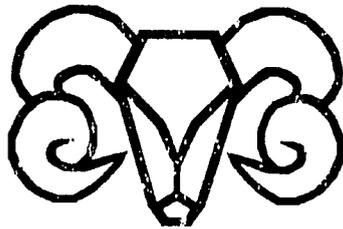


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**Small Ruminant
Collaborative Research
Support Program
Annual Report for
Peru
Program Year Eight
1986-87**



Small Ruminant CRSP
University of California
Davis, California 95616

<u>COUNTRY</u>	<u>SR-CRSP DISCIPLINE</u>	<u>PRINCIPAL INVESTIGATOR</u>	<u>PRINCIPAL COUNTERPART</u>
Brazil:	Animal Breeding & Management	M. Shelton	E.Figueiredo
	Animal Health	H. Olander	F.S. Alves
	Animal Nutrition	W.L. Johnson	N.N. Barros
	Economics	H. Knipscheer	J. Souza-Neto
	Range Management	J. Malechek	E. Oliveira
	Sociology	M. Nolan	M.C. Neumaier
Indonesia:	Animal Nutrition	W.L. Johnson	M. Rangkutı
	Economics	H. Knipscheer	A. Muljadi
	Genetic Improvement	E. Bradford	Subandriyo
	Sociology	M. Nolan	K. Suradisastra
Kenya:	Animal Breeding Systems Analysis	T. Cartwright	F. Ruvuna S. Tallum
	Animal Health	T. McGuire	F. Rurangirwa
	Economics	H. Knipscheer	F. Nyaribo
	Production Systems Feed Resources Nutrition/Management	H. Fitzhugh	M. Onim P. Semenye
	Sociology	M. Nolan	A.N. Mbabu
Morocco:	Genetic Improvement	G.E. Bradford	A. Lahlou-Kassi
	Nutrition	W.L. Johnson	F. Guessous
	Range	J. Malechek	H. Narjisse
	Sociology	M. Nolan	A. Hammoudi
Peru:	Animal Health	J. DeMartini	E. Ameghino
	Breeding & Management	P. Burfening	M. Carpio
	Economics	H. Knipscheer	D. Martinez
	Range Management Sociology	F. Bryant M. Nolan	A. Florez M. Fernandez

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

ANNUAL REPORT FOR PERU

1986 - 1987

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If more information is desired, the Principal Investigator of the specific project may be contacted at his U.S. institution or by enquiry from the Management Entity, Small Ruminant Collaborative Research Support Program, University of California, Davis 95616. In addition to this series of annual reports by host country, the Management Entity has compiled a complete roster of trainees and a full listing of over 2000 theses, book chapters, scientific journal articles, abstracts of papers presented at meetings, and written and verbal technical presentations which reflect the activity of the SR-CRSP prior to 1988.

1986-87 ANNUAL REPORT

Introduction

As Peruvian and U.S. researchers continue to investigate small ruminant production in Peru, new findings continue to emerge. Thus, the results also continue to have application to similar eco-regions of other Andean countries like Bolivia, Ecuador, Columbia, Argentina, and Chile. Research has focused on sheep, and to a lesser extent, alpacas and llamas.

Genetic improvement and more recently, reproduction has been the mission of the Montana State University project. Their findings indicate that, for example, lambs born later in the lambing season had heavier birth weights, but decreased survival rates, and lighter body and fleece weights. Further, the heavier the dam at parturition, the greater the lamb birth weight, and the greater the chance the lamb will survive. It is interesting to note that even in the harsh Andean environment, genetic progress can be made from selection because all heritable estimates ranged from 0.04 to .24. They also found that traits like the survival and birth weight was .10 and .34 heritable, respectively. Working in the U.S., these researchers also have shown that long-term selection programs can markedly improve litter size in sheep.

Three important diseases found in Peru, which also occur in the U.S., have been targeted by Colorado State University for major research emphasis. These include ovine pulmonary carcinoma (OPC), ovine progressive pneumonia (OPP) and caprine arthritis-encephalitis (CAE). All three cause severe losses in Peru. Diseases of reproduction also have been studied to understand causes of infertility, abortion, stillbirth and perinatal mortality in Peru. The high prevalence of neonatal mortality in alpacas has been attributed to Clostridium perfringes, type A, enteropathogenic E. coli, and because dams apparently fail to transfer maternal antibodies. Peruvian colleagues of Colorado State University have launched massive research in Peru and the U.S. to understand all these diseases. Research in peasant communities also is underway to test livestock management and parasite control strategies.

Improved management strategies of small ruminants require knowledge of how herbivores grazing in common, partition the herbage resource. Furthermore, understanding the nutritional status of free-ranging animals is fundamental to improved management aimed at enhancing their nutrition. Peruvian colleagues of Texas Tech University have sought to define these relationships for small ruminants grazing native rangelands. Results show that alpacas have the most opportunistic feeding strategy and compete directly with llamas and/or sheep when range conditions vary. Thus, llamas and sheep could be managed together in a production system, while alpacas should be managed alone. Current stocking ratios used in Peru are incorrect because, until now, no one has investigated voluntary intake levels of sheep, llamas, and alpacas. Their research shows that sheep consume more forage by far per kg of metabolic body weight ($BW^{.75}$) than either camelid. Stocking rates

and ratios should be adjusted accordingly. In a related study, water deprivation of goats and sheep on the north coast of Peru indicated weight gain of both small ruminants are similarly affected.

Efforts by rural sociologists of the University of Missouri and economists of Winrock International have both focused on research in peasant communities. Their work has led to the development of strong linkages with communities and will provide the foundation of future research aimed at validating how well technology will transfer to family-oriented, community production systems in Peru. Termed "Participatory Action Research", their research approach goes beyond on-farm-trials to use peasants in identifying basic research problems. Further, they work with peasant families and strive to address organizational problems often associated with peasants, by increasing self confidence, organizational capabilities, and awareness of a collective ability to overcome problems. This important role of sociology and economics is required to test and refine technology packages which incorporate the research findings of Montana State, Colorado State, and Texas Tech Universities.

1986-87 ANNUAL REPORT

Title: Evaluation and improvement of small ruminants in Extensive Management Systems

Principal Investigator: P. J. Burfening

U.S. Institution: Montana State University (MSU)

Collaborating Institutions: INIPA
Universidad Nacional Agraria, La Molina (UNA)
Universidad Nacional de Altiplano, Puno (UNA-P)

Collaborating Personnel: Manual Carpio, Animal Scientist, UNA
Dr. Juan Chavez, Animal Breeder, UNA
Rolandro Alancastre, Animal Scientist, UNA-P
Victor Bustinza, Animal Breeder, UNA-P
Dr. Maximo Gamarra, Manager, SAIS Tupac Amaru
Dr. J.G. Berardinelli, Assistant Professor of Animal Physiology, MSU
Dr. D.D. Kress, Professor of Animal Breeding, MSU
Dr. R.L. Blackwell, Professor of Animal Breeding, MSU

RESEARCH RESULTS

Factors affecting survival of young from birth to weaning (7 mo) in alpacas were evaluated in data collected at the Estacion Experimental de Camelidos Sudamericanos La Raya in the Altiplano region of Peru. Age of dam effects on survival rate were curvilinear; survival rate increased from approximately 78% for offspring of 3-yr-old dams to about 91% for those from 9 to 11 yr old dams, then declined to about 85% for 15 yr old dams. Weight of dam, about 2 months prior to parturition, was negatively associated with survival of the young ($b = -.7\%/kg$). Lambs born early in the lambing season had a higher survival rate than those born late; the regression of survival on birth date was $-.2\%/d$. Survival rates were curvilinearly related with birth weight being highest at birth weights of 9 to 11 kg (90%), while for those with very small birth weights (4 to 5 kg) the survival rates were between 20% and 40%. The estimated heritability of survival and birth weight was $.10 \pm .17$ and $.34 \pm .23$, respectively. The estimated genetic correlation between survival rate and birth weight was $-.18 \pm .82$; the corresponding environmental and phenotypic correlations were positive (.37 and .26, respectively).

Environmental and genetic parameters affecting growth and fleece weight of sheep in the central highlands of Peru were evaluated. Ewes were mated in May and June with lambing in October and November just prior to the start of the wet season. Ewes and rams were of the Junin breed and

were maintained at an elevation of 3,700 to 5,200 m between 10° and 18° south and maintained on native pastures with no supplemental feed. Traits studied were birth weight, survival from birth to weaning, weaning weight (approximately 120 d of age), body weight and fleece weight at first shearing (approximately 8 mo of age) and body weight and fleece weight at second shearing (approximately 16 mo of age). Independent variables were fixed effects of year of birth of lamb, sex of lamb, sex x year and linear and quadratic effects of birth date of lamb, body weight of dam and birth weight of lamb were appropriate and random variable sire of lamb within year. Year of birth affected ($P < .01$) all traits and sex of lamb affected all traits except weaning weight and body weight at second shearing and sex x year affected all traits except birth weight and weaning weight male lambs were heavier than females and the sex x year interaction resulted in a change in magnitude of the difference rather than a change in ranking of the sexes. Lambs born later in the lambing season had heavier birth weights, decreased survival rates, and lighter body and fleece weights. Increased body weight of the dam resulted in increased birth weight, lamb survival and increased body weights and fleece weights. Increasing birth weight resulted in increased survival and increased body weights and fleece weights. There was an important negative quadratic effect of survival on birth weight resulting in decreased survival of lambs at heavy birth weights. Sire within year affected ($P < .01$) all traits studied heritability estimates were .17, .04, .21, .24, .18, .13 and .12 for birth weight, survival from birth to weaning, body weight and fleece weight at first shearing and body weight and fleece weight at second shearing, respectively. Genetic correlations among traits were all positive with the exception of birth weight with fleece weight at second shearing. These results indicate that under the harsh condition of the Andes that after removing or adjusting to environmental sources of variation there is significant genetic variation available for growth and fleece traits and genetic progress can be made from selection.

