Small Ruminant

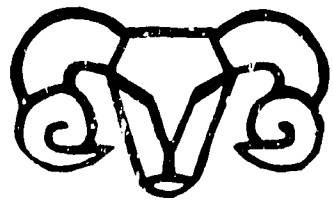
Collaborative Research Support Program

Annual Report for

Brazil

Program Year Seven

1985-1986



Small Ruminant CRSP
University of California
Davis, CA 95688

THE SMALL RUMINANT
COLLABORATIVE RESEARCH SUPPORT PROGRAM
(SR-CRSP)
ANNUAL REPORT FOR BRAZIL
PROGRAM YEAR SEVEN
1985-1986

Edited and Compiled by the Management Entity

SMALL RUMINANT

COLLABORATIVE RESEARCH SUPPORT PROGRAM

ANNUAL REPORT

BRAZIL 1985-1986*

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*Similar reports for Indonesia, Kenya, Morocco and Peru as well as a summary report of the full program are available from the Small Ruminant CRSP Management Entity, University of California, Davis, CA 95616.

SMALL RUMINANT CRSP

IN BRAZIL 1985/86

ANNUAL REPORT

INTRODUCTION

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

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

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

BREEDING

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

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

REPRODUCTION

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

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

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

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

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

HEALTH

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

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

RANGE

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

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

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

NUTRITION

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

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

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

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

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

ECONOMICS

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

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

MANAGEMENT

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

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

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

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

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

The work of several disciplines involved point out the biological potential and seem to provide some technological support for marked improvement in efficiency and offtake from the sheep and goat industries of the NE of Brazil. Socio-economic constraints and the slow pace of technology

transfer (Extension) appear to be the primary constraints. The latter is not a responsiblilty of the SR-CRSP. The socio-economic contraints may represent an inability of the individual producer to access the resources necessary to improve production or a concern about the risk factors involved. On a higher level, it may represent the absence of a market structure to reward the producer for these efforts. These factors are difficult for the SR-CRP to impact, and the most likely approach for SR-CRSP research is to work with the producer to improve his capability for improved production and to respond to market opportunities. In this connection, a number of approaches appear to be indicated. It has been shown that the low percentage of adult females in the breeding flock is a contributing factor to a low rate of offtake. Improved growth rate and earlier marketing of surplus animals offers the means of altering this picture. Numerous studies have shown that supplemental feeding during dry periods offers the potential for early improvements in reproduction, survival and growth. It may, in some cases, be feasible or economical to meet these needs through purchased supplements. More likely, this should be accomplished by farm grown feedstuffs. Research work has shown that a number of plant species offer potential in this respect. In most years, moisture is adequate for some type of production, and the necessary technology is available, though not necessarily at the producer level. Manipulation or management of the caatinga (selective or partial canopy removal) appears to offer the potential for marked improvement in offtake per unit area. There is a need for further research to show the long term effect of these practices on productivity of the caatinga. Research completed to date appears to provide guidelines for development or implementation of the necessary genetic improvement programs. There remains a need to implement the indicated programs. Opportunities for immediate genetic improvements appear to be limited largely to those producers interested in improving milk production through some type of crossbreeding and improved management system.

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

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

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

NAME	DEGREE	PROGRAM	TRAINING DATES	NATIVE COUNTRY
UNIVERSITY OF MISSOURI				
Neumaier, Marisa[1]	MS Rural Sociology	Missouri	6/81 - 8/83	Brazil
NORTH CAROLINA STATE UNIVERSITY				
Brown, Lynn E.	MS Animal Nutrition	North Carolina	9/78 - 12/83	US
Burstein, Helaine[2]	PhD Animal Nutrition	North Carolina	9/81 - 3/87	US
Gaskins, H.R.[1]	MS Animal Nutrition	North Carolina	8/81 - 5/86	US
Quiroz, Roberto	MS Animal Nutrition	North Carolina	5/82 - 8/84	Panama
daSilva, Jose. E.[1]	PhD Animal Nutrition	North Carolina	1/79 - 2/81	Brazil
TEXAS A&M UNIVERSITY/MANAGEMENT				
Barbosa, Eneas L. R.	MS Range Management	Texas A&M/Breeding	6/83 - 9/85	Brazil
Fernandes, Antonio Amaury Oria[1]	MS Animal Breeding	Texas A&M/Breeding	9/82 - 12/84	Brazil
de Figueredo, Elsio Antonio Pereira[1]	PhD Animal Breeding	Texas A&M/Breeding	7/84 - 5/86	Brazil
Lewis, Ron[1]	MS Animal Breeding	Texas A&M/Breeding	9/83 - 9/86	US
de Moraes, Elino A.[1]	PhD Range Science	Texas A&M/Breeding	9/81 - 9/85	Brazil
Norris, Therese[1]	MS Reproductive Physiology	Texas A&M Breeding	5/85 - 5/87	
Snowder, Gary	PhD Animal Breeding	Texas A&M/Breeding	9/84 - 9/85	US
de Sousa, Wandrick Haus	MS Animal Breeding	Texas A&M/Breeding	7/85 - 9/87	Brazil
Willingham, Timothy[1]	MS Physiology Reproduction	Texas A&M/Breeding	9/82 - 9/87	US
Reeh, Donald[1]	MS Animal Production	Texas A&M/Breeding	9/84 - 9/86	US

NAME	DEGREE	PROGRAM	TRAINING DATES	NATIVE COUNTRY
UTAH STATE UNIVERSITY/RANGE				
Gobena, Amanuel	PhD Range Science	Utah Range	1/84 - 6/88	Ethiopia
Hardesty, Linda Howell[2]	PhD Range Science	Utah/Range	12/81 - 9/86	US
Kirmse, Robert[2]	PhD Range Science	Utah Range	4/82 - 12/84	US
Kronberg, Scott[2]	PhD Range Science	Utah Range	9/83 - 12/88	US
Mesquita, Roberto[1]	MS Range Science	Utah/Range	9/82 - 6/85	Brazil
Oliveira, Ederlon[1,2]	PhD Range Science	Utah/Range	9/83 - 7/87	Brazil
Pfister, James A.[2]	PhD Range Secience	Utah/Range	9/79 - 6/83	US
Queiroz, Joao S. de[2]	PhD Range Science	Utah/Range	4/80 - 12/85	Brazil
Schacht, Walter[2]	PhD Range Science	Utah/Range	1/84 - 12/86	US
UTAH STATE UNIVERSITY/REPRODUCTION				
Clark, Dana	MS Reproduction	Utah/Reproduction	9/81 - 6/82	US
Ferris, Charles	MS Reproduction	Utah/Reproduction	9/79 - 6/83	US
Mole, Jane	PhD Reproduction	Utah/Repro	1/82 - 6/84	US
Simplicio, Aurino [1]	PhD Repro. Physiology	Utah/Reproduction	8/82 - 12/85	Brazil
UNIVERSITY OF CALIFORNIA/HEALTH				
Alves, Francisco Selmo A.	MS Comp. Pathology	UCD Health	5/85 - 5/88	Brazil
Brown, Corrie[2]	PhD Comp. Pathology	UCD Health	8/83 - 1/86	US
East, Nancy[2]	MPVM	UCD Health	8/79 - 1/80	US
Padilha C., Terezinha	PhD Comp. Pathology	UCD Health	1/82 - 12/85	Brazil
WINROCK INTERNATIONAL/ECONOMICS				
Gutierrez, Nestor[2,3]	PhD Agricultural Economics	Winrock/Economics	10/79 - 1/83	Colombia

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[1] Partial support
[2] Research conducted in Brazil
[3] Attended Purdue University

TRAINING OF OVERSEAS DEGREE CANDIDATES OVERSEAS WITH CRSP SUPPORT

STUDENT	PROGRAM/INSTITUTION	SUPPORT	DATES	NATIVE COUNTRY
NORTH CAROLINA STATE UNIVERSITY				
de Assis-Arruda, Francisco	MS Animal Husbandry Federal University of Ceara	North Carolina	1/80 - 12/83	Brazil
Guimaraes, Watson[3]	MS - Nutrition Ceara Federal Univ.	North Carolina	1/86 - 12/87	Brazil
de Vasconcelos, Maria Auxiliadora	MS Animal Science Fed. Univ. of Pernambuco,Recife	North Carolina & Utah Range	4/86 - 9/86 10/86 - 4/88	Brazil
UNIVERSITY OF CALIFORNIA/HEALTH				
Domingo, Santo	MS Clinical Pathology Fed. Univ. Of Pernambucei, Recife	UCD Health	6/85 - 5/87	Brazil
UTAH STATE UNIVERSITY/RANGE				
Mara, Sandra	MS Animal Science Fed. Univ. of Ceara	Utah/Range	1/84 - 3/86	Brazil
de Vasconcelos, Maria Auxiliadora	MS Animal Science Fed. Univ. of Pernambuco,Recife	North Carolina & Utah Range	4/86 - 9/86 10/86 - 4/88	Brazil
UTAH STATE UNIVERSITY/REPRODUCTION				
Alves, Jose U.	MS Mgmt. Reproduction Santa Maria University	Utah/Repro	5/82 - 4/85	Brazil

