to meet needs of smallholder agriculturalists in the humid/subhumid tropics, emphasizing dual-purpose utilization of goats for production of milk and meat.

The Production Systems project will provide leadership in integrating research results for dual-purpose production systems. Research results will stem from efforts of SR-CRSP projects in Kenya -- Breeding, Health, Sociology, Economics, Systems Analysis and Production Systems (figure 1).

In addition to responsibility for integration, the Production Systems project has responsibility for three research areas., namely goat nutrition-management, feed production-preservation, and small farm systems. Objectives for these research activities include:

- A. Nutrition-Management Strategies for Dual-Purpose Goats
 1. Evaluate performance of dual-purpose goats on rations derived from low-cost feed resources produced on small farms in western Kenya.
 2. Develop practical feeding strategies for meeting year-round nutrient requirements of goats at different stages of maturity and levels of production.
 3. Evaluate simple, low-cost practices for control of goats; protection from climatic and disease stresses, predation, and theft; and preserving food value of meat and milk.

B. Feed Resource Production and Preservation

1. Evaluate feed production from by-products and residues from food crops typical to small farms in western Kenya.
2. Evaluate dual purpose (food/forage) crops that have shown potential elsewhere in Kenya and other countries.
3. Evaluate productivity (food and forage) from multiple cropping systems.
4. Evaluate methods of preserving feed nutrients surplus in rainy season for use in dry season when feed is in short supply.
5. Evaluate fertilizer value of goat manure to improve crop yields.

C. Small Farm Systems (in collaboration with Health, Sociology, Systems Analysis and Economic projects)

1. Characterize small-scale farm systems in Kenya, including biological, economic, and human resources and constraints.
2. Evaluate interactions between components of farm systems, . e.g., complementation and(or) competition between livestock and cropping activities for land, labor, and capital resources.
3. Provide baseline data for assessment of biological, economic, and sociological interventions in small farm systems.

Approach

A consistent supply of protein is often lacking in the diets of families on small farms in the humid tropics. Milk is a good protein supplement, especially for children and pregnant women. Although many farms cannot provide sufficient feed for a lactating cow, they can support several lactating goats. Several goats in place of a cow have certain advantages: loss of an individual animal impacts less on family welfare; initial investment per animal is low; mating does to kid in different seasons allows a small but consistent daily supply of milk throughout the year; litters of two or three kids at 7- to 8-month intervals markedly increase offtake of slaughter stock for family consumption or sale to provide much-needed income.

To be acceptable to small-scale farmers, the dual-purpose goat production system must be based on low-cost, low-risk technology and be minimally competitive with cropping activities for land, labor, and capital resources. The research problems, therefore, are to develop animals of the appropriate genotype; to develop feed resource-nutrition-health management packages appropriate to the small farm resource base; and to evaluate these packages for technical, economic, and social feasibility.

The research approach followed has come to be known as Farming System Research (FSR); i.e.,

- o Characterization of target farming systems, including identification of resources and constraints,
- o Design of interventions and alternative systems based on results from analysis of traditional system and component research and experience of researchers and farmers,
- o Testing of interventions and alternative technology packages on farms.

The Production Systems project has responsibility for three priority areas not being addressed by other SR-CRSP projects in Kenya:

- o Nutrition and management of dual-purpose goats
- o Utilization and acceptability of goat milk products
- o Production and preservation of feed from limited resource base on small farms

A major responsibility of the Production Systems project is integration of research results in the design of interventions and alternative technology packages and testing these packages to ensure they meet farmers' needs (figure 1). During years 7 through 9, scientist managed research on goat nutrition-management and feed production-preservation will be conducted both under the relatively controlled environment of the experiment station at Maseno and on farms of cooperators in Nyanza and Western provinces. In collaboration with the Breeding Project, 120 second parity crossbred does will be placed on farms in 1986 (year 7) to evaluate their lactation and reproductive performance. The critical test of the dual-purpose goat production packages will be through extensive trials managed by participating farmers. Scientist inputs will be limited to monitoring animal performance and acceptance of research based recommendations. Three to four goats each will be placed on approximately 250 farms in Western and Nyanza Provinces.