The 'ram effect' was tested in a large population of improved sheep in the central Sierra of Peru. The trial was conducted at the Consac production unit of SAIS Tupac Amaru. Twenty-two hundred and forty-four ewes ranging in age from 2 to 6 years were randomly assigned within breeding group to one of two 'ram effect' treatments. Treatments were 1. Control; no exposure to vasectomized rams prior to the start of the breeding season and 2. Stimulated; exposed to vasectomized rams for 14 days prior to the start of the breeding season. The ewes in the two treatments were maintained approximately 2 kilometers apart during the stimulation period. At the end of the stimulation period, the control and stimulated groups were combined and placed with fertile rams for the 55 day breeding season. The data collected was fertility (lambing, yes or no) and lambing date. Ram stimulation resulted in 3.3% more ewes ($P < .05$) lambing during the lambing season. There was a change in the distribution of the lambing dates. Ram stimulation resulted in 14.4% more ewes lambing ($P < .01$) during the first 17 days of the lambing season, 10.1% ($P < .01$) more ewes lambing in the control group than in the stimulated group. However, if the ewes that became pregnant and lambing during the first 17 days of the lambing season are removed from the total number of ewes to approximate the potential ewes that could have

been bred during the second 17 days of the breeding season then 412/501 (82.2%) and 297/366 (81.4%) of the control and stimulated ewes lambed, respectively. Thus, it would appear that the 'ram effect' had no influence on the pregnancy rate as estimated from the lambing rate in the second cycle. This type of a treatment is inexpensive to apply. The major cost is the vasectomized rams, and the ewes need to be isolated from the male influence for a period of approximately 60 days. If the ewes do not have a period of isolation from exposure to the male stimulus then the 'ram effect' will not work in the manner that it did in this study.

Work at Montana State University found that selection for either high or low reproductive rate over a 20 year period resulted in marked changes in litter size in the two lines of sheep. Investigations into the causes of the changes in litter size indicate that the principal cause of the change in litter size is increased or decreased ovulation rate. Ovulation rates for the high and low lines were 1.79 and 1.27 CL per ewe respectively compared to 1.53 for the random bred control line. These results clearly show that selection for increased reproductive rate over a long period of time is effective and that the principal change is in ovulation rate.

A study was conducted to determine if white-faced rams could be selected as effectively and used as ram lambs than as the traditional system of selecting them as yearling rams. Purebred Targhee rams were selected as either ram lambs on the basis of 6-month adjusted body weight and visual observation for fleece quality or as yearling rams on the basis of postweaning average daily gain and fleece weight. Purebred Targhee ewes were randomly assigned within age to either ram lambs or yearling rams. Reproductive performance of the ewes mated to the two ages of rams and growth rate, fleece weight and fleece quality of their progeny were evaluated. There was no difference in lambing rate between ewes mated to the two ages of rams but there were more lambs born and weaned from the ram lambs than the yearling rams. There was no difference in weaning weight, fleece weight, measures of fleece quality or body weight of the progeny sired by rams selected at two different ages.

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- Chavez, J. 1986. Genetic Analysis of Growth and its Relationship with Lifetime Production in Rambouillet, Targhee and Columbia Ewes under Range Conditions of Montana. Ph.D. Thesis. Montana State University, Bozeman, MT.

TRAINING:

a. Degree oriented:

- Chavez, J.F. Peru. Ph.D. MSU. Animal and Range Science. July 1986.
- Schoenian, S. U.S. M.S. MSU. Animal and Range Sciences. August 1988.
- Cabrera, Prospero. M.S. Nat. Agrarian University. Animal Production. January 1987.
- Lopez, Manuel. M.S. Nat. Agrarian University. Animal Production (in progress).
- Quevedo, Pilar. M.S. Nat. Agrarian University. Animal Production (in progress).

1986/87 ANNUAL REPORT

Title: Economic Analysis of Small Ruminant
Production and Marketing Systems

Principal Investigator: Hendrik C. Knipscheer

Host Country: Peru

Personnel: Co-workers:
N. Gutierrez
A. Cruz
F. Gutierrez
E. Garcia
J. Flores
M. Fernandez

U.S. Co-workers:
D. Martinez
C. Valdivia

RESEARCH RESULTS

This year has been a year of restructuring of the economics program in Peru. Because of the difficult political climate, field data collection was avoided and high priority given to farming activities. N. Gutierrez participated as trainer of four workshops, of which two were abroad (Costa Rica and Mexico).

At the same time a strategy was developed on how to test and validate the new technologies being developed by the SR-CRSP. The first phase of this testing has been the selection of the target area. Because of the involvement of the sociology program in the community project, the location selected was the Central Sierra. It already has been possible to identify the principal interaction within the multi-crop and multi-species production systems in this area. Moreover, also the agricultural and resource constraints are now known. The livestock problems can be prioritized as follows: 1) range and forage, improvement and management of communal range, and identification and production of legumes adaptable in high-altitude dryland farming areas; 2) improvement of local breeds through selection; 3) animal health, design and testing of local animal health calendars, testing of alternative forms of parasite control; 4) organization of production, production management roles and decision making within the community farm system, inter-family work groups and the exchange of technological knowledge and skills, methods of research/action with community farmers group training, design and evaluation of validations, information feedback from among farmers, relationships between labor availability and the requirements of new or modified technologies; and 5) market organization.

It was found that organizational as well as ecological conditions under which the community farmer producers will require an integrated effort at defining production constraints as well as in the evaluation of possible technological alternatives which would improve the living standard of the family within the context of community.

Several econometric models were developed of intensified animal management. Analyses will be continued by Dr. Gutierrez and several publications are anticipated.

As part of her Ph.D. thesis, Mrs. Corrinne Valdivia will continue to review the cooperative system in Peru, with special emphasis on livestock. During 1986-1987 Mrs. Valdivia was able to interrupt her Ph.D. course work for a field visit in Peru in order to update the review material.

PUBLICATIONS

No major paper or articles.

TRAINING

The economics project supports two fellows, Mr. Domingo Martinez and Mrs. Corrinne Valdivia. Both students are enrolled in a Ph.D. program in agricultural economics at the University of Missouri-Columbia and have completed the major part of their course work.

ANNUAL REPORT

1986/87

Title: An Investigation of Small Ruminant Health Problems

Principal Investigator: James C. DeMartini

U.S. Institution: Colorado State University

Host Country Institution: IVITA/San Marcos University; INIPA

Personnel: US/CSU
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M. Laimore, Grad. Stud., Pathology
C. Kimberling, Inv., Clinical Sci.
I. Ramirez, Grad. Stu., Microbiology
R. Rosadio, Grad. Stu., Pathology
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D. Huaman, Inv., Microbiology
A. Hung, Inv., Clin. Sci.
L. Inope, Inv., Epidemiology
G. Leguia, Inv., Parasitology
N. Noe, Inv., Microbiology
B. Pizarro, Inv., Pathology
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RESEARCH RESULTS

Retroviral Infection of Sheep and Goats

We have shown that ovine pulmonary carcinoma (OPC, sheep pulmonary adenomatosis) is responsible for severe losses of adult sheep in Peru and that ovine progressive pneumonia (OPP), caused by an ovine lentivirus (OvLV), also is present in Peru. Caprine arthritis-encephalitis (CAE), a disease of goats caused by a retrovirus related to OvLV, has been identified in improved-breed dairy goats imported into Peru and their contacts. These three diseases all occur in the United States. Our research is directed toward characterizing the causative virus of OPC in order to develop a serological test for infected animals, studying the pathogenesis of OPC and OPP in neonatal lambs, isolation of OvLV and CAEV in Peru and continuing the attempt to control OPC and OPP in sheep by changes in management.

Ovine pulmonary carcinoma: In the second report of OPC in the United States, we have described clinical, pathologic and virologic features of 5 sheep naturally-affected with OPC (Rosadio et al, 1987a). The issue of the etiology of OPC was made more complex by the observation that all 5 of these sheep also were infected with OvLV; we reviewed the literature on the etiology and pathogenesis of OPC in the context of our own recent work (DeMartini et al, 1987b). Initial attempts at transmission of OPC from the naturally-occurring OPC cases to neonatal lambs were highly successful, but OvLV was simultaneously transmitted (DeMartini et al, 1987a). Thus, more extensive and better controlled transmission studies became necessary. Groups of lambs (29 total) were inoculated intratracheally with OPC-derived lung fluid, lung tumor, or control materials (Rosadio et al, 1987b). All but one of the lambs injected at birth with OPC-derived lung fluid, but no controls injected with media or OvLV-containing fluid, developed signs or lesions of OPC between 9 and 32 weeks of age. Lambs injected at birth, 2 weeks of age, or 5 weeks of age were significantly more susceptible to OPC induction than lambs injected at 10 weeks of age. All lambs with experimentally transmitted OPC also were infected with OvLV, a finding consistent with recent work from South Africa. Additionally, a p26 antigen of a type D retrovirus was identified by immunoblotting in experimental and natural OPC cases (Rosadio et al, 1987c). This antigen appears specific for OPC and will therefore be used as a marker for screening cell cultures potentially infected with the OPC virus, and perhaps as an antigen in a serological assay. Currently, a radioimmunoassay using this antigen is being applied to screen supernatant fluids for evidence of replication of OPC retrovirus in cells transfected with OPC tumor cell DNA.