STUDENT	PROGRAM/INSTITUTION	SUPPORT	DATES	NATIVE COUNTRY
WINROCK INTERNATIONAL/ECONOMICS				
de Costa, Odorico	MS Marketing Federal University of Ceara	Winrock/Economics	11/80 - 2/82	Brazil
Moura Fe, Fatima	MS Animal Science Federal University of Ceara	Winrock/Economics	8/81 - 8/83	Brazil
Souza, Jose de	MS Marketing Federal University of Ceara	Winrock/Economics	9/80 - 2/82	Brazil
Valderi, Vieira da Silva	MS Production Systems Federal University of Ceara	Winrock/Economics	8/81 - 8/83	Brazil
TEXAS A&M UNIVERSITY/BREEDING				
Nascimento, Edna[1]	MS Range Management Federal University of Ceara	Texas A&M/Breeding	9/81 - 9/86	Brazil
TEXAS A&M UNIVERSITY/MANAGEMENT				
Wanderley, A Costa[2]	MS Rural Economics Univ. F. Paraiba	TAMU/Management	12/84 -	Brazil

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[1] Support for thesis research only

[2] Partial support

SR-CRSP SPONSORED SHORTCOURSES

COURSE	NUMBER OF PARTICIPANTS	SPONSORED BY	WHERE HELD	DATES
Reproduction	18	Utah/Cal Poly	Sobral, Brazil	9/80 (2 weeks)
Forage-Vegetation Sampling	16	Utah/Range	Sobral, Brazil	5/81 (2 days)
Diet Analysis Techniques	9	Utah/Range	Sobral, Brazil	3/82 (2 days)
Animal Breeding & Systems	21	TAMU/Breeding & Systems	Sobral, Brazil	5/82 (2 days)
Nutrition Part I: Nutrition Update for Sheep & Goats	20	North Carolina	Sobral, Brazil	7/82 (5 days)
Nutrition Part II: Practical Training in Feed Analysis Procedures	10	North Carolina	Sobral, Brazil	8/82 (5 days)
Methods of Measuring Caatinga Vegetation	25	Utah Range	Brazil	(3 days)
Techniques of Animal Diet Analysis	12	Utah Range	Brazil	(2 days)
State of the Art Workshop	25	Brazil Site	Brazil	April 86
SCHEDULED WORKSHOPS				
IV International Goat Conference		SR-CRSP financial support	Brazil	March 87

SR-CRSP SPONSORED INFORMAL TRAINING

SUBJECT MATTER	NUMBER OF PARTICIPANTS	TRAINER	PROJECT	LOCATION	DATES
Microbiological Laboratory Procedures	4	Mary Sawyer	UCD Animal Health	Sobral, Brazil	1983
Animal Experimentation Procedures for Trainees	2 to 6 per year	Carlos Zometa	TAMU Management	Pendencia, Brazil	1983-85
Nutrition Laboratory Techniques	4 technicians	Tom Robb	NCSU Nutrition	Sobral, Brazil	5/81-12/83
Range Sampling Procedures	3 students fulfilling experience requirement from Colegio Aricola Gailherme Gouveia	W. Schacht	Utah Range	Sobral, Brazil	July-Aug. 85
Training in establishing RIA laboratory and conducting RIA for selected Hormones	Angela Maria Eloy	Utah Repro	Utah/Reproduction	Utah	3/15/86 8/15/86

INDIVIDUAL TRAINING INCLUDING PARTIAL SUPPORT TO ATTEND PROFESSIONAL MEETINGS *a

NAME	TRAINING	PROJECT	DATES
E. Figueirido	Third International Conference on Goat Production and Disease, Tucson, AR	TAMU Breeding-Mgt.	Jan. 1982
A. Carneiro	Trainee in Reproduction, Brazil	USU Reproduction	- - - - -
W. Guimaraes	Research Techniques in Nutrition at CNPC, Sobral	NCSU Nutrition	- - - - -
R. Mesquito	Society for Range Management, Orland, FL	Utah/Range	2/8-15/86
Carlos A. Zometa	80th Annual Meeting of the American Dairy Science Association	TAMU/Systems	6/2/86

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*aSee also publication section for papers presented by SR-CRSP participants at meetings.

SR-CRSP

ANNUAL REPORT

1985-86

I. **Project Title:** Management & Breeding of Sheep & Goats to Maximize Meat & Milk Production for Arid or Tropical Environments

II. **Host Country:** Brazil

III. **Principal Investigator:** Maurice Shelton

IV. **Personnel:**

Host Country Co-Workers:
F. Arruda
E. Figueiredo
F. Melo Lima
N. Barros
A. Fernandes
F. Machado
M. Neto
P. Leite
W. Sousa
W. da Silva Correia
C. Zometa
J. Kawas

U.S. Co-Workers:
J. Huston
P. Thompson
T. Willingham
L. Ripley

V. **Introductory**

The TAMU project was initiated in Brazil as a breeding project which must be considered as a long term effort to be productive. More recently, the term management was added as an additional responsibility. Each of these will be discussed briefly in a long term context as well as the limited objectives for the 1985-86 period.

The presence of an adapted and productive genotype is likely to be the most important factor contributing to a successful livestock industry, particularly in an adverse environment. Also, the introduction of new or exotic genotypes is one of the most frequent interventions which has been attempted in agricultural development programs. Thus, the goal of the animal breeding components of this project in respect to Brazil, has been to develop and set in motion breeding programs which will enhance the development of adapted and more productive genotypes. In respect to the SR-CRSP, the overall goals have been to generate information or to establish principles which will contribute to the more efficient accomplishment of this task in other regions of the world. More specific or limited objectives for the 1985-86 period were

to analyze the data collected to date on hair sheep under the conditions of Northeast Brazil in order to calculate the pertinent genetic parameters with the goal of utilizing this information to develop appropriate selection programs. Breeding work in the U.S. is devoted largely to evaluating the utilization of more prolific genotypes (Barbados Blackbelly, Booroola Merino and Finnish Landrace) in comparison with selection within existing breeds to increase reproductive rates and to extrapolate results from these studies to other regions. A second goal of work in the U.S. has been to look at reproductive wastage to determine to what extent an increased ovulation rate results in an increase in overall productivity. The latter is a particularly critical question in respect to those strains with high ovulation rates. Breeding work with goats has not progressed to the same degree as that with sheep either in the U.S. or Brazil. Breeding work with goats in Brazil is still largely concerned with breed comparisons particularly with respect to their use in crossbreeding or in new breed formation. Some work in the U.S. has been concerned with genetic parameter estimates with goats.

In respect to management, the initial thrust in this project was in support of the dairy goat program in Paraiba. Good progress has been made in this area with respect to the technical aspects of production, but socio-economic aspects present identifiable constraints. However, our interest in the term management deserves or requires a much broader interpretation than mere support for the dairy program in Paraiba as essentially all interventions would be implemented at the farm level through what might be broadly interpreted as management. This would encompass in addition meat production from sheep and goats and the level of supplemental feeding which can be justified. The latter poses few technological questions, but does require consideration of the costs and realized response. Some work on an overall production system which encompasses the many aspects of management is still needed. Research relating to these questions is being conducted at Sobral, Quixada, Paraiba and in the U.S.

VI. Research Accomplishments

Good progress has been made in the past year in analyses and reporting of collected data. Some of the reports completed during the year are shown in the publications section. Some results will be reviewed in the same general order as they occurred in the workplan for this year. The numbers in parenthesis refer to the specific identification of the report covering this work which is found in the list of publications. The data are too voluminous to cover in this report. Copies of pertinent reports can be provided.

Work in the multidisciplinary collaborative project under the leadership of Dr. Kawas (125) has shown that the provision of energy supplements to goats contributed to improved reproductive efficiency primarily through reduced mortality. Energy supplementation also tended to reduce the interval from parturition to first estrus (potential kidding interval) along with some increase in kidding rate. At high levels, the supplemental energy may only result in a substitution for forage. Many other aspects of this study will be reported at a later date.

Other work in which Dr. Kawas has collaborated has been concerned with evaluating the feeding value for sheep and goats of a number of native and cultivated plants (112). Included are introduced and cultivated forages such

as Cunha, sorghums and native brush or browse plants. Reduced forage quality was attributed to a decreased dry matter intake and digestibility, decreased nitrogen content and increased rumination and total chewing activities. Decreased intake appeared to be associated more with an increase in cell wall components, and a reduction in digestibility more with lignification. Dry matter intake and digestibility were affected by stage of maturity and forage specie. Dry matter intake was lower for the grass forages and digestibility was lower for the range species.

In another study, an 84 day growth and digestion trial was conducted to determine the influence of level of energy supplementation on forage and total diet dry matter intake by Somali hair sheep (113). The design was completely randomized with four treatments. All animals were offered a protein supplement at 0.5% of the body weight and an energy supplement (cassava meal) at 0.4, 0.8, 1.2 and 1.6% of the body weight. Napier grass greenchop was offered ad libitum. Forage and total dry matter intake were significantly ($P<.05$) decreased with an increase in energy supplementation. Dry matter disgestibility, digestible dry matter intake, body weight and feed efficiency were increased ($P<.05$) with an increase in the level of energy in the diet. Empty body weight was greater ($P<.05$) for lambs fed increasing levels of energy.

Several other studies have been completed and are in process of being analyzed and summarized at the present time.

Work in Pariba has been reduced in scope in this time period since Dr. Zometa was not present at that site during this budget period. However, some work has been continued and some data have been summarized.

A field trial was completed with goats in which a complete mineral mixture was evaluated on three sites in comparison with appropriate controls In this study, no response was obtained in weight gains as a result of providing a complex mineral mixture. Supporting laboratory work has not been completed. The absence of a response in this one study should not be taken as conclusive that mineral supplementation is not needed, but it is at least suggestive that a marked response to minerals is unlikely.