Participating farmers will be randomly selected using a sampling frame defined on agroecological and socioeconomic criteria.

Production of goats will be a joint activity of Breeding and Production Systems project. Dairy males (Nubian, Alpine, Toggenburg) will be mated to East African does to produce dual-purpose goats (DPG) for evaluation. Planned production and evaluation schedule is:

Project Year	Activity
7	Mate imported dairy bucks to East African does
7	First born crossbred DPG
8	Breed DPG yearling does to dairy bucks
9	DPG does: first lactation performance on farms
10-11	DPG does: second, third, and fourth lactations on farms
12	Analyze on-farm research, develop final recommendations

Training

Project funds are allocated to support training for graduate degrees. Three Kenyans and two Americans have completed advanced degrees with support from the Production Systems project. Currently, Mohamed Salim Khainga is in training at Texas Tech University for a M.S. degree in ruminant nutrition with

emphasis on forage-based diets., Kenneth Otieno is in training at the University of Reading for a M.Sc. degree in tropical animal production. Other personnel are supported for short-term training in farming systems research and nutrition laboratory methodology conducted by CIMMYT, ILCA, and other African centers.

Production Systems scientists also conduct workshops in farming systems research methodology, in nutrition-management of goats, and in the processing-preservation of goat milk. These training courses are held for both research-extension personnel and for local producers in western Kenya.

Most Kenyan counterpart staff assigned to Production Systems scientists have been recent graduates of the University of Nairobi or Egerton College. They have had little training or prior experience in design, conduct, and analysis of experiments. Production Systems scientists provide on-job training in research to these counterpart staff. Each counterpart is given principal responsibility for one or more experiments, including analysis and reporting results at scientific meetings held annually in Kenya.

Contribution To Overall SR-CRSP Program

The Production Systems project's responsibility to develop and evaluate a dual-purpose goat production package necessarily involves close collaboration with other SR-CRSP projects in Kenya. Production Systems has responsibility for coordinating research activities in Kenya to facilitate an integrated research program. Specific research activities in goat nutrition-management and feed production-preservation fill essential needs in the Kenyan research program.

Interaction With Other USAID Programs

USAID/Kenya is planning support for a major, 15-year agricultural technology program in Kenya. Priority will be given to research to improve productivity of mixed crop-livestock farms in Kenya. Interest has been expressed in the potential for dual-purpose goats on these farms with the anticipation that research by SR-CRSP will be expanded and extended to mixed farming systems throughout Kenya. Initial USAID support is expected to begin in FY86 and continue through FY92, which includes SR-CRSP years 7 through 12.

Additionally, results and experience from SR-CRSP program in Kenya should have broader application for small farms throughout the humid tropical areas of Africa. USAID programs concerned with improving family nutrition and income in these areas should benefit from the Production Systems project in Kenya.

Interaction With IARCS

The farming systems research approach followed by SR-CRSP in Kenya is supportive of and supported by the farming systems research training programs conducted by CIMMYT in Kenya. In addition, Production Systems scientists are collaborating with ILCA scientists on evaluation of forage legumes for feeding goats and the effects of nutritional supplementation on reproductive performance of goats on the equator with no photoperiod efforts.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

(\$ in thousands)

SR-CRSP BUDGET CATEGORY: Production Systems - Winrock International Livestock and Research Center

	Year 10			Year 11			Year 12		
	US	Overseas	Total	US	Overseas	Total	US	Overseas	Total
Salaries	15	106	121	16.5	116.6	133.1	18.15	128.26	146.41
Fringe benefits	4	31	35	4.4	34.1	38.5	4.84	37.51	42.35
Supplies & expenses	1	28	29	1.1	30.8	31.9	1.21	33.88	35.09
Equipment	-	-	-	-	-	-	-	-	-
International travel		12	12	-	13.2	13.2	-	14.52	14.52
Domestic travel	1	1	2	1.1	1.1	2.2	1.21	1.21	2.42
Other direct costs	-	6	6	-	6.6	6.6	-	7.26	7.26
Indirect costs	-	35	35	-	38.5	38.5	-	42.35	42.35
Total	21	219	240	23.1	240.9	264	25.41	264.99	290.4

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