Ovine progressive pneumonia: To study the pathogenesis of OvLV-induced lymphoid interstitial pneumonia (LIP, OPP), neonatal lambs were injected intratracheally with low and high passage virus isolates (Lairmore et al, 1986); low passage field isolates were more likely to produce LIP within 4 to 6 months than high passage isolates. The pathogenicity of 4 OvLV strains, 2 of which had been derived from OPC cases, was then compared (Lairmore et al, 1987a); strain-related differences in tissue distribution of virus, kinetics of serum antibody response, and severity of lung lesions were found. The OPC-derived lentivirus strains did not induce lesions of OPC in the lambs within 6 months of inoculation. However, differences in in vitro replication of these virus strains in alveolar macrophages seemed to correlate with pathogenic capacity (Lairmore et al, 1987b). Additionally, spontaneous production of interferon by pulmonary leukocytes was positively correlated with occurrence of LIP in the experimental lambs (Lairmore et al, 1987c). These results were useful in elucidating the mechanisms by which OvLV induce disease, defining the host and virus factors that determine whether disease will be a consequence of infection, and increasing knowledge of OvLV-associated immune responses and the varied manifestations of OvLV infection. Finally, no evidence for a direct role of OvLV in the etiology of OPC was obtained.

In Peru, efforts to reduce the prevalence of OPP and OPC in certain flocks at SAIS Tupac Amaru by means of flock management were continued. Serological evidence indicated that lambs born to primiparous ewes and raised separated from all other sheep after they

were weaned were less likely to become infected with OPPV than lambs born to multiparous ewes and not separated from other sheep after they were weaned (Madewell, et al, 1987b). Antibodies to OvLV in goats, presumably indicating exposure to CAEV, were detected in 7 of 12 herds studied; the highest rate of infection was in a herd near Lima which contained goats imported from the U.S. Efforts are currently underway to isolate OvLV and other retroviruses from sheep with OPC and CAEV from goats in Peru from high prevalence flocks. Simultaneously, OvLV and CAEV serum antibody results are being correlated with clinical signs and lesions of these retrovirus-induced diseases.

Causes of Abortion in Peruvian Sheep Enterprises

Previous studies have implicated several infectious agents as causes of infertility, abortion, stillbirth and perinatal mortality in Peru. Serum samples from 120 ewes with reproductive problems have been collected and are in the process of being tested for antibodies to Chlamydia psittaci using an ELISA test. A 31.6% seroprevalence rate for 14 serovars of Leptospira sp. has been found in 189 samples from sheep in the Department of Ancash. Logistical and security problems have prevented planned studies to isolate causative agents from aborted fetuses and fetal membranes. At CSU, research in range rams in Colorado has indicated the value of examination of semen for leukocytes as an indication of Brucella ovis infection and as a part of the breeding soundness protocol (Kimberling et al, 1986); an eradication program based on serologic study has been proposed (Afzal and Kimberling, 1986). A major difference was observed in ram semen quality between two SAISs in Peru depending on whether or not they vaccinated for B. ovis. Further humoral and cell-mediated immune responses studied in rams experimentally infected with B. ovis indicated that cell-mediated responses developed earlier and correlated better with protection than humoral responses (Afzal et al, 1986).

Prevalence of Mycoplasma sp. Infections in Sheep, Goats and Alpaca

Mycoplasma mycoides subsp. mycoides, large colony type, has been previously isolated from 3-4 week old kids with pneumonia and arthritis from a farm near Lima. One of 16 milk samples from milking goats in the same herd also yielded the agent, and 43 additional samples from the North Coast of Peru are being processed. Growth media for Mycoplasma sp. are being evaluated and rabbit antiserum to the agent is being characterized.

Causes of Perinatal Mortality in Alpaca

The high prevalence of neonatal mortality in alpaca has been related to Clostridium perfringens, type A (CPA, Ramirez and Ellis, 1986), enteropathogenic E. coli (EEC, Ramirez and Elis, 1986), and increased susceptibility to infectious disease by failure of passive transfer (FPT) of maternal antibody (Garmendia et al, 1987). To improve the methods for diagnosis and prevention of CPA, an enterotoxin produced by the bacterium was purified using monoclonal antibodies and characterized, its in vitro and in vivo pathogenicity examined, and ELISA assay developed to detect it (Ramirez, 1987). In a vaccine trial,

120 pregnant alpaca were vaccinated with CPA toxoid and 120 females left as controls. No differences in cria mortality were noted, but no cases of CPA enterotoxemia were registered either at the LaRaya research station or in surrounding enterprises. Anti-CPA antibody levels in serum and colostrum are presently being determined at CSU using an ELISA procedure. Further studies of these newly developed diagnostic and preventative measures for CPA enterotoxemia are in progress, as are new studies on the role of FPT and means of its prevention.

A parasitic cause of economic losses of alpaca is Sarcocystis aucheniae. To elucidate the biological cycle, pathogenicity, and immune response associated with this parasite, experimental inoculation studies were done. Three cria inoculated with oocysts from dog heart all died between 22 and 28 days. This is the first indication that this parasite is capable of causing acute death in alpacas; further studies are in progress.

Patterns of Disease in Community Sheep

Two hundred two families in four peasant communities located at three different ecological levels in the Department of Junin were surveyed to obtain information concerning socioeconomic conditions and the status of health of sheep, cameloid, and cattle populations. Illnesses of major and minor importance for young animals were identified, as were management and veterinary practices used by these families to control disease. This baseline information will be important as we undertake tests of livestock management and parasite control strategies in these communities.

PUBLICATIONS:

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- Ellis, J.A., A.E.V. Chavera, and J.C. DeMartini. Morbidity and Mortality Among Small Holder Sheep Flocks in Peru, with Special Emphasis on Respiratory Diseases. In Press. Int. Sheep and Goat Res.
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- Lairmore, M.D., J.M. Poulson, T.A. Adducci, and J.C. DeMartini. 1987a. Lentivirus-induced Lymphoproliferative Disease: Comparative Pathogenicity of Phenotypically Distinct Ovine Lentivirus Strains. In press. Amer. J. Path.
- Madewell, B.R., E. Ameghino, H. Rivera, L. Inope, and J. DeMartini. 1987. Seroreactivity of Sheep and Goats to Small Ruminant Lentivirus-ovine Progressive Pneumonia Virus. Amer. J. Vet. Res. 48:372-374.
- Noe, N., A. DeMassa, H. Andresen, C. Morales, J. Levano, T. Amaya and M. Salman. 1987. Caprine Mycoplasmosis in Peru Caused by Mycoplasma mycoides subsp. mycoides: A Case Report. In Press. Prevent. Vet. Med.
- Reif, J.S., E. Ameghino, and M.J. Aaronson. 1987. Chronic Exposure of Sheep to a Zinc Smelter in Peru. In press. Env. Research.
- Rivera, H., B.R. Madewell, and E. Ameghino. 1987. Serologic Survey of Viral Antibodies in the Peruvian Alpaca (Lama pacos). Amer. J. Vet. Res. 48:189-191.
- Rosadio, R.R., J.M. Sharp, M.D. Lairmore, J.E. Dahlberg, and J.C. DeMartini. 1987a. Lesions and Retroviruses Associated with Naturally-occurring Ovine Pulmonary Carcinoma (Sheep Pulmonary Adenomatosis). In press. Vet. Pathol.
- Rosadio, R.R., and J.C. DeMartini. 1987c. Retrovirus-induced ovine pulmonary carcinoma (sheep pulmonary adenomatosis) and lymphoid interstitial pneumonia. II. Virology. In preparation.

Rosadio, R.R., M.D. Lairmore, H.I. Russell, and J.C. DeMartini. 1987b. Retrovirus-induced ovine pulmonary carcinoma (sheep pulmonary adenomatosis) and lymphoid interstitial pneumonia. I. Age susceptibility and lesion development. In preparation.

Contributions to monographs

DeMartini, J.C., R.H. Rosadio, and M.D. Lairmore. 1987b. The Etiology and Pathogenesis of Ovine Pulmonary Carcinoma (Sheep Pulmonary Adenomatosis). Elsevier Publications.

Extension bulletins/publications

Afzal, M. and C.V. Kimberling. 1986. How to Control Brucella ovis-induced Epididymitis in Rams. Vet. Med. April/86:364-370.

Ameghino, E. 1985. Mortalidad Perinatal en Corderos de la Sierra Central. IVITA/Univ. Nac. Mayor de San Marcos, Bol. Div. No. 20 p. 1-59.

Kimberling, C.V., D. Schweitzer, J. Butler, M. Bulgin, C. Bagley, and R.P. Ellis. 1987. A New Way to Eradicate Ram Epididymitis. Vet. Med. 84:424-429.

Noe, N. and Andresen, H. 1986. Micoplasma en Caprinos de la Ciudad de Lima. Rev. de Ciencias Vet. Vol. 2 N° 3. Pag. 31.

Ramirez, A. and R.P.Ellis. 1986. Nuevos Conceptos Sobre la Entertoxemia y Colibacilosis en Alpacas. Vida Agropecuaria.

Ramirez, A., Huaman, D. and Ellis, R. (1985). Enterotoxemia de la Alpaca. INIPA - Univ. Calif., Davis. Progr. Colab. de Investig. in Rum. Men. Series de Reportes Tecnicos N° 63. Col. State Univ. Lima, Peru. Pag. 1-40.