Some data have been summarized during the year (*, 55) relating to milk production from goats in the Northeast. Producer surveys indicate an interest in the possibility of cheese production from goats, but a reluctance to undertake fluid milk production. They indicated the primary constraints to be (a) the genetic potential for milk production of the animals available, (b) feed resources and (c) technical information. Limited data indicate a low level of milk production by local or indigenous types, and selection within native types would be expected to yield slow progress. Several studies have shown that exotic types (Alpine or Anglo Nubian) and crosses between these and local (SRD) give an increased milk yield. The Alpine has a much higher milk yield than Anglo Nubian, but a lower solids content. A number of these exotics or their crosses are already found under farm conditions, at least on

*Zometa, C.A., M.G.G. Cunha, M. Shelton, W.H. Sousa and P.R.M. Leite, 1986. Basic Economic Configerations of Goat Milk Production in Semi-Arid Brazil. Manuscript Prepared.

those which have expressed an interest in milk production. Experience and research to date indicate that the exotics or their crosses can be successfully produced if they are provided with a high level of care. Limited experimental data (unreported) has shown that the Alpine should not be utilized unless some improved feeding can be employed. It is not clear at present if the same applies to crossbreds. Thus, the potential exists to correct the first limitation, but this question is highly interrelated with the other limitations identified. Several studies (138, 55, 84, 124) have been conducted in which rations have been formulated and tested. In general, available information is not the primary limitation.

In those cases where rations have been formulated using purchased ingredients, the costs exceeded the product value obtained in all except the high producing types such as the Alpine. Even in the latter case, the feed costs represented a higher cost of production than could be justified. Thus a producer would be faced with the necessity to use by-product or home grown feeds. Several studies have been conducted looking into this possibility (55, 138). Urea or cultivated high protein forages may be used to some extent to reduce the reliance on oilmeal proteins. Algaroba, cassava or molasses can be utilized to replace the grain portion of the ration. Economic interpretation of the potential for use of these by-products or home grown feeds has not been made. Technology availability at the farmer level may indeed be a limitation because it is not available to him or that it cannot be implemented by him. However, technology is generally available if socio-economic limitations do not impede the transfer of information or its adoption by the farmer. At present, this is a serious problem with respect to method of forage preservation. It is difficult to make hay during the rainy season and equipment is limited for making silage. Some research on this problem is needed. Work in Paraiba and at Sobra (CNPC) has shown that Cunha (Clitoria ternatea) hay or forage can substitute for purchased inputs of oil meals such as cottonseed meal. A wild (non-cultivated plant) legume known as mata pasta (Cassia sp.) is not consumed as green forage, but can be used to a limited part of the ration in the form of hay or silage.

Data collection has been completed on a genotype x environment interaction study in which three types of lactating goats (Alpine, SRD and crossbreds) were used. Preliminary analysis indicate the expected difference between the genotypes in respect to milk production. Supplementation of the goats grazing caatinga made a large difference in performance. There is evidence of a genotype x environment interaction in which the level of milk production by the Alpines declined more rapidly in the absence of supplementation. They were also slower in rebreeding with reduced overall breeding efficiency following a lactation period in the absence of supplemental feeding.

Management of kids is a major problem in attempts to produce milk from goats. Some studies have been completed dealing with this point (*, 55, 75). In general, these studies have shown that kids can be early weaned if feeding and management levels are adequate. Whey can be used as a partial substitute for milk.

Fencing is often a major problem with goat production. Cost figures have been obtained comparing various styles of fencing including electric fencing (140), with projections expressed as a function of area fenced and

stocking rates. Studies were initiated dealing with methods of preservation of wood fences. Results of this type of study would be available at some time in the future. Results obtained to date are being summarized in a paper to be presented at the IV International Goat Conference (102).

QUIXADA - MANAGEMENT

A number of problem areas have been identified in respect to the use of goats for meat production (65, 115). Among these are abortion contributing to low kidding rates, high kid mortality, slow growth rate and low carcass yields. Some work has been completed in the U.S. relating to abortion (95, 96).

Energy level in the ration significantly affects level of abortion. A period of feed restriction also elevated abortion, but in this study exercise was not shown to have an effect. Other work conducted in the U.S. has shown that real-time ultrasonic scanning can be successfully used in pregnancy testing of goats. However, this work suggests that it may not be practical to use it for this purpose under practical producer conditions, but it may be useful in research relating to abortion. High mortality has been observed at other locations, but the causes and potential corrective measures need to be explored. Work completed in Brazil (collaborative project) suggests that the provision of supplemental energy contributes to improved reproductive rates with much of the effect shown to be derived from improved kid survival. Crossbreeding studies have shown that the use of exotic breeds such as the Anglo Nubian will increase kid growth rates. Selection within strains or breeds seems less encouraging.

Studies are being conducted at Quixada relating to choice of breeding season for both sheep and goats. Results are not yet available.

In work completed in the U.S. (23) heritabilities of weights in goats were generally low. Earlier studies have also suggested low heritabilities for carcass traits. Most of typical environment variables affect birth and weaning weight, growth and survival. Also, in this study, later kiddings produced more weight through increased twinning and improved kid survival. However, the desirability of delaying breeding season may be affected by market dates or the interaction of market requirements with weight or condition of the animals. Overall reproduction problems may relate to level of nutrition and development Data collected in the U.S. (173) derived from meat goats were analyzed to determine the relationship of age and weight at breeding. In this study, involving 305 meat type goats, size at fall breeding had a great influence on kid production at one year of age. Age was largely without effect except as explained by size. The percent of does kidding at one year of age was less than 15% for those weighing less than 15 kgs. at the time of exposure to males as compared to over 75% for those weighing 25 kgs. or more. An important relationship also exists between body weight and reproductive performance of adult animals which includes not only the % kidding but the number of multiple births as well. These data are interpreted as though the variation in size relates to environmental modification of the same genetic size, and should not be interpreted to apply to goats with inherent differences in body weights. These data relating to the importance of development would be expected to apply to other types of goats, but the actual weight values would likely differ for other breeds or genotypes.

SOBRAL - MANAGEMENT

One study was conducted during the year to study the effect of a number of variables (presence of shade, time of day and level of feed intake) on body temperature, respiratory rate and growth rate of hair sheep in Brazil (111). All the environmental variables studied influenced respiratory rate. However, with increase in respiratory rate, the animals were generally able to maintain their body temperature within the normal range. Respiratory rates were not excessive suggesting that under the study conditions temperature stress was not a major problem. It should not be assumed that the same would be true of the grazing animal.

U.S. - MANAGEMENT

Among ewes which are reasonably well or adequately developed for the breed, increased feeding at or prior to breeding (flushing) improved reproductive level for those bred early in the breeding season (relative to photoperiod) but had much less effect during the peak of the breeding season (189).

Chemical castration was investigated (181) for potential use in developing areas. One particular interest was in connection with delayed castration until preliminary selection of breeding animals could be made. In this particular case, the results were not satisfactory, but it may be found more suitable for use earlier in life.

An experiment is underway to contra. two levels of management for meat and fiber producing goats. The results are not yet available for analyses.

In another case, an experiment was performed to study the effects of amount of crude protein supplementation (133, 100, and 67% of NRC requirements) and the time that supplementation was initiated (mid- or late gestation, or at parturition) on ewe and lamb performance. Preliminary results show no consistent differences in weight, but there was some increase in fleece weight with increasing protein level and increasing duration of supplementation. Lamb growth rates (average daily gain, ADG; 14 and 28 day adjusted weights) were consistently improved in lambs raised by ewes receiving the higher protein supplements for a longer period of time. Also, differences in ADG between single and twin lambs were smaller in the low protein and control groups than in the high protein groups.

BRAZIL - BREEDING

A number of manuscripts relating to genetic improvement of hair sheep have been prepared from the graduate programs of A.A.O. Fernandes (114, 115) and E.A.P. Figueiredo (22, 121) who have completed advanced degrees in Animal Breeding at Texas A&M. The environmental factors and genetic parameter estimates obtained from these data generally conform to the values obtained from the literature which previously were largely derived from wool sheep. In general, the heritability estimates were reasonably high indicating a good potential for selection. Reproductive performance tended to be reasonably good in comparison to Brazilian conditions. However, body weights or weight gains were low requiring that the animals be kept for a long time prior to market or slaughter. There is an immediate need for improvements in

management to correct this problem. Studies are being initiated relative to breeding dates and supplemental feeding schedules.

Simulation studies (121) based on data obtained at Sobral and Quixada indicate that in terms of efficiency of production, caution should be exercised in long term selecting for increased size. The genetic level for milk production was without a marked effect on efficiency. On the other hand, the genetic potential for increased lamb production, based on simulation results, did improve the efficiency of meat production. As a word of caution, these studies involved input data for lamb survival from the experimental flock at Quixaeda (EPACE), which was better than average in respect to lamb survival. Thus the results might have been different utilizing a different set of inputs.

Some more recent analyses have been completed during the year relating to the goat crossbreeding project at Quixada (65, 115). These data point out some of the problems relating to reproduction. Breed differences are indicated in prolificacy, growth and mortality.

Two breeding projects were included in the work plans which were to be conducted at Sobral. One of these had to do with initiating a selection program to develop a meat type goat from a crossbred foundation. However, during the year the emphasis was switched from meat to milk, and in any case no data have been generated to the extent that any type of analysis could be attempted. Hopefully, the work on development of a meat type goat can be carried on at another location.

The second project related to improvement of sheep at the farm level by use of improved rams to increase the growth rate and eliminate genetic defects. Although this was originally projected to utilize rams of each of the three recognized breeds participating, farmers have all requested sires of the Santa Ines breed. Thus the experiment has resolved itself into an evaluation of the results of crossing to this breed at the producer level. Results to date have been very positive and encouraging in respect to growth rates (127). No unusual problems have been encountered in respect to reproductive performance or survival. However, with continued grading up to Santa Ines males, the flock structure will shift from Crioula to percentage Santa Ines females. Thus this project should, based primarily on time trends, provide an evaluation of the results of such grading up process. This is of considerable importance in the Northest as a similar shift is occurring or will occur throughout the industry.