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DeMartini, J.C. and R.H. Rosadio. 1986. Pulmonary Adenomatosis: Etiology and pathogenesis. Symposium on Animal Retroviruses. Joint Meeting of Am. Soc. Trop. Vet. Med and Am. Soc. Trop. Med. and Hyg., Denver, CO.

Lairmore, M.D., R.H. Rosadio, H.I. Russell and J.C. DeMartini. 1986. Pathogenesis of Ovine Lentivirus in Neonatal Lambs. Fed. Proc., 45:690 (Abst. No. 3113).

Lairmore, M.D., J.C. DeMartini, R.H. Rosadio, H.I. Russell, G.A. Akita, and S. Wheeler. 1986. Ovine Lentivirus-induced Lymphoid Interstitial Pneumonia: A Model of Lymphoid Interstitial Pneumonia Associated with AIDS. Amer. Coll. of Vet. Path. p. 181

Rosadio, R.H., J.C. DeMartini, M.D. Lairmore, H.I. Russell, and J.M. Sharp. 1986. Age Susceptibility of Lambs to Experimentally-induced Retroviral Pulmonary Diseases. Amer. Coll. of Vet.

Theses

Lairmore, M.D. Studies on the Immunopathogenesis of Ovine Lentivirus-induced Lymphoid Interstitial Pneumonia. 1987. Ph.D. dissertation, Department of Pathology, Colorado State University, Fort Collins, CO.

Nieves, R. A. Potential Enteropathogenic Mechanisms of Escherichia coli Isolated from Neonatal Alpacas. 1987. M.S. Thesis, Department of Microbiology, Colorado State University, Fort Collins, CO.

Ramirez, I.A. Alpaca Clostridium perfringens type A Enterotoxemia: Purification and Assays of the Enterotoxin. 1987. Ph.D. dissertation, Department of Microbiology, Colorado State University, Fort Collins, CO.

Rosadio, R.R. The Pathology and Pathogenesis of Retrovirus-induced Ovine Pulmonary Carcinoma. 1987. Ph.D. dissertation, Department of Pathology, Colorado State University, Fort Collins, CO.

TRAINING:

Degree-oriented:

Lairmore, M.D., U.S. citizen, Ph.D., Department of Pathology, CSU. Degree completed, 1 July 1987. Partial support from SR-CRSP.

Nieves, R.A., U.S. citizen, MS, Department of Microbiology, CSU. Degree completed, 15 March 1987. Partial support from SR-CRSP.

Ramirez, I.A., Peruvian citizen, Ph.D., Department of Microbiology, CSU. Degree completed, 15 March 1987. Totally supported by SR-CRSP.

Rosadio, R.R., Peruvian citizen, Ph.D., Department of Pathology, CSU. Degree completed, 15 March 1987. Totally supported by SR-CRSP.

Non-degree oriented/short term/oral presentations:

Ameghino, E. (1986). Infectious, Nutritional, Organic and Fortuit Diseases in Alpacas. Course on production systems in alpacas of the Puno Department. Fac. of et. Med. and Anim. Sci., Univ. Nac. del Altiplano, IDSA. For professionals.

Ameghino, E. (1986). Course on Sheep and Alpaca Production. Organizer of this at SAIS Picotani, Puno. For workers.

Ameghino, E. (1986). Seminar on Andean Sub-regional to Control and Eradicate Foot and Mouth Disease. PAHO, Panamerican Center of FMD, Lima. For veterinarians from Colombia, Ecuador, Bolivia and Peru.

Ameghino, E. (1986). Advances on Animal Health Through CRSP. Meeting in Lima when Dr. Robertshaw came in November.

Nieves, R.A., R.P. Ellis, and M.L. Kesel. 1987. Enteropathogenicity in the RITARD Model of Escherichia coli Isolated from Alpacas. Amer. Soc. Micro.

Noe, N., DaMassa, A. and Andresen, H. 1986. Poster presented on caprine mycoplasmosis in Peru. VI Internat. Congress on Mycoplasmaology, Alabama, USA.

Ramirez, A., Y.A. Teramoto, K.L. Roberts, and R.P. Ellis. 1987. Monoclonal Antibodies to Enterotoxin; Derived from Clostridium perfringens, Type A Isolated from Enterotoxemic Neonatal Alpacas. Amer. Soc. for Microbiology.

Rivera, H., Madewell, B., Ameghino, E. and Inope, L. 1986. Serological survey on viral antibodies in goats.

Savage, D. 2nd year Vet. Student from CSU. 6 weeks work and training at IVITA, Lima, under supervision of E. Ameghino.

1986-87 ANNUAL REPORT

Institution: Texas Tech University
Project Title: Improving Small Ruminant Nutrition,
Management, and Production through
Proper Management of Native Range and
Improved Pastures
Host Country: Peru

Personnel:

P.I. - Fred C. Bryant
Co-P.I. - Dr. Arturo Florez, UNA- Central Sierra
Ing. Ramiro Farfan, INITA - La Raya
Ing. Juan Astorga, UNTA - Puno

Host Country Co-Workers -

Ing. Godofredo Atamari, UNTA - Puno
Ing. Timoteo Huisa, IVITA - La Raya
Ing. Rosa Higaonna, INIPA - North Coast
Ing. Jose Atto, U.N. Piura - North Coast

U.S. Co.I. -

Dr. Jim Pfister, Range Management, Dept. of Range & Wildlife
Management, Texas Tech University
Dr. Ron Sosebee, Range Management, Dept. of Range & Wildlife
Management, Texas Tech University
Dr. Bill Dahl, Range Management, Dept. of Range & Wildlife
Management, Texas Tech University
Dr. C. M. Britton, Range Management, Dept. of Range & Wildlife
Management, Texas Tech Univ.
Dr. Dave Wester, Range Management, Dept. of Range & Wildlife
Management, Texas Tech University
Dr. Gerry Matches, Improved Forages, Dept. of Plant and Soil
Science, Texas Tech University
Dr. B. L. Allen, Soils, Dept. of Plant and Soil Science, Texas
Tech University
Dr. Frank Craddock, Sheep Production, Dept. of Animal Science,
Texas Tech University

RESEARCH RESULTS

Many of our studies are long-term in nature (3-5 years). Thus, results reported herein are restricted to studies where results came available between July 1, 1986 and July 1, 1987.

1. Diet selection of llamas, alpacas, and sheep (T. Huisa, R. Farfan, F. San Martin).

Research results show that llamas prefer taller, more coarse bunchgrasses, sheep prefer shorter plants, while alpacas are

intermediate to llamas and sheep expressing more opportunistic feeding behavior than sheep or llamas. Based on dietary overlap and forage competition, llamas and sheep could be managed together in a production system, while alpacas should be managed alone.

2. Nutrition of free-ranging llamas, alpacas and sheep on native rangeland (F. San Martin, R. Farfan, T. Huisa).

Sheep select diets highest in crude protein (CP) followed by alpacas and llamas. For all species, improved pastures used in the dry season would double the protein supply from about 8% CP to 16% CP. On a metabolic weight basis (BW .75), sheep consume an average of about 30% more forage per day than llamas or alpacas regardless of season, range site or whether grazing improved pastures. Furthermore, on native pasture during the dry season sheep ate over 2.0% of their body weight per day while llamas and alpacas ate only 1.2 to 1.5%, regardless of range site. Thus, stocking ratios of alpaca:sheep should thus be 1.0:1.0 and llamas:sheep, 1.5:1.0, not the currently recommended ratios of 1.8:1.0 for both.

3. Comparative digestive physiology of sheep and llamas (F. San Martin).

Llamas were better able (10% more) to digest low quality feedstuffs than sheep.

4. Root development of annual legumes using the slant-tube technique (C. Bojorquez).

After a 2-year evaluation of annual legume species, it is feasible to select legume species and cultivars which have rapid root development if this proves to be a characteristic associated with better seedling survival in field studies in developing countries. Also, the slant-tube technique is an inexpensive, efficient technique for screening legumes for differences in rooting characteristics.

5. An evaluation of short duration grazing in northern Mexico (S. Soltero).

Both short duration grazing (SDG) and continuous yearlong grazing (CG) reduced total plant cover over the study period. Higher than normal stocking rates, however, are not recommended under SDG for dry, arid regions of Mexico because of accelerated reductions in plant cover.

6. Nutrition of goats consuming shinnery oak (F. Villena).

As the percent of oak under penned conditions in goat diets increases, digestion decreases. However, oak (Quercus sp.) in goat diets under range conditions depressed voluntary intake more when plants were immature than when plants were mature. Apparently, methanol extracts of oak (phenols and tannins) depresses intake more so than ether extracts (waxes).

7. Water deprivation of goats and sheep on the north coast of Peru (J. Atto, J. Pfister, E. Nolte).

Both goats and sheep gained the same amount of weight (>3 kg) regardless of water deprivation. Goats generally consumed more water after each drinking period than did sheep.

PUBLICATIONS:

Publications in Refereed Journals

- Bryant, F. C. and R. Farfan. 1984. Dry Season Forage Selection by Alpaca (Lama pacos) in Southern Peru. J. Range Manage. 37:330-333.
- Florez, A., E. Malpartida, F. C. Bryant, and E. P. Wiggers. 1986. Nutrient content and Phenology of Cool-season Grasses in Peru. Grass and Forage Sci. 40:365-369.