The results obtained to date in breeding projects have been used to formulate preliminary recommendations relative to breeding policies for sheep and goats in the Northeast (121, 127, 129, 130).

BREEDING - U.S.

A partial analysis has been completed utilizing the records obtained on meat goat flocks maintained in the U.S. (23). The results have been briefly mentioned at another point in this report.

In another study (104) Angora x meat goat crosses have been made in the U.S. There is an increasing interest in developing an Angora Goat or Mohair industry in areas where they have not previously existed. Crossbreeding to

non-Angoras is one technique to establish new flocks or populations. The F1 from this cross produces a very low yield of fiber (much less than 1/2 that of the pure Angora). Also, the various percentage Angoras continue to produce kemp in the fleece. The F1 animals show a good hybrid vigor response in kid production.

Selection for increased lambing rates (26) of existing or endogenous breeds offers the potential to increase production. However, all indications are that the response would be slow suggesting that in both the U.S. and in areas such as the study area in Brazil either crossbreeding or selections based on crossbred foundations should be considered.

In an evaluation of the prolific genotypes (190) animals which were carriers of the F gene from Booroola had mean ovulation rates of 2.40 as compared to 2.03 for 1/2 Finnish Landrace and 1.46 for pure Rambouillet. Under Texas conditions, the Barbados Blackbelly have not shown a particularly high ovulation rate. Other studies have shown a high loss rate or a great disparity between ovulation rate and embryos present particularly at the higher ovulation rates (53). Even so the high ovulating types result in an increased number of triplet or greater births. Under production conditions of this area, triplet parturitions resulted in fewer lambs raised than twin parturitions, but more lambs were weaned from triplet parturitions than for singles (43).

VII. Significance of Findings

This project has been concerned with breeding of sheep and goats for meat and milk production. This work has been conducted in both Brazil and the U.S. with the exception that the work with milk goats has been limited to Brazil.

In respect to management, the work has been concentrated on milk goats at EMEPA (Paraiba) and general nutritional investigations under the supervision of Dr. Kawas at Sobral. The latter was funded by the TAMU project for the 1984/85 period and jointly with other projects (N.C. State, Utah reproduction) for the 1985/86 period. In addition, some of the more general aspects of management have been treated in Paraiba and at Sobral and Quixada in Ceara. Data, in respect to milk production at the farm level, is generally adequate to provide a basis for making technical recommendations. This applies to various aspects of nutrition and management. Economic limitations appear to present constraints. The broader aspects of management relative to meat production of both sheep and goats is less well advanced. Technology is less a constraint than socio-economic factors. However, economic interpretations require response data to potential practices such as change of breeding season and levels of supplemental nutrition. Some of these data are lacking. Although socio-economic constraints may be serious, the primary means of attacking these by means of research is by making the industry more efficient through interventions at the producer level.

Animal breeding is a very important concept in respect to animal production in an adverse environment. Work in this area has been conducted at Sobral and Quixada in Brazil and in the U.S. Due to long term and continuing nature work in this field, one never reaches a definitive endpoint. However, work completed to date seems adequate to indicate future direction in breed choice and breeding policy. In brief, the indications are that appropriate

selection programs be designed and carried out with each of the available breeds of hair sheep in Brazil. Genetic parameter estimates have been calculated under Brazilian conditions to facilitate this effort. Similar programs are indicated with hair sheep in the U.S. There is a need and a potential gain from effective crossbreeding programs, but there is a problem with appropriate sire breeds. Some work, at least in Brazil, needs to be directed toward this end. Work with goats is less advanced. Breed comparisons have been completed along with some crossbreeding studies. It is recommended that local breeds be preserved and improved. Genetic parameter estimates for goats have not been calculated under Brazilian conditions, but some values have been reported for meat goats in the U.S. Current indications are that selection within breeds will yield a slow response. As a result, the current recommendations are that selection for both meat and milk be made on crossbred foundation to increase genetic variability and genetic progress.

VIII. Future Direction

It is currently projected that this project will go through a phase out process in the 1986/87 period and will not be present in Brazil beyond September 1987. It is the general belief of the PI that some advantage can be realized from a continued low level involvement with the Brazil program to permit recovery of the maximum amount of results from cooperative programs to date. Also, participation in some type of regionalization or outreach program in the 1987/88 period would appear to be indicated.

During the phase out period, as presently scheduled, the effort will be concentrated in three areas. These are to contribute to and to participate in the IV International Goat Conference, prepare manuscripts for potential publication from results obtained to date and to assist Brazilian co-workers in the formulation of future projects and programs, particularly in respect to animal breeding, as influenced by the phase out of the SR-CRSP. Some advantage would be realized from a continued low level involvement in Brazil with respect to both breeding and management.

IX. Funding

Subgrant - $135,000
Matching - $ 44,955
Host country contribution - unknown

BRAZIL

Breeding/Management - Texas A & M University

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SR-CRSP

ANNUAL REPORT

1985-86

I. Project Title: Economic Analysis of Small Ruminant Production and Marketing Systems

II. Host Country: Brazil

III. Principal Investigator: Hendrik C. Knipscheer

IV. Personnel:

Host Country Co-Workers:
Jose de Souza-Neto, EMBRAPA/CNPC

U.S. Co-Workers:
A. John De Boer
Greg Baker

V. Project Goals

A. Provide a well-trained group of professional agricultural economists with the analytical skills, research experience, and professional motivation to contribute to the conduct of multidisciplinary research on small ruminants and their producers.

B. Develop long-term reliable data bases on cooperating producer farms to provide animal performance data to EMBRAPA researchers and to allow whole-farm economic modeling to be carried out.

C. Develop cooperative research projects with biological sciences to gain better understanding of producer rationale for sheep and goat production practices.

D. Publication and dissemination of research results representing a wide variety of research and which will contribute to a better understanding within the scientific community of small ruminants and their place in selected rural economies of developing countries.

VI. Objectives

Complete a review of the periodical surveys covering production system description, animal performance, genetic abnormalities, resource allocation, and animal management systems.

Testing of new technologies in collaboration with the biological sciences. Identification and description of target area would constitute the first phase of this research activity.

Description of dairy goat production in Northeast Brazil

VII. Research Accomplishments

A review of the economic studies in Brazil showed that sheep and goats are important components of farming systems in the semiarid tropics of Brazil. In the higher rainfall areas, small ruminants are usually grazed with cattle on mixed farms that typically produce maize, beans, and tree cotton. As rainfill decreases, goats become more important relative to hair sheep and cattle and cropping activities also decrease. During drought periods, goats become relatively more important.

Land management reflects minimal levels of capital inputs resulting in little control over grazing or animal management. Use of crop residues and forage crops was primarily for cattle, then sheep with goats accorded lowest priority. Offtake rates for sheep exceeded that for goats in good years but not in bad years, but overall small ruminant offtake levels were low reflecting high mortality rates, low fecundity, and herd reductions which occurred during the study period. Current management systems and resource constraints make it difficult to implement genetic upgrading of current herds/flocks or to target specific range/forage improvement strategies at small ruminants. Also, researchers should realize that climatic fluctuations will continue to have larger technical and economic impacts upon farm resource productivity than will improved technology generated by CNPC/SR-CRSP programs. Climatic variability will also make it difficult to carry out sound on-farm validations of potential technologies.

The site description was completed for the technology evaluation study. The Saco do Belem Agrarian Reform project was chosen as the site. The project is divided into three areas with 66 smallholders per area. Each smallholder received four parcels of land: 0.5 ha for a house, 5.0 ha for crops, 20.0 ha for improved pasture, and 62.5 ha for community native pastures.

Fifty-one smallholders were surveyed in early December 1985, a total of 17 per area. Most of the smallholders had settled at the project site, except in area III where less than two-thirds of them were living at the project. The living conditions were very poor. Most of the smallholders ate meat no more than once a month.

A majority of the producers lived, farmed, and grazed their animals on the 20.0 ha parcel and did not follow the land use pattern planned by INCRA. The farmers had an average of 4.06 ha of land in cultivation. The average herd size was 17 goats, 16 sheep, and 10 head of cattle. The majority of the animals received no supplementation. The only reproductive practice in use was castrating the young male animals. The animals were vaccinated an average of once a year and dewormed an average of twice a year. Most of the producers had a good knowledge of the plant species which existed on their land but had no idea on how to improve the production of forage material. Most of the animals were marketed through buyers which came to the project.

The major constraints to improving the production system at the project were judged to be nutritional constraints during the dry season, the poor health condition of the animals, lack of a controlled breeding season and good breeding animals, lack of the proper facilities, lack of credit, training, and the poor infrastructure in general. The technology to be recommended to the smallholders will focus on improving the health conditions of their animals,

improving the nutritional state of the pregnant and newborn animals, and selecting better animals for reproduction purposes.

The production systems used by producers of dairy goats in Northeast Brazil were described. Seventy-one producers were surveyed in the States of Paraiba, Pernambuco, and Rio Grande do Norte. Most producers were found to have a mixed production system consisting of crops, cattle, sheep, and goat production. Only 13% of the producers surveyed produced only goats. Sixty-six percent of the producers in all states held all species. The average goat herd consisted of 196, 134, and 83 herd in Paraiba, Pernambuco, and Rio Grande to Norte, respectively. Producers in Paraiba had the largest number of does (96), with 46% in lactation. The does in Pernambuco had an average lactation period of 150 days, which was substantially higher than the average for the other states. The average milk production varied between 0.74 and 1.20 liters per day. Eighty percent of the dairy goat producers in Rio Granda do Norte consume all the milk on the farm, while 20% process the milk into cheese for sale after meeting family requirements. Seventy-one percent of producers surveyed in Paraiba and Pernambuco sell their milk products commercially, while 29% consume the milk on the farm. Two market channels were found to exist for the milk products: Seventy-one percent of the producers sold their products to middlemen, while 29% sold their products in local markets or on the farm.