Manuscripts Previously Listed as Submitted or in Press
Which Are now Published

- Pitts, J.S. and F. C. Bryant. 1987. Steer and vegetation response to short duration and continuous grazing. J. Range Manage. 40:386-389.
- Reiner, R. J., and F. C. Bryant. 1986. Botanical Composition and Nutritional Quality of Alpaca Diets in Two Andean Rangeland Communities. J. Range Manage. 39:424-427.
- Reiner, R. J., and F. C. Bryant. 1986. Forage Intake of Alpacas Grazing Andean Rangeland in Peru. J. Anim. Sci. 64:868-871.
- Wilcox, B. P. and F. C. Bryant. 1986. an Evaluation of Range Condition in the Andes of Central Peru. J. Range Manage. 40:41-45.
- Wilcox, B. P., F. C. Bryant, and B. L. Allen. 1986. Grassland Communities and Soils on a High Elevation Rangeland of Central Peru. Phytologia 61:231-250.

Manuscripts Now In Press or Which
Have Been Submitted

In Press:

- Pfister, J. A., F. C. Bryant., A. Florez, and J. Gamarra. 1988. Flushing of Range Sheep with Cultivated Pastures in the Andes of Peru. J. Range Manage. (In Press).
- Wilcox, B. P., B. L. Allen, and F. C. Bryant. 1988. Selected Properties of Soils in the High Andean Puna and Central Peru. Geoderma. (In Press).

Submitted:

- Bojorquez, C. L., A. G. Matches, and H. M. Taylor. 1988. Root and Top Growth of Winter Annual Legumes Using the Plant Tube Technique. Crop Sci. (Submitted)
- Carey, J. A., B. F. Craddock, A. Florez, and F. C. Bryant. 1986. Effects of Grazing Strategy and Stocking Rates on Wool Quality and Quantity in the Andes of Peru. J. Range Manage. (Submitted)
- Urbano, J. E., E. M. Flores, F. C. Bryant, J. A. Pfister and A. Florez. 1988. Evaluation of Diet Selectivity by Sheep under Rotational and Continuous Grazing in Peru. J. Range Manage. (Submitted)

Technical Communications

- Aguirre, L. 1986. Soil-plant-water Relationships of the Key Grass Species in Southern Peru. In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp. 25-57.
- Atamari, G. and L. C. Fierro. 1986. Grazing Sheep Behavior and Energy Budgets in the Altiplano Region of Southern Peru. In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III pp. 58-75.
- Bryant, F. C., 1986. Making More Profit with Fewer Animals. In: D. E. Gynn and T. R. Troxel. (Eds.) Symp. Proc. International Ranchers Roundup. pp. 186-191. Kerrville, TX.
- Bryant, F. C., A. Florez, and A. F. Schlundt. 1986. Sheep Production, Stocking Rates and Rotational Grazing in the Andes of Peru. In: D. J. Joss, P. W. Lynch, and O. B. Williams, (Eds.) Proc. International Rangeland Congress, pp. 245-246.
- Bueno, L. S. and A. Florez. 1986. Autoecological studies of the Key Grass Species of the Andean Grasslands. In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp 1-13.
- Farfan, R., L. C. Fierro, T. Huisa, A. Rosales, and F. C. Bryant. 1986. Voluntary intake of Llamas in the Andes of Southern Peru. In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp 89-98.
- Fierro, L. C., T. C. Cartwright, H. D. Blackburn, and F. C. Bryant. 1986. Systems Analysis and Computer Simulations of Corriedale Range Ewes in Peruvian Altiplano. In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp 107-118.

- Fierro, L. C., T. Huisa, A. Rosales, and C. Schreiber. 1986. Nutritive Value of Llama Diets During the Drought and Rainy Seasons in Southern Peru. *In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru*, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp 119-122.
- Florez, A., F. C. Bryant, and A. F. Schlundt. 1986. Grazing Strategies and Sheep Production in the Andes of Peru. *In: D. J. Joss, P. W. Lynch, and O. B. Williams, (Eds.) Proc. Intntl. Rangeland Cong.*, pp 236-237.
- Florez, A., F. Bryant, J. Gamarra, J. Pfister, and J. Arias. 1986. Estudio de la Influencia de Diferentes Niveles Nutricionales al Pastoreo Sobre el Crecimiento de la Fibra de Alpaca. Technical Report No. 78. INIPA, SR-CRSP, UNA-LaMolina, Peru and Texas Tech Univ., Lubbock. 23 pg.
- Florez, A., F. Bryant, E. Malpartida, and J. Pfister. 1986. Pastoreo Complementario una Alternativa de Utilizacion de las Praderas Nativas Altoandinas. Technical Report No. 79. INIPA, SR-CRSP, UNA-La Molina, Peru and Texas Tech Univ., Lubbock. 48 pg.
- Florez, A., F. Bryant, L. Bueno, and N. Rodriguez. 1986. Efecto de Diferentes Grados de Utilizacion Sobre el Rendimiento del Valor Nutritivo de Cinco Gramineas de las Praderas Altoandinas. Technical Report No. 80. INIPA, SR-CRSP, UNA-LaMolina, Peru and Texas Tech Univ., Lubbock. 36 pg.
- Florez, A., A. Carrasco, N. Gutierrez A., and O. Carhuamaca. 1986. Desempeno Biologico-economico de la Asociacion Rye Grass-Trebol para Engorde de Ovinos en La Sierra del Peru. Technical Report No. 82. INIPA, SR-CRSP, UNA-LaMolina, Peru and Texas Tech Univ. Lubbock., 47 pg.
- Florez, A., F. Bryant, J. Gamarra, J. Pfister, and J. Arias. 1986. Empadre de Alpacas al Ano de Edad Usando Pasturas en la Region Altoandina del Peru. Technical Report No. 83. INIPA, SR-CRSP, UNA-LaMolina, Peru and Texas Tech Univ. Lubbock, 35 pg.
- Florez, A., F. Bryant, E. Malpartida, and J. Gamarro. 1986. Determinacion de la Carga Ovina Optima en Praderas Nativas Altoandinas Bajo el Sistema de Pastoreo Rotativo. Technical Report No. 84. INIPA, SR-CRSP, UNA-LaMolina, Peru and Texas Tech Univ., Lubbock. 40 pg.
- Reiner, R. J. and F. C. Bryant. 1986. Diet Content and Alpacas in Two Range Sites of the Southern Andes of Peru. *In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru*, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp 76-88.
- Reiner, R. J., F. C. Bryant, and T. Huisa. 1986. Forage Intake of Grazing Alpacas in Southern Peru. *In: Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru*, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp. 99-106

Rodriguez, N., A. Florez, and E. Malpartida. 1986. Nutrient Content of the Key Grass Species of the Central Andes. In. Investigacion Sobre Pastos y Forrajes de Texas Tech Univ. en el Peru, (eds.) Fierro, L. C. and R. Farfan. Volume III, pp. 14-24.

Abstracts

- Blackburn, H.D., T.C. Cartwright, and F.C. Bryant. 1987. Productivity of Corriedale Sheep Using Ryegrass Pastures as a Supplement. American Society of Animal Science.
- Bojorquez, C.L., A.G. Matches, and H.M. Taylor. 1986. Root and Top Growth of Winter Annual Legumes Using the Plant Tube Technique. p. 107. Agron. Abstracts.
- Bryant, F.C., F. San Martin, R. Reiner, and L.C. Fierro. 1987. Comparison of Selectivity Between Alpaca and Sheep on a Festuca dolycophylla Range Site in Peru. Abstr. No. 236. Abstracts of Papers, Soc. for Range Manage.
- El Aich, A., M. Harkousse, A. Chyra, F.C. Bryant, and L. Rittenhouse. 1987. Dry Matter Intake and Stocking Rate Levels for Timahdit Sheep in Morocco. Abstr. No. 238. Soc. for Range Manage.
- Gomez, J.F., J.C. Shin, C.L. Bojorquez, A.G. Matches, B.L. McMichael, and H.M. Taylor. 1986. Using the Slant Tube Technique to Predict Rooting Depth of Forage Legumes in the Field. p. 112. Agron. Abstracts.
- San Martin, F., F.C. Bryant, R. Farfan, and A. Rosales. 1987. Comparison of Sheep, Llama, and Alpaca Selectivity on Two Native Range Suites and an Improved Pasture in Peru. Abstr. No. 237. Soc. for Range Manage.
- San Martin, F., J.A. Pfister, F.C. Bryant, and T. Huisa. 1987. Comparative Digestibilities of South American Camelids (Pseudo ruminants) and True Ruminants. Abstr. No. 054. Soc. for Range Manage.
- Soltero, S., F.C. Bryant, A. Melgoza, and L.C. Fierro. 1987. Grazing Distribution Under Short Duration and Continuous Grazing on an Oak-bunchgrass Range Site in Northern Mexico. Abstr. No. 216. Soc. for Range Manage.
- Villalobos, C., L. C. Fierro, S. Soltero, and F.C. Bryant. 1987. Nutritive Quality of Cattle Diets Under Short Duration and Continuous Grazing on a Oak-bunchgrass Range Site in Northern Mexico. Abstr. No. 251. Soc. for Range Manage.

Theses

(students supported in full or partially by the SR-CRSP)

Peruvians trained in U.S.:

1. Aguirre, Lucrecia. 1985. Soil-plant Water Relations in the Altiplano of Peru. M.S. Thesis. Texas Tech University, Lubbock.
2. Bojorquez, C.L. 1987. Root and Top Growth of Winter Annual Legumes Using the Plant Tube Technique. M.S. Thesis. Texas Tech University, Lubbock.
3. Farfan, R. 1982. Dry Season Forage Preferences of Alpaca in Southern Peru. M.S. Thesis. Texas Tech University, Lubbock.
4. Nolte, E. 1985. Forage Evaluation in Ohio. Ph.D. Dissertation. Ohio State University, Columbus.
5. San Martin, F. 1987. Voluntary Intake, Selectivity and Digestive Efficiency of the South American Camelids Compared with Sheep. Ph.D. Dissertation. Texas Tech University, Lubbock.
6. Villena, F. 1987. Nutrition of Goats Grazing Sand Shinnery Oak (Quercus havadii) Ranges in West Texas. M.S. Thesis. Texas Tech University, Lubbock.