VIII. Funding

Grant No. AID/DAN-1328GSS-4093-001 from 1985/86 subgrant:	$289,529
Matching Contribution from 1985/86 subgrant:	96,510

BRAZIL

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SR CRSP

ANNUAL REPORT

1985-86

I. **Project Title:** University of California at Davis
Animal Health Project

II. **Host Country:** Brazil

III. **Principal Investigator:** Harvey J. Olander

IV. **Personnel:**

Host Country Co-Workers:
F. Arruda
J. Santa Rosa
M. Berne
S. Alves

U.S. Co-Workers:
C. Brown
E. Biberstein
A. Damassa
N. Baker
D. Brooks
N. East

V. Introductory

The University of California Animal Health Project has directed its investigations toward the control of major disease problems of small ruminants in northeast Brazil as perceived by the Brazilian animal scientists and animal holders. The major disease problems identified and chosen as likely targets for a successful research effort and meaningful developmental effects in Brazil were caseous lymphadenitis, intestinal parasitism and pneumonia. The significance of these problems was confirmed by field surveys early in the course of the project. The impressions derived correlate well with the generally accepted perceptions of the situation in sheep and goats throughout the world. It is also generally recognized that lack of water and poor nutrition are major causes of livestock losses but also are contributing factors to poor animal health in arid countries, especially those with depressed economics.

When the SR-CRSP began its involvement in Brazil, the CNPC had a meaningful ongoing research program in parasitology. Also, a project on pneumonia consisting primarily of a necropsy survey had also been initiated, but it needed microbiological laboratory support for more meaningful development. The CNPC had had limited involvement with caseous lymphadenitis, consisting of casual clinical surveys and sporadic testing of vaccines which had been provided by other Brazilian research stations.

From the onset, the U.C.Davis Animal Health project has supported the furtherance of Brazilian research efforts by providing consultation, technical equipment and supplies and especially by promoting the training of local people as technicians in the various laboratories. The major research thrust of the project has been the study of caseous lymphadenitis. That effort has resulted in the establishment of a functional microbiology research laboratory to service other CRSP and CNPC Animal Health projects. This was accomplished primarily through the development of facilities and the training of competent laboratory personnel.

VI. Research Accomplishments

CASEOUS LYMPHADENITIS AT DAVIS

A major accomplishment of the project in 1985-86 was the preliminary experimental development and the demonstration of considerable efficacy of a toxoid vaccine to protect goats from disseminations of infection from the site of inoculation.

Two groups of five goat kids each were vaccinated subcutaneously twice at a two-week interval with two different concentrations of a formalized exotoxin of Corynebacterion Pseudotuberculosis, along with Freund's incomplete adjuvant. Twenty days subsequent to the second vaccination, these kids, along with five unvaccinated controls, were inoculated intradermally with live C. pseudotuberculosis. Animals were monitored for 13 weeks. At necropsy, five of the ten vaccinated animals had no C. pseudotuberculosis lesions, three had abscesses limited to the inoculation site and draining lymph node, two had disseminated abscesses and the fifth had a single abscess in an internal node. Serologically, nine of the ten vaccinated animals developed positive antibody titers to the organism's oxotoxin within one week post-infection. The tenth sero- converted one week later, whereas the group of control animals required three weeks to develop a positive antibody response. Antibodies to the exotoxin early in infection may protect against spread of the organism.

All animals were injected intradermally at regular intervals with a skin test reagent made of fragmented bacterial cells. There were no positive skin reactions prior to challenge. After challenge, grossly observable responses increased throughout the trial. Skin testing may prove useful in certain clinical and experimental situations.

The work has been published in the American Journal of Veterinary Research and was reported at the Workshop of the SR-CRSP at the CNPC in Sobral, April 14-18, 1986.

There is a need to test this procedure more extensively with varied regiments under field conditions. We assume that the challenge of natural exposure is less severe than our experimental procedure and protection will be more complete.

CASEOUS LYMPHADENITIS & OTHER BACTERIOLOGIC STUDIES AT CNPC

The collaborative projects on caseous lymphadenitis in Brazil, projected in the workplan for 1985-86, have not proceeded as hoped. After a brief period of sharing the facilities, Paulo Almeida, the Brazilians bacteriologist, and

Eugene Johnson, the IICA consultant, refused to work with one another. Almeida has left the CNPC. Johnson has continued to utilize the facilities and support provided by the SR-CRSP, but he has considered his efforts to be for his personal benefit only, even when work plans, materials and data which has been instigated, provided and developed by others has been the basis for his output (his attempts to publish two papers without the permission, knowledge or acknowledgement of other contributors of materials and data have made the veracity of his work questionable. The editors of Veterinary Microbiology have questioned his results, also.

Nevertheless, Johnson is using a test, a Diffusion in Gel-Enzyme Linked Immunoassay, for detecting C. pseudotuberculosis infection, which is new in goats. Unbiased testing will be required to assess the value and significance of the test.

Allegedly, Johnson has also been working with scientists at EPABA in Bahia on a vaccine prepared from an age-attenuated culture. I have no direct knowledge of the status of that work. He has also been utilizing materials collected from and by the CRSP multidisciplinary project at CNPC to follow the kinetics of antibody production and immunotransfer in lactating goats and kids.

Prior to their falling out, Johnson and Almeida completed a paper describing the results of a three-year mastitis project, as planned and maintained by the U.C. Davis Animal Health Project at Fazenda Pendencia, in Pernambuco, prior to their arrival a CNPC (the authors did not credit the Animal Health Project for any role in the project).

PNEUMONIA STUDIES AT CNPC

In limited studies on Pneumonias, J. Santa Rose, in collaboration with Johnson, demonstrated that Pasteurella and Corynebacterium spp. were the most commonly associated bacteria at the CNPC. More extensive and more critical studies are needed to assess the significance of these findings.

PARASITOLOGY AT CNPC

The parasitology project to determine the seasonal dynamics of nematode infections in goats has completed the collection of materials and data for the final year of the study. Compilation of the data is not completed. Facilities at Saco do Belem are being developed to critically assess strategic anthelminthic regimens based on the seasonal dynamics demonstrated previously. Studies on the parasitologic aspects of the multidisciplinary project were abandoned by the scientists in Sobral as being incompatible with the overall purpose of the project.

Isolation and veterinary clinical facilities planned for construction in 1985-86 have been abandoned by the CNPC administration.

VII. Significance of Findings

The several diagnostic tests developed in the research on caseous lymphadenitis will be of great value in continuing research, but also in the diagnosis of the disease in the field. This will be of special significance

to small holders in protecting them from the unexpected losses associated with subclinical disease. These tests will also aid in developing rational culling, eradication and vaccination programs.

If the efficacy of the toxoid vaccine in proven in the field, this simple preparation and procedure will provide considerable assurance for small and large goat holders in reducing losses at slaughter. The finding of multiple internal abscesses in clinically normal animals after an extensive investment of time and other resources can represent a major loss. In a similar fashion, strategic anthelminthic programs that may develop from the studies on seasonal dynamics of parasitism would result in superior and less expensive control of parasitic diseases.

VIII. Future Directions

Work plans for 1986-87 are limited by the reduction of project support to less the 50 percent of the previous budget. The major effort will be the establishment of field trials for testing the efficacy of the toxoid vaccine.

IX.Funding

Subgrant amount	$151,500
U.C. Matching	55,834
Brazil (Overhead and 1.0 scientist year salary)	35,000

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SR-CRSP

ANNUAL REPORT

1985-86

I. **Project Title:** Nutrition and Supplemental Feeding for Small Ruminants in Northeast Brazil

II. **Host Country:** Brazil

III. **Principal Investigator:** William L. Johnson

IV. **Personnel:**

Host Country Co-Workers:
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V. **Objectives**

Good nutrition is essential for efficient animal production in any part of the world. In semiarid Northeast Brazil, where native caatinga range is the main source of feed for goats and sheep, the highly variable wet and dry seasons lead to serious fluctuations in quality and quantity of caatinga forage and consequent problems in maintaining satisfactory growth and reproduction levels. Supplemental feeding is an obvious solution. However, studies in several states of Northeast Brazil have shown that farmers with low capital resources are not willing to lay out cash for animal feed supplements, and especially not for small ruminants.

Our overall objective, therefore, has been to add to the options available to farmers with minimum resource levels, by evaluating alternative strategies for supplementing sheep and goats during critical times of the year and critical phases of their productive cycle. Specific objectives of work in 1985-86 have been to determine the nutritive value of locally available feedstuffs, and to develop practical alternatives for supplementation strategies.

VI. Research Accomplishments

Intake and digestibility of caatinga leaf litter fed to SRD goats in confinement.

Caatinga leaf litter is the major feed resource for goats from approximately mid-dry season until the onset of the next rains, but very little is known about its value as a forage. Our objective was to study the effect of energy supplementation on the intake and apparent digestibility of leaf litter. Of particular concern was whether a corn supplement would complement or substitute for the leaf litter. A digestibility trial was conducted with 44 individually confined, mature native (SRD) goat wethers, average weight 20.6 kg, fed a total of 1.7 kg of previously collected dry season caatinga leaf litter, ad libitum in two feedings per day. The quantity of feed offered allowed for at least a 40 percent selection margin. Chemical analyses of the caatinga leaf litter showed it to be low in crude protein (6.6 percent) and high in total cell-wall fiber (64.5 percent NDF).

Four levels of corn supplementation were imposed: 0, .3, .6 and 1.2 percent of body weight, respectively, for treatments A, B, C and D. Leaf dry matter intake for the four groups were (percent of BW) 3.57, 3.54, 3.31 and 3.20; total dry matter intakes, leaf plus corn, were (percent of BW) 3.57, 3.80, 3.95 and 4.23. Digestibility of dry matter was 66, 68, 63, and 69 percent and digestibility of crude protein was 50, 49, 43 and 51 percent respectively, for treatments A, B, C and D. These results generally agree with what has been found previously when low quality forages have been supplemented with energy. The lowest corn level, 53 g/day (TRT B) did not affect leaf DM intake. The tendency for a decreased leaf intake, hence substituting supplement for forage, was evident at higher corn intake levels; however, there was an increase in total DM intake as supplement levels increased. The fact that total DM digestibility did not change even when corn comprised up to 25 percent of the diet (TRT D) can be interpreted to imply a decrease in leaf litter digestibility as corn levels increase, assuming corn DM digestibility to be higher than the recorded mean diet DM digestibilities. This decrease, if real, could be due to a lower selectivity index, or to a faster rate of passage; but not likely to both effects since they are contradictory. Digestibility of DM in all TRT's was somewhat higher than might be expected from a forage with NSF and lignin concentrations as high as we observed.

Energy supplementation of goats grazing in the Caatinga during the late dry season.

Forty-five grade Anglonubian wether kids, six months of age, were allowed to graze 30 ha of partially cleared native caatinga at the CNPC, for 20 weeks including the late dry season (Sept. to Dec.) and early rainy season (Jan.-Feb.). Three treatments were imposed: (A) 150 g of corn per animal per day throughout the 20-week period; (B) the same level of corn, but starting 40 days later; and (C) no supplementation. Weight gains during the first 40 days were 9, 10 and -8 g/day for treatments A, B and C; corresponding gains for the second 40 days (end of dry season) were -27, -38 and -42 g/day; and for the third 40 days (beginning of the rainy season), 76, 81 and 77 g/day (treatment effect not significant, $P < .05$). Since the level of supplementation represented only about 20 percent of the NRC tabular values for daily energy

requirements for growing kids with a medium activity level, it is assumed that the partially cleared caatinga area had very limited forage availability by the end of the dry season, and that the level of supplementation offered was inadequate for the animals' needs. Furthermore, there seemed to be little carryover effect of the energy supplementation, to influence early rainy season growth.

Influence of level of energy supplementation on forage intake and performance of Somali lambs.

An 84-day growth and digestibility study was conducted to determine the influence of level of energy supplementation on forage and total dry matter intake and weight gains of Somali lambs (a tropical hair sheep breed). Thirty-six recently weaned lambs, initial weight 16.6 kg, were assigned to one of four energy levels: cassava meal fed at .4, .8, 1.2 or 1.6 percent of body weight each day, in addition to a protein supplement (80 percent soybean meal, 10 percent urea, 10 percent mineralized salt) fed at .5 percent of body weight and chopped green napier grass (Pennisetum purpureum) ad libitum. Digestibility was measured by total fecal collection during the last 7 days of the trial. Results are summarized in Table 1.

Table 1. Intake, diet digestibility, and animal gains by Somali lambs consuming napier grass, a protein supplement, and four different levels of cassava meal.

	Cassava meal level (% of BW)			
Parameter	.4	.8	1.2	1.6
Dry matter intake (g/kg $BW^{.75}$)				
Concentrate	17	25	34	42
Forage	81	75	76	65
Total	98	100	110	107
DM digestibility (%)	48	50	57	60
Dig. DM intake (g/kg $BW^{.75}$)	48	49	63	64
Weight gain (g/day)	44	51	72	95

Acceptability of silage and hay of various forages by goats and sheep.

Preserved forages are one option for providing supplemental feed for the dry season. This study compared the acceptability of several hays and silages in separate cafeteria studies with sheep and goats. Table 2 shows the crude protein (CP), total cell-wall fiber (NDF) and lignin concentrations in the dry matter of the hays and silages. Relative acceptability was not greatly influenced by method of preservation (although not all of the forages were presented as both hay and silage), nor by animal species. The consistently most preferred species were Leucaena and Stylosanthes. Of intermediate ranking were Cassia, Crotalaria, and Wissadula. The least preferred species included Combretum, Croton, Paspalum, and Setaria.

Table 2. Chemical composition of hays and silages used in a cafeteria trial with sheep and goats (% of dry matter).

	Hay			Silage		
Forage	CP	NDF	Lignin	CP	NDF	Lignin
Cassia sp.	15	33	4	11	45	8
Combretum leprosum	9	35	7			
Crotalaria juncea	17	54	9			
Croton sonderianus	9	40	8	8	47	12
Leucaena leucocephala	20	42	7	17	42	8
Paspalum sp.				5	74	9
Setaria sp.				6	70	8
Stylosanthes humilis	14	47	7	11	47	7
Wissadula sp.	13	53	7	10	45	8

Nutritive value of Clitoria ternatea (Cunha) and forage sorghum cut and ensiled at two stages of maturity.

Adjacent fields of cunha and sorghum were each divided in half. Early and late forages were harvested, ensiled, and fed ad libitum to 40 adult male SRD goats for 21 days in a randomized design. The cunha was harvested at 42 or 72 days regrowth; the sorghum was harvested when the grain was in milk or mature stage. Composition, intake, digestibility, and rumination and chewing times are shown in Table 3. Dry matter intake was higher for cunha than sorghum; however, digestibility was lower, with the net result that digestible dry matter intake was similar for both species. Further studies are needed to determine optimum levels for these forages in mixed diets, in order to balance nutrients offered with nutrients needed by the animals, and to minimize the effect of any anti-quality factor that might be present in cunha.

Table 3. Nutritive value of cunha and sorghum forages harvested and ensiled at two stages of maturity.

	Cunha		Sorghum	
Parameter	42 da	72 da	Milk	Hard
DM yield, kg/ha	1,655	2,989	4,696	6,003
Composition (% of DM):				
Before ensiling -				
Neutral-detergent fiber	42	50	66	57
Crude protein	20	18	7	7
Lignin	7	10	6	7
After ensiling -				
Neutral-detergent fiber	50	56	77	69
Crude protein	19	18	5	5
Lignin	10	11	8	9
Intake per day, g/kg Met. Wt:				
Dry matter	76	77	66	60
Digestible dry matter	51	46	51	43
Digestibility of DM (%)	67	60	77	72
Rumination time (minutes/day)	407	474	554	575
Eating time (Minutes/day)	369	357	285	254

Nutritive value of native (juazeiro and matapasto) and introduced (cunha) forages for goats and sheep.

Six male goats, average weight 25.3 kg, and six male sheep, avg wt 37.3 kg, were fed Clitoria ternatea (cunha), aerial parts; Ziziphus joazeiro (juazeiro), leaves and smallest twigs; and Cassia sp (matapasto), upper aerial parts. Forages were harvested at the beginning of the dry season, dried, and fed as hays in a random design, with 14 days preliminary and 7 days for fecal and urine collection. Table 4 presents the results. The slightly lower intake but higher digestibility by goats is inconsistent with their smaller body size and consequent expectation of a faster rate of passage. These forages should be evaluated for possible presence of anti-quality factors which may interfere either with intake or digestibility when fed as the sole dietary component; and they should be tested in mixed diets, to determine optimum levels for maximizing their positive contribution to the diet.

Cunha and matapasto in mixed diets for lambs in confinement.

In a continuation of a series of trials on dry season confinement feeding options for lambs, 60 ten-month Santa Ines male lambs were randomly assigned to one of five confinement diets or to graze in the caatinga with a supplement of 200 g of corn/day.

Table 4. Nutritive value of three forages harvested at the beginning of the dry season.

Parameter	Cunha	Juazeiro	Matapasto
Crude protein (% of DM)	23	15	8
Organic matter digest. (%):			
Goats	56	44	71
Sheep	53	40	60
Organic matter intake (g/MW):			
Goats	63	68	10
Sheep	70	77	46
Nitrogen balance (g/day)			
Goats	15	7	- 2
Sheep	17	6	0.2

A 70-day growth trial (all animals) was followed by a 21-day digestibility trial (five lambs per treatment) with total collection of feces and urine during the final seven days. All diets contained 51 percent ground corn stover, 20 percent ground corn grain and 1 percent salt. The additional ingredients and digestibility results are shown in Table 5. Mean intake (per kg metabolic weight) was 111, 107, 104, 91 and 78 g/day for Diets 1-5, respectively. The highest daily gains were obtained with Diet 1 (122 g) followed by Diets 4 (116 g), 2 (113 g), 5 (102 g), 3 (55 g) and the grazing treatment (42 g). Digestibility of the fiber components was improved with the substitution of leaf meals for cottonseed cake. Digestibility of nitrogen declined, however; and N balance was reduced with Diet 3. Under conditions of this study, matapasto can apparently be used at 14 percent and cunha at levels up to 28 percent.

Table 5. Digestibility of corn stover based diets with matapasto or cunha leaf meals, fed to Santa Ines lambs.

Diet No.	Protein ingredient (%) Cotton seed cake	Mata-pasto	Cunha	Digestibility (%) of-- Dry matter	Cell-wall (NDF)	Nitrogen	Nitrogen balance (g/d)
1	28			56	43	66	3
2	14	14		55	51	60	4
3		28		55	51	44	2
4	14		14	55	53	57	2
5			28	55	51	55	2

Nutritive value of mixed diets with various energy sources for Santa Ines lambs in confinement.