Peruvians trained in Peru:

1. Alcarraz, R. Roque. 1983. Estudio Comparativo de la Produccion de Carne de Ovino y su Rentabilidad en una Empresa Asociativa de la Sierra Central. UNA, La Molina.
2. Gamarra, B. J. 1984. Efecto de los Sistemas de Pastoreo y Carga Animal Sobre los Principales Indices Pecuarios en el Periodo Paricion-destete con Borreguillas en la SAIS Pachacutec Ltda. No. 7. UNA, La Molina.
3. Garcia-Chafloque, J.C. 1984. U.N. Pedro Ruiz Gallo, Lambayeque.
4. Garcia, H. 1983. Habitos de Pastoreo del Ganado Caprino en la Pradera de Olmos.
5. Gonzalea, E. 1984. Engorde de Ovinos con Diferentes Mezclas de Forraje Verde de Pasto Elefante y Alfalfa en la Costa Central. UNA, La Molina.
6. Gonzales-Ponce, A. 1983. Produccion y Calidad Forrajera de Alfalfa Asociada con Dactylo Durante la Epoca de Crecimiento. UNTA, Puno.
7. Lares, A., I. 1984. Determinacion de la Capacidad de Carga Optima en un Pastizal Natural Alto-Andino Bajo el Sistema de Pastoreo Rotativo con Ovinos. UNA, La Molina.

8. Ortega-Acata, S. 1985. Impacto del Pastoreo Rotativo y Diferido Sobre la Composicion Botanica y Valor Nutritivo de la Dieta en Ovinos en Pastizales de Gradados Sometidos a Tratamiento de Recuperacion. UNA, La Molina.
9. Oscanoa-Gamarra, L. 1985. Estudio Comparativo de la Nutricion de Ovinos en Pastoreo Rotativo vs. Continuo. UNA, La Molina.
10. Rueda-Urbano, J. 1985. Efecto de la Carga Animal Sobre la Composicion Botanica de la Dieta en Ovinos. UNA, La Molina.
11. Silva-Peralta, A.P. 1984. Determinacion de Sitios, Densidad y Cobertura en la Pastura Natural de la Comunidad de Olmos. U.N. Pedro Ruiz Gallo, Lambayeque.
12. Soto-Bueno, L. 1984. Estudio Autoecologico de las Principales Especies Forrajeras Nativas de la Puna Peruana. UNA, La Molina.
13. Vasquez-Rodriguez, N. 1984. Determinacion del Valor Nutritivo de las Principales Especies de los Pastizales Naturales de la SAIS "Pachacutec" en Cinco Eventos Fenologicos. UNA, La Molina.
14. Villa, R. Velarde. 1983. Algunas Relaciones de Suelo-planta en Praderas Alto-Andinas. UNTA, Puno.

Mexican:

1. Fierro, C. 1985. Forage Intake, Diet Composition, and Bioenergetics of Grazing Sheep in Southern Peru. Ph.D. Dissertation. Texas Tech University, Lubbock.
2. Soltero-Gardea, Sergio. 1987. Evaluation of Short Duration Grazing on an Oak-bunchgrass Range Type in the Central Region of Chihuahua, Mexico. M.S. Thesis. Texas Tech University, Lubbock.

Moroccan:

1. Mounsif, Mohamed. 1986. Carbohydrate Trends in Artemisia candata. M.S. Thesis. Texas Tech University, Lubbock.

American:

1. Carey, J. 1984. Effects of Range Management Practices on Wool Production. M.S. Thesis. Texas Tech University, Lubbock.
2. Pitts, J. 1984. Cattle and Vegetation Response Continuous Grazing. M.S. Thesis. Texas Tech University, Lubbock.
3. Reiner, R. 1985. Nutrition of Alpacas Grazing High Altitude Rangeland in Southern Peru. Ph.D. Dissertation. Texas Tech University, Lubbock.

4. Wilcox, B. 1982. Plant Communities and Soils of the Central Andes of Peru. M.S. Thesis. Texas Tech University, Lubbock.

TRAINING 1986/87

1. Degrees in U.S.

Bojorquez, Custodio
Citizenship: Peru
Degree Objectives: M.S. - Forages
Host Institution: IVITA
Dates: Jan. 1984 - Dec. 1986 (graduated)

Soltero, Sergio
Citizenship: Mexican
Degree Objectives: M.S. Range
Host Institution: INIP-SARH
Dates: Dec. 1984 - May 1987 (graduated)

San Martin, Felipe
Citizenship: Peru
Degree Objectives: Ph.D. Range Science
Host Institution: IVITA/San Marcos
Dates: Jan. 1984 - Dec. 1987

Villena, Francis
Citizenship: Peru
Degree Objectives: M.S. Range Science
Host Institution: INIPA
Dates: Jan. 1986 - Dec. 1987

Mounsief, Mohammed
Citizenship: Morocco
Degree Objectives: M.S. Range Science
Host Institution: Mekness
Dates: Jan. 1985 - Aug. 1986

2. Short-term

Villena, Corolla
Citizenship: Peru
Degree Objectives: Laboratory Technician
Host Institution: INIPA
Dates: Jan. 1986-Feb. 1987

3. Degrees in Peru

Ccari, Estaban
Citizenship: Peru
Degree Objectives: ING-Range
Host Institution: UNA-Puno
Dates: Jan. 1986-May 1987

Atamari, Godofredo
Citizenship: Peru
Degree Objectives: M.S.-Range
Host Institution: UNA-Puno
Dates: Jan. 1985-Dec. 1987

Condori, Hector
Citizenship: Peru
Degree Objectives: ING-Range
Host Institution: UNA-Puno
Dates: Jan. 1986-May 1987

Paricahura, Claudio
Citizenship: Peru
Degree Objectives: ING-Range
Host Institution: UNA-Puno
Dates: Jan. 1986-May 1987

Velande, Roberto
Citizenship: Peru
Degree Objectives: ING-Range
Host Institution: UNA-Puno
Dates: Jan. 1986-May 1987

Silva, Angostine
Citizenship: Peru
Degree Objectives: ING-Range
Host Institution: INIPA
Dates: Jan. 1985-Dec. 1987

1986/87 ANNUAL REPORT

Title: Sociological Analysis of Small Ruminant Production Systems

Principle Investigator: Michael F. Nolan

U.S. Institution: University of Missouri-Columbia

Host Country Institution: INIPA

Personnel: Host Country Co-Workers:
J. Flores, Univ. of Cusco
J. Portugal, Direccion de Comunidades Campesinas y Nativas (DCCN)

U.S. Co-Workers:
M. Fernandez, UMC Research Assoc.
K. Jamtgaard, UMC Research Assoc.
C. McCorkle, UMC Research Asst. Prof.

RESEARCH: :

Integrated Research in Peasant Communities

In spite of major changes in the orientation and funding of this effort, important work did continue during this past year. Due primarily to budget cuts, the SR-CRSP was unable to continue directly supporting the community project during 1986-87. The SR-CRSP had been working with peasant communities in three areas of Peru: the Mantaro Valley near Huancayo, Písaq near Cusco, and Quishuara near the La Raya station also in Southern Peru. Although clear from the beginning that the SR-CRSP would not be a permanent presence in the communities, the departure was nonetheless unfortunate. Some two dozen families had participated in lengthy interviews during the previous twelve months and there were hopes that these communities would be participants in the validation of improved livestock production procedures. Fortunately, resident scientist Maria Fernandez was able to obtain emergency funding from Oxfam America, which prevented the total collapse of the effort underway since 1983. Unfortunately, Oxfam support was obtained only for the Mantaro Valley site, and the technology validation efforts at the other two sites had to be discontinued. Maintaining a continuing presence in representative peasant communities is critical, since field testing alternative production techniques with limited-resource producers may someday be desired. Cooperation with peasant communities may resemble other multiple-institution efforts. Yet the ability to work with peasant institutions depends upon establishing a working relationship over a period of time, during which representatives of each institution establishes a pattern of trust with the other. Once this has been abrogated, re-establishing a working relationship is difficult. Working with new communities is also difficult, since in addition to a background of trust, baseline production data from years prior to interventions is also absent.

Oxfam support sponsored continued work with women's production groups within the community of Aramachay. These groups met on a regular basis with local livestock experts, and discussed methods for improving livestock production. It is expected that experience gained in this area will serve as the basis for a technology validation process, based in the Huancayo area, to resume in the near future.

The Rural Sociology project also undertook a programmatic change in strategy in 1986/87, and this was reflected in work in Peru. Publishing results from previous research was given a high priority. Thus, four monographs were published relating to community project research. Perceiving the need to develop a publication series useful for extensionists in Peru, emphasis was given to publishing in Spanish, as well as developing a low-cost format for the bulletins.

The first of these was an overview of the production zones in the Mantaro Valley (Fernandez and Huaylinos, 1986). Using secondary data, the valley was classified into three distinct agro-ecological zones: the valley floor, an intermediate mixed production zone, and a high altitude zone. The social and production organization within each of these zones was examined. This provides an important regional backdrop against which to evaluate work which has been done in the communities by the SR-CRSP since 1983. Also included were topics such as the history and operation of the "communal farms" which are a common feature of communities in the region; and a discussion of which products reach markets, and the means by which they do so.

Fernandez, Gutierrez, and Swindale (1986) focus on the second of these zones, the intermediate zone, dominated by agro-pastoral peasant communities, which have been of particular interest in the past for the Rural Sociology Project. Documented are features such as access to irrigation, agricultural and livestock technologies employed, and current production practices.

A third publication elaborated an approach for conducting research and intervention in communities. Termed "Participatory Action Research," this model goes beyond on-farm-trials to explore the usefulness of including peasant farmers in the problem definition and basic research stages. It strives to directly address some of the organizational problems often associated with peasants, by increasing self-confidence, organizational capabilities, and awareness of a collective ability to overcome problems. The utility of this approach was documented for the central Sierra site, and results were published in Spanish (Fernandez, 1986).

Finally, a bulletin (Bilinsky, 1986) was released based upon a study of labor and other non-monetary exchanges in the agro-pastoral community of Aramachay in the central Sierra. The complex arrangements for exchanging services and products in the agro-pastoral peasant economy were elaborated.

Synthesis of Results

As part of a plan to more systematically disseminate the results of

research already undertaken in Peru, a first draft of "Pastores de Llamas Y Alpacas en los Andes Centrales" (Flores Ochoa, editor) was completed as of October 1986. Also, four monographs in the INIPA/SR-CRSP Community Studies series (Fernandez, editor) reached print in 1986, and others are in progress.

In the U.S., the Rural Sociology Project in Peru was well represented in a special Project session at the 1986 Farming Systems Research and Extension Symposium: Food and Feed and in the related anthology now in preparation under the working title, "Plants, Animals, and People: Crop-Livestock Systems Research on the SR-CRSP Sociology Project" (McCorkle, in progress). Chapters on the Project's research in Peru account for approximately half of the book.

Likewise, two chapters on salient aspects of SR-CRSP/Peru sociological research (ethnoveterinary research and development, and a nation-wide typology of peasant production systems) are included in the cross-CRSP anthology "Bringing People In: Social Research in International Agricultural Development" (working title). This anthology is an outgrowth of a three-day conference organized and hosted by the UMC Sociology Project in October 1986.

Cooperation with the Peruvian Agency for Peasant Communities

The Rural Sociology project has been collaborating since 1983 with the Direccion de Comunidades Campesinas y Nativas (DCCN) regarding a unique database of agricultural indicators that was gathered by that agency in 1977. Included were 2,716 officially recognized peasant communities, over 99 percent of the population. While additions and modifications to the database were made several years ago, obtaining access to computers and software capable of handling the database continued to be a problem for the agency. Therefore, the Rural Sociology Project developed an alternative for storing and accessing the data by means of floppy diskettes, which can be processed by micro-computers. While this did not solve the problem of limited access to micro-computers and software, it was agreed that these problems were of a lesser magnitude than was previously the case. Therefore, rather than being forced to rely upon long-distance relationships with foreign institutions, the DCCN has been able to increasingly make better use of its own resources and data.

Also related to the Rural Sociology/DCCN cooperation, a presentation of research results relating to the development of a typology of Peruvian production systems was presented at the 1986 Farming Systems Research and Extension conference, and included in the proceedings of that conference. A draft chapter was also prepared for inclusion in the anthology (presently in progress) at UMC.

PUBLICATIONS:

Books and Chapters in Books

- Guillet, D. W. 1987. On the Potential for Intensification of Agropastoralism in Arid Zones of the Central Andes. In D. L. Browman, (ed.), Arid Land Use Strategies and Risk Management in the

- Andes: A Regional Anthropological Perspective. Westview Press, Boulder, CO pp 81-98.
- McCorkle, C.M. 1987. Punas, Pastures, and Fields: Grazing Strategies and the Agropastoral Dialectic in an Indigenous Andean Community. In D. L. Browman, (ed.), Risk Management and Arid Land Use Strategies in the Andes: A Regional Anthropological Perspective. Westview Press, Boulder, CO. pp 57-79.
- Perevolotsky, A. 1987. Herder-Farmer Relationships in the Tropical Desert of Piura, Peru: The Role of Uncertainty and Variable Environment. In D. L. Browman, (ed.), Risk Management and Arid Land Use Strategies in the Andes: A Regional Anthropological Perspective. Westview Press, Boulder, CO pp. 25-56.

Journal Articles and Proceedings (Refereed)

- Fernandez, M. E. 1987. Division del Trabajo por Sexo (Gender Division of Labor). Mujer y Sociedad 7(12):43-44.

Abstracts

- Fernandez, M.E. 1986. Tema Central: La Investigacion-Accion-Participativa y el Enfoque de Sistemas de Produccion con los Campesinos Altoandinos (Central Topic: Participative Research-Action and the Farming Systems Focus with Highland Peasants). Carta de RISPAL Red de Investigacion en Sistemas de Produccion Animal en Latinoamerica 2(Dec):3-7.

Technical Communications

- Bilinski, P. 1986. Trueque e Intercambio No-Remunerado de Mano de Ubra en una Comunidad Altoandina del Peru (Barter and Non-Monteary Exchange of Labor in a Highland Peruvian Community). SR-CRSP/INIPA Technical Report No. 86, Community Studies Series. Lima (75 pp).
- Fernandez, M.E. 1986. La Investigacion Accion Participativa y el Enfoque de Sistemas de Produccion con los Campesinos Altoandinos (Participatory Action Research and the Farming Systems Approach with Highland Andean Peasants). SR-CRSP/INIPA Technical Report No. 61. Community Studies Series. Lima (86 pp).
- Fernandez, M. E. and H. Salvatierra. 1986. The Effect of Gender-Related Production Management on the Design and Implementation of Participatory Technology Validation. Selected Proceedings of Kansas State University's 1986 Farming Systems Research Symposium -- Farming Systems Research & Extension: Food and Feed. Kansas State University, Manhattan, KS. pp 739-750.
- Fernandez, M.E. and N. Gutierrez, and A. J. Swindale. 1986. Como Son las Comunidades de la Zona Intermedia del Valle del Mantaro? (What Are the Intermediate Zone Communities of the Mantaro Valley Like?) SR-CRSP/INIPA Technical Report No. 62, Community Studies Series. Lima (61 pp.).

Fernandez, M.E. and A. A. Huaylinos. 1986. Sistemas de Produccion Agropecuarios y Zonas Agroecologias del Valle del Mantaro. (Agropastoral Production Systems and Agro-ecological Zones of the Mantaro Valley). SR-CRSP/INIPA Technical Report No. 60, Community Studies Series. Lima (71 pp).

Jamtgaard, K. 1986. Agro-Pastoral Production Systems in Peruvian Peasant Communities. Selected Proceedings of Kansas State University's 1986 Farming Systems Research Symposium -- Farming Systems Research & Extension: Food and Feed. Kansas State University, Manhattan, KS. pp 751-765.

McCorkle, C.M. 1986. Integrative Strategies of Labor Organization for Crop-Livestock Production in an Indigenous Andean Community. Selected Proceedings of Kansas State University's 1986 Farming Systems Research Symposium -- Farming Systems Research & Extension: Food and Feed. Kansas State University, Manhattan, KS. pp 513-531.

TRAINING:

Martha Abuhadba, M.S. Program, Dept. of Rural Sociology, University of Missouri-Columbia. September 1986-present.

Manuel Estofanero. M.S. Program, Dept. of Rural Sociology, University of Missouri-Columbia. September 1986-present.

1986/87 ANNUAL REPORT

Title: Systems Analysis and Synthesis of Small Ruminant Production Systems

Principal Investigator: T. C. Cartwright

U.S. Institution: Texas Agricultural Experiment Stations (TAES)
Texas A&M University System

Host Country Institution: INIPA, Peru

Personnel: Host Country Co-Workers
L. F. Coronado, Research Officer UNA,
Estacion de Altura, Huancayo

U.S. Co-workers
H. D. Blackburn, Co-investigator,
Research Scientist, TAES
F. C. Bryant, Professor, Texas Tech
Universtiy
F. Ruvuna, Resident Scientist, Kenya,
TAES
E. L. Lentz, Graduate Assistant, TAES
P. J. Howard, Graduate Assistant, TAES

RESEARCH RESULTS

The Systems Analysis project was involved at three work sites in FY 86-87: Peru, Brazil and Kenya. The major emphasis of the project has been to apply the developed and validated simulation models in different SR-CRSP countries. The simulations were performed to integrate information generated by other SR CRSP and host country projects into a form which could lead to more complete analysis and formulation of recommendations concerning the application of technologies as balanced sets. In addition to computer simulations a short course in August, 1986, was held at Texas A&M to instruct interested persons on the use of the sheep and goat simulation models. Participants attending were from West Germany, Mexico, Zimbabwe, Morocco, Tanzania and the U.S. This effort enhances regionalization and practical application of SR CRSP results.

Peru Systems Analyses

Discussions with the Range Science componenet of the Peru CRSP indicated a need to know how sheep would respond to various ryegrass supplementation practices; i.e., how to translate forage research results into optimal use by sheep. With forage data collected by Texas Tech as input parameters for the sheep simulation model, we simulated how various supplementation practices, using ryegrass pastures, would affect biological and economic aspects of sheep production on the Altiplano. Of major interest was how or if sheep should be supplemented

in the dry season. Additional simulations were performed to determine how breeding ewes as lambs would affect the production system. Major results of the study showed that supplementing the flock in the dry season was not beneficial biologically or economically; the net return for such practices lost from \$14.50 to \$52.10 per 100 head of sheep. Lambs sold per ewe and lamb weight sold per ewe were lower when ewes were first bred as lambs, but this adverse effect could be more than overcome by supplementing ewe lambs under one year of age from April through October. This simulated experiment indicates that a profit of \$53.30 per 100 head of sheep could be achieved (Blackburn, Cartwright and Bryant, 1987). This study illustrates two general points. First, it is an example of the application of systems analysis to utilize information from a specific discipline and extend it to examine practical animal production problems. Also, it illustrates how two (or more) practices can be integrated and evaluated to develop technology packages.