As part of the series of trials investigating strategies for dry season feeding of lambs, five different energy ingredients were used in diets for male Santa Ines lambs, during a 21-day digestibility trial. The basal diet (treatment 1) was comprised of 51 percent ground (10 mm) corn stover, 1 percent salt, and 48 percent cunha (Clitoria ternatea). In Diets 2, 3, 4 and 5 the cunha was reduced to 28%, being replaced with 20% corn grain, sorghum grain, cassava root meal or carob (algaroba) pod meal, respectively. Results are present in Table 6. Digestibility of dry matter was improved ($P<.05$) in Diets 2 through 5 compared with the basal diet; digestible DM intake, however, was not significantly different.

Table 6. Nutritive value of diets with various energy sources fed to lambs in confinement.

Energy source	Composition (% of DM) Cell-wall fiber	Crude protein	Lignin	Intake (g/da/kg MW) Dig. of dry matter	Dry matter	Dig. DM	Nitrogen balance (g/day)
Cunha	65	9	8	46	82	38	3
Corn	58	8	9	55	80	44	3
Sorghum	61	7	10	53	73	39	2
Cassava	57	7	8	56	72	40	4
Carob	60	8	10	53	85	45	4

Breeding season effects on body weight, milk production, and reproductive performance of SRD goats grazing caatinga.

Fifty native SRD does were assigned randomly to one of two breeding seasons: October (dry season, to kid early in the rainy season) or January (early rainy season, to kid at the end of the rainy season). Does were milked twice per day, three days per week from parturition until the following October 1 (lactation length of seven months and four months for the dry and wet season breeding groups). Mean milk yield per day was 300 g and 270 g for

the dry and wet season breeding groups (P>.05); lactation milk yield was 55.8 vs 22.9 kg per animal for the two groups (P<.01). Weight changes were more favorable for the dry season group (P<.05): x maximum gain 2.5 kg and maximum loss -3.8 kg, compared with .4 kg and -8.4 kg for the wet season group. Kidding rates were 1.7 and 1.4 kids/doe for the dry and wet season groups (P<.05); the higher twinning rate for the dry season group may be due to a flushing effect from the 100 g/day of corn fed to them at breeding time.

Protein and energy needs for growth of hair sheep.

Santa Ines and Morada Nova sheep were used for this trial, in a factorial design with two breeds, three energy levels (cell-wall fiber concentrations) and three protein levels (7.5, 10 and 12.5 percent). The nine diets were fed ad libitum (10 percent refusal level) for 11 weeks, with animals entering crates for urine and fecal collection, rotationally, during weeks seven through ten. All animals were slaughtered at the end of the trial. Preliminary results are shown in Table 7.

Table 7. Intake and weight gains of Morada Nova and Santa Ines lambs on different energy-protein combinations.

Diet	Dry matter intake (g/day)	Digestible energy intake (Mcal/day)	Weight gain (g/day)
Low energy and			
- low protein	1,127	2,170	111
- medium protein	1,113	2,624	114
- high protein	1,142	2,642	97
Medium energy and			
- low protein	1,020	2,335	103
- medium protein	1,068	3,035	135
- high protein	1,261	3,349	183
High energy and			
- low protein	780	2,319	92
- medium protein	1,073	3,472	171
- high protein	1,120	3,652	158

VII. Significance of Findings

Based on our findings during the past year, together with results from previous years, the following conclusions are possible:

During part of the year, forage from the caatinga alone is inadequate for more than a maintainence level of animal performance.

A. In fact, growing sheep and goats will usually lose weight during the latter part of the dry season, and may die; and adult females will have an unsatisfactory breeding performance, at the least, if unsupplemented during the dry season.Caatinga leaf litter, the main feed resource available for the dry season, is marginal in nutritional value even when a high degree of selectivity is

possible; and toward the end of the most severe dry seasons, there is no litter left to select from.

B. Feeding weaned lambs in total confinement may be an economically viable option.

In several trials, diets made up of cheap, locally available feeds have supported good growth rates. This practice will not only keep the lambs alive and growing during the dry season, but will greatly accelerate their readiness for market and relieve grazing pressure on limited caatinga resources.

C. Supplemental dry season feeding for growing or adult goats, or for adult sheep, may also be economical, but only with feeds that are both inexpensive and high quality; and only at judicious, carefully controlled levels.

When the residual feed on caatinga range is insufficient to sustain normal growth or satisfactory reproduction, marginal levels of supplements can provide nutrients for the rumen microorganisms or directly to the animal, without substituting for the caatinga forage (leaf litter). At higher levels of supplementation, some substitution will occur.

What is not yet known in sufficient detail is the optimum balance of energy, rumen-soluble protein, and rumen-bypass protein for supplementaing growing kids or lactating does and ewes, and how these optimum ratios will be influenced by the quantity and quality of residual feed in the caatinga. However, it is clear that high fiber feeds (greater than 60% NDF) are of little use, other than maintenance when the caatinga runs out of all feed.

D. Flushing can be an effective practice, if feeding conditions are otherwise marginal; its application should be based on economics.

E. Several options are available in terms of forages or byproducts to use for supplemental feeding.

Forage legumes may offer the best option in the long run. However, there are still many unanswered questions regarding agronomic management and irrigation; preservation (hay or silage); possible anti-quality factors which limit palatability and/or protein availability; and optimum combinations with other feeds, such as an energy source.

Cunha gives excellent yields of high quality forage, with irrigation. It can be ensiled, but not enough is known about how to achieve an optimum fermentation. And it is quite clear that research results obtained with cunha as the sole dietary ingredient do not necessarily apply when it is fed as a marginal supplement or in combination with other ingredients.Tropical forage grasses consistently give poor results when fed as supplements or as the sole diet. The only exception may be a low-fiber, high-protein grass harvested at a very early stage of maturity and fed to allow a

very high rate of selectivity. Otherwise, the high fiber in tropical grasses severely limits intake by small ruminants, by filling the rumen with slowly degradable material.

F. Diets are available that can support goat dairy production.

Napier grass properly managed; forage sorghum; caatinga in the rainy season; these are some of the options as a forage base for lactating dairy goats. Forage legumes, cottonseed cake, and even urea are options as protein supplements; and there is a range of energy supplements available: sorghum, corn molasses, algaroba, even cassava meal if used judiciously. For efficient levels of lactation, the diet must not be allowed to exceed a relatively modest level of NDF. This level has not yet been well defined, but is not likely to be higher than 45-50 percent on a dry matter basis.

G. Good nutrition is necessary, but cannot substitute for good management.

Parasite control, provision of water and salt, minimization of heat stress, alert reproduction management---these factors must be taken care of along with the provision of an adequate diet, if either meat or milk production from small ruminants is to be efficient.

H. The task of a research program is to provide options, not ironclad answers, for extension specialists and producers to test in the field.

Every farm is slightly different in terms of labor, land, animal, and water resources, and market possibilities. What makes good economic sense for one producer may be totally wrong for his neighbor.

The CNPC can now consider itself armed with a number of options for improving feeding systems on any given farm. It is up to the outreach staff to make these options known to extension personnel and farmers who can choose among the options and test specific ideas in the field.

VIII. Future Directions

It has been agreed that North Carolina State University will end its research collaboration with the National Goat Research Center during 1986. Not because the job is finished, but because funding is no longer adequate to carry on a viable collaborative effort.

The timing of the termination of our collaboration is unfortunate for three reasons. First, because we now have the problems better defined than at any previous time, and future research can therefore be much more efficiently focussed; secondly, because we have several viable ideas ready for field testing; and thirdly, because the CNPC has more complete facilities for nutrition and feeding systems research than an any previous time.

However, all is not ideal; a continuing missing link at the CNPC is the lack of stable leadership for nutrition research at the PH.D. level. The Small Ruminant CRSP has stretched its resources to provide such leadership on

an interim basis, since August 1981. The NCSU subgrant was never sufficiently funded for this purpose, and placing Dr. Robb, and later Dr. Kawas, in Sobral was possible only with budget supplements, joint appointments with part-time administrative responsibilities, or by salary-sharing among several subgrants. With declining budgets such band-aid solutions are no longer possible.

Nutrition and feeding systems research will, no doubt, continue at some level at the CNPC; it is too important to be neglected. The immediate and logical measure is for the range-related components to build an even stronger dimension of animal supplementation research and animal productivity evaluation.

Items which suggest themselves for the research agenda:

a. On farm trials, evaluating some of the suggestions given above in controlled, practical situations, with maximum participation of EMATER (extension service) personnel.

b. A continuing effort should be made to use agricultural byproducts and readily available local plant foliage to develop low cost supplementation schemes which are within the means of small producers.

c. The proper combinations of energy, rumen-soluble protein, and rumen bypass protein need to be defined for given levels of animal productivity.

d. The chemical of physical nature of anti-quality factors in local feedstuffs needs further definiation. Possible factors include lignin-linked phenols and tannins, which can negatively effect palatability, dry matter intake, digestibility, and/or protein utilization, even in feeds which appear to have a satisfactory chemical composition.

e. Ensiling techniques need thorough evaluation. Stage of maturity at harvest; protein and soluble carbohydrate levels in the ensiled forage; and how to provide cheap but airtight storage, are problems needing research.

IX. Funding

Subgrant for 1984-85:	$48,740
Subgrant for 1985-86:	36,740
Matching by NCSU, 1984-85:	21,865
Matching by NCSU, 1985-86:	21,840
Estimated matching by EMBRAPA, 1984-85:	20,000
Estimated matching by EMBRAPA, 1985-86:	20,000

(Estimates are for 12-month program years, and are net of institutional overhead charges.)