PUBLICATIONS

Refereed Journals

- Blackburn, H.D. and T.C. Cartwright. 1987. Description and validation of the Texas A&M Sheep Simulation Model. *J. Anim. Sci.* 65:373.
- Blackburn, H.D. and T.C. Cartwright. 1987. Simulated genotype, environment and interaction effects on performance characters of sheep. *J. Anim. Sci.* 65:387.
- Blackburn, H.D. and T.C. Cartwright. 1987. Simulated production and biological efficiency of sheep flocks in a shifting environment. *J. Anim. Sci.* 65:399.
- Cartwright, T. C. and H. D. Blackburn. 1987. Systems analysis for developing goat production. *Proc. IV Int'l. Conf. on Goats* 11:905.
- Cartwright, T. C. and H. D. Blackburn. 1987. Portability of animal breeding research to developing countries. *J. Anim. Sci.* (Submitted).
- Blackburn, H.D. and T.C. Cartwright. 1987. Simulation on an individual animal level as an aid in determining breeding objectives. *J. Anim. Sci.* (Submitted).
- Blackburn, H.D. and T.C. Cartwright. 1986. Impact of environmental stress on the performance of sheep with different mature sizes and milk production potentials. *3rd World Congress on Genetics Applied to Livestock Production* 11:510.
- Blackburn, H. D. and T.C. Cartwright. 1987. Evaluating sheep production enterprises using the Texas A&M sheep computer simulation model. *SID Research Digest* 3:2:23.

Monographs

Blackburn, H. D., T. C. Cartwright, G. M. Smith, N. McC.Graham and F. Ruvuna. 1987. The Texas A&M Sheep and Goat Simulation Model. Texas Agr. Exp. Sta. Bul. no. 1559. (158 pages).

Extension Bulletins

Lentz, E. L. and H. D. Blackburn. 1987. User Guide for specifying input parameters for the TAMU Sheep and Goat Simulation Models, SAV Version. Small Ruminant CRSP. Tech. Rep. 90. (14 pages)

Blackburn, H. D., T. C. Cartwright, P. J. Howard and F. Ruvuna. 1987. Development of dual purpose goat production for smallholders in Western Kenya using computer simulation and system analysis. Small Ruminant CRSP. Tech. Rep. 89, (47 pages).

Blackburn, H. D. and T. C. Cartwright. 1986. A conceptual overview of the TAMU sheep production model. In: Sheep and Goats, Wool and Mohair. Texas Agric. Exp. Sta. CPR 4371-4411.

Blackburn, H. D. and C. R. Field. 1986. The performance of Somali Blackhead sheep and Galla goats. Integrated Project on Arid Lands. Rep. No. E-8.

Blackburn, H. D. and T. C. Cartwright. 1986. Simulated effects of drought on sheep production. Integrated Project on Arid Lands. Rep. No. E-8.

Abstracts

Blackburn, H.D., T. C. Cartwright, and F. Ruvuna. 1987 Simulation of breed, nutrition and management effects on milk production and weaning weight of dual-purpose goats. Proc. IV Int'l. Conf. on Goats II:1541.

Blackburn, H. D., L. C. Fierro, T. C. Cartwright, F. C. Bryant and E. Figueiredo. 1986. Simulacion computatizada de epocas de empadre y programa de suplementacion nutricional en al produccion de ovinos Corriedale an el sur de Peru. In. Xth Reunion ALPA. (pp. 31).

Blackburn, H. D., P. J. Howard, T. C. Cartwright and F. Ruvuna. 1987. Simulation of the effect of flock size and nutrition on goat productivity in Kenya. Proc. IV Int'l. Conf. on Goats II:1540.

Tallam, S. K., T. C. Cartwright and C. D. Lu. 1987. Validation of TAMU Goat simulation model for intensive dairy goat production. Proc. IV Int'l. Conf. on Goats II:1539.

Fierro, L. C., F. C. Bryant., H. D. Blackburn and T. C. Cartwright. 1986. Systems analysis and computer simulations of herded sheep in southern Peru. 39th Society for Range Mgt. (p. 233).

- Cartwright, T. C., Ruvuna, P. J. Howard and H. D. Blackburn. 1987. Designing breeding strategy for a synthetic dual purpose goat. J. Anim. Sci. 65 (Suppl. 1):202.
- Blackburn, H. D., T. C. Cartwright and F. C. Bryant. 1987. Productivity of Corriedale sheep using ryegrass pastures as a supplement. J. Anim. Sci. 65 (Suppl. 1):445.
- Howard, P. J., T. C. Cartwright, H. D. Blackburn and E. L. Lentz. 1987. Interactions among genotype and nutrition for dual purpose goat productivity. J. Anim. Sci. 65(Suppl. 1):431.
- Cartwright, T. C., H. D. Blackburn and F. Ruvuna. 1986. Development of dual pupose goat production in Western Kenya - system analysis perspective. Proc. 5th SR-CRSP Workshop, Kabete (in press).
- Cartwright, T. C., P.J. Howard, H. D. Blackburn, E. L. Lentz. 1986. Viability of dual purpose goat production in Western Kenya - system analysis perspective. Proc. 5th SR-CRSP Workshop, Kabete (in press).
- Tallam, S. K., T. C. Cartwright, J. F. M. Onim and M. N. Mathuva. 1986. A prospective analysis of semi-intensive dairy production. Proc. 5th SR-CRSP Workshop, Kabete (in press).
- Tallam, S. K., F. Ruvuna, T. C. Cartwright and J. F. M. Onim. 1986. Effect of early weaning kids for dual purpose goat production in western Kenya. Proc. 5th SR-CRSP Workshop, Kabete (in press).
- Cartwright, T. C., P. J. Howard, F. Ruvuna and H. D. Blackburn. 1985*. Feasibility of Dual Purpose Goats for Small Farms of Western Kenya: A Systems Analysis of Meat and Milk Offtake Potential and Limiting Factors. Proc. 4th SR-CRSP Kenya Workshop, Kakamega (p 89).
- Blackburn, H. D., T. C. Cartwright, F. Ruvuna, A. W. Mukhebi and J. F. M. Onim. 1985*. Breed, Nutrition and Management Effects on Milk Production and Weaning Weight of Dual-Purpose Goats. Proc. 4th SR-CRSP Kenya Workshop, Kakamega (p.104).
- Tallam, S. K., T. C. Cartwright, C. D. Lu, P. J. Howard and H. D. Blackburn. 1985*. Validation of Kenya Goat Simulation Model for Application to Dairy Goat Production. Proc. 4th SR-CRSP Kenya Workshop, Kakamega (p 114).

Dissertation

- Rajab, M. H., 1987. Simulation of genetic and environmental interaction of three tropical hair sheep breeds for meat production (in Brazil). Ph.D. Dissertation. Texas A&M Univ., College Station (155 pages)**.

* These 1985 proceedings were not listed last year because they were not published.

** Cross-listed with the Breeding Project.

TRAINING

A Workshop on systems analysis and use of The Texas A&M Sheep and Goat Models for Simulation was held in August, 1986.

Participants were:

Wolfgang Pittroff, Univ. of Hohenheim, F.R.G.
(Applications are intended for Peru and Mali)
Carlos Fierro, Mexico
(Worked in Peru on Texas Tech Range Project)
Mario Beffa, Zimbabwe
A. Eddebbarh, Morocco
Fabian Pagama, Tanzania
P. J. Howard, U.S.
E. L. Lentz, U.S.

Individual tutorial instruction on model structure, functions and use took place in U.S., Kenya, Peru and Botswana.

H. M. Rajab, a citizen of Syria, completed his Ph.D. in August, 1987 using breeding data from SR-CRSP in Brazil to simulate sheep selection programs for Northeast Brazil. Mr. Rajab was funded from other sources (U.S. AID). (Rajab is also listed under Breeding Project.)

E. L. Lentz, U.S. permanent resident, is working toward a Ph.D. She received minor Breeding Project Funding. Expected date of completion is December, 1988. (Also listed under Breeding Project.)

P. J. Howard, U.S. citizen, is working toward a Ph.D. She received minor Breeding Project funding. Expected date of completion is September, 1988. (Also listed under Breeding Project.)

COLLABORATING ORGANIZATIONS

Federal (U.S.):

United States Agency for International Development
Science and Technology Bureau

Board of International Food and Agriculture

Joint Committee on Agricultural Development

Overseas Collaborators:

BRAZIL--Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA)

INDONESIA--Agency for Agricultural Research and Development (AARD)

KENYA--Ministry of Agriculture and Livestock Development (MALD)

MOROCCO--Institut Agronomique et Veterinaire--Hassan II University (IAV)

PERU--Instituto Nacional de Investigacion y Promocion Agropecuaria (INIPA)

State Subgranted Institutions:

University of California, Davis

Colorado State University, Fort Collins

Montana State University, Bozeman

University of Missouri, Columbia

North Carolina State University, Raleigh

Texas A&M University, College Station

Texas Tech University, Lubbock

Utah State University, Logan

Washington State University, Pullman

Winrock International Institute for Agricultural Development,
Morrilton, Arkansas

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William C. Weir	Program Director after 9/30/87
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Lindy Watts	Administrative Assistant
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