BRAZIL

Nutrition - North Carolina State University

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SR-CRSP

ANNUAL REPORT

1985-86

I. **Project Title:** Rangeland Research for Increasing Small Ruminant Production

II. **Host Country:** Brazil

III. **Principal Investigator:** John C. Malechek

IV. **Personnel:**

Host Country Co-Workers:
E. Oliveira
R. Mesquita
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V. **Introductory**

The Utah Range project has proceeded with four general goals: 1) to conduct research that will lead to technology appropriate for the needs of rangeland sheep and goat production in northeastern Brazil; 2) to conduct research focusing on principles of agroecology that will apply broadly to semi-arid tropical ecosystems worldwide; 3) to train graduate students and other professionals for careers in international range management and research; and 4) to train professionals and subprofessionals in research procedures and methodologies unique to range animal nutrition and production.

With these goals in mind, we have proceeded from the assumption that sheep and goats are but a part of the agricultural ecosystem in which they are produced. To fully understand production limitations and potentials, knowledge of this larger system is equally, if not more, important than a detailed understanding of the animal per se. Therefore, a great deal of our attention has been on climate, soil, and plant interrelationships, as well as plant-animal relationships (including animal nutrition). An important linkage has also existed with the Winrock Economics and Missouri Sociology projects to bring the people (manager) component into this set of relationships.

As a result of these considerations, the Utah Range project has been comparatively expensive. Also considering that long-term responses and large year-to-year variations are integral parts of research dealing with native plant communities, results have sometimes not been forthcoming as rapidly as in some of our sister projects.

Much has been learned from our various component subprojects about the caatinga vegetation and small ruminant production on caatinga ranges. The time is now approaching when this information should be tested in an integrated fashion on production-scale tests involving reproducing animals. Given the probable future of the Small Ruminant CRSP, much of this testing will probably be left to the responsibility of our EMBRAPA collaborators. We intend to continue our involvement in northeastern Brazil as long as possible because much remains to be done. The level of involvement will be a function of continued funding support and broader CRSP program-level decisions.

VI. Research Accomplishments

Effect of supplemental nitrogen and energy on dry season weight gains of goats grazing caatinga range

It is generally considered that nutritional stress during the dry season is one of the primary factors limiting goat production in Northeast Brazil. This study was conducted to determine if dry season diets of free ranging SRD goats are deficient in nitrogen, energy or both. Forty recently weaned male goats were randomly assigned to one of four treatments: 1) caatinga range; 2) caatinga range plus 5 g of urea/day; 3) caatinga range plus 140 g of molasses/day; and 4) caatinga range plus molasses (140 g/day) and urea (5 g/day). Although average daily weight gains for the 12 week growth trial were nearly twice as high for the molasses and urea group as for the other three treatment groups, rates of weight gain were similar for all four treatments during the first half of the growth trial. Botanical and nutritive composition of animals' basal caatinga forage diets remained relatively constant during the first half of the study; however, diet quality decreased and diet botanical composition showed a shift towards lower quality constituents (stems) during the last half of the trial.

We conclude that nutritive value of dry season forage in the caatinga vegetation type studied is relatively high and can support modest weight gains in young goats when forage availability is not limited. During the mid to late dry season, however, forage availability conditions change and the quantity of palatable, good quality forage does become limited due to such factors as grazing, trampling, and decomposition. At this time, goats are no longer able to select an adequate quality diet, as indicated by weight responses and diet composition, and supplementation of both N and energy is required to sustain early dry season rates of growth.

Vegetation and Goat Nutrition Responses to Selected Levels of Tree Canopy Cover Reduction

The caatinga vegetation type of northeastern Brazil, composed of drought deciduous trees and shrubs with an understory of annual plants, generally serves as the year-round forage resource for goats in this large region. Clearing caatinga forest by slash-and-burn cultivators, wood cutters and livestock producers, is an integral part of the traditional exploitive land use practices. For land management purposes, simple modifications of traditional land clearing schemes need to be developed, within an agroforestry perspective, in order to ensure continued forage and wood production as well as ecosystem stability.

Two intermediate levels of tree stand thinning (reduced to 25% and 55% tree canopy cover) were compared to complete clearing (0% cover) and a control (95% cover of intact caatinga forest) in terms of herbage production and nutrition of free-ranging goats utilizing the sites. Herbaceous standing crop was six to eight times greater for the three manipulation treatments (approximately 1900 kg/ha) than for the control (250 kg/ha). Leaf litter biomass from the drought deciduous woody plants was higher ($P < .05$) on the control (1900 kg/ha) than on the manipulation treatments (approximately 1000 kg/ha); however, coppice shoots on the manipulation treatments retained substantial amounts of green leaves throughout the dry season. Goats selected diets higher ($P < .1$) in cell wall content on the control than on the manipulation treatments; however, dietary lignin and crude protein contents were similar for all treatments. Thinned caatinga has potential for multiple use land management due to its high yields of good quality forage that is within reach of grazing and browsing animals while maintaining valuable wood and forage producing trees in the stand.

Fiber composition of fistula extrusa samples: Influence of low-temperature oven-drying

Oven-drying esophageal fistula forage samples as compared with freeze-drying has been reported to alter the chemical composition of these samples. Despite this, many researchers continue to oven-dry diet samples. Additionally, very little information is available on the interacting effects of drying method and season of diet sample collection (in relation to forage maturity). Esophageal fistula forage samples were collected from goats and sheep grazing in semi-arid northeast Brazil. These samples were thoroughly hand-mixed, then separated into two portions. One portion was frozen and later freeze-dried. A second portion was dried at 40°C for 3 days. Oven-drying at 40°C significantly increased neutral detergent fiber (NDF), acid-detergent fiber (ADF), and lignin. There was a strong interaction between collection period and fiber composition. Esophageal fistula samples collected during the dry season were low in moisture, and oven-drying had little influence on these samples. However, forage samples collected during the wet season were low in dry matter, and even low-temperature oven-drying significantly altered fiber composition. Many researchers assume that low temperature drying (i.e. < 50°C) will not influence fiber values, but this is not the case for forages high in moisture.

Ecological biochemistry of caatinga browse plants and related animal response

Woody plants in the tropics characteristically contain high concentrations of secondary metabolites. The role of such chemicals in plant-animal interactions is unclear and controversial. One school of thought holds that such chemicals are synthesized as specific deterrants against predation by various herbivores. Another idea is that these compounds represent metabolic sinks for carbon produced in photosynthesis that cannot be directly used in plant growth because of limitations imposed by a deficiency of other essential nutrients such as nitrogen and phosphorus. Whatever the evolutionary basis, it is clear that certain of these chemicals render plants distinctly unpalatable to browsing animals, and some (e.g. tannins) may elicit undesirable nutritional consequences to the animal that eats them.

We know that certain important caatinga species contain high levels of tannins, and perhaps other secondary compounds. Dr. John Bryant and his research group at the University of Alaska have demonstrated a major potential for manipulating such compounds through application of fertilizers. With this approach in mind, this study has the following objectives: 1. Determine response of plant secondary metabolite pools to availability of regrowth-limiting soil nutrients; 2. Determine which particular secondary metabolites are important to plant palatability for sheep and goats; 3. Determine browsing response of free-ranging sheep and goats to plants manipulated by application of fertilizers; and 4. Assess nutritional importance of selected secondary chemicals.

Amanual Gobena arrived in Sobral to begin his work in October, 1985. During November and December 1985, he established study sites on two different soil types, collected preliminary data, and applied fertilizer to four important caatinga tree species. The major portion of his field data will be collected between May and July, 1986 which primarily involves feeding behavioral and nutritional responses of small ruminants to fertilized and non-fertilized caatinga browse plants. The biochemical and bioassays for important chemicals will be handled in Bryant's lab in Alaska.

Energy expenditures associated with grazing, browsing, & bipedal stance for goats and sheep under free grazing conditions

Measures of energy expenditure of domestic animals are used as a basis to estimate energy requirements for maintenance and for different phases of animals' productive cycles. However, not much is known about the energy expenditures of free-grazing animals, especially small ruminants, due to methodological problems.

This study, the basis of Oliveira's dissertation research, has 5 objectives: 1. To estimate and compare the daily energy expenditures of goats and sheep under free-ranging conditions. 2. To determine the energy cost associated with browsing and bipedal stance on the total daily energy expenditures of goats and sheep. 3. To construct an energy budget for goats and sheep under free-ranging conditions. 4. To estimate the amount of energy harvested by free-ranging animals under the experimental conditions. 5. To evaluate the use of the Carbon Entry Rate Technique as a way to estimate the energy expenditures of free-ranging animals.

Three experiments were conducted in Logan, Utah, during the grazing season of 1985, and one or two more will be conducted during the season of 1986. Ederlon Oliveira is currently running lab analyses on the samples collected during last year's grazing season and is getting ready to conduct another series of field trials. He anticipates completion of this research and of his Ph.D. program by January, 1987.

Comparative Foraging Ecology and Nutrition of Sheep and Goats on Caatinga Rangeland

Work by Scott Kronberg has progressed to the point that data are now being accumulated on a regular basis. The time from his arrival until December was devoted to fencing and preparation of new experimental pastures at the DNOCS area, constructing of necessary facilities and equipment, and conducting feasibility trials.

Results from the first forage intake trial comparing sheep and goats indicated a substantially higher rate of intake by sheep as compared to goats (3.8 vs 4.1 percent of body weight). Studies on comparative nutrition and feeding behavior are on-going with completion of field work in Brazil projected for March or April of 1987.

Factors Determining the Coppicing Ability of Caatinga Browse Plants: Implications for Forage Production

Final data analyses are in-progress by Linda Hardesty and completion of her dissertation is projected for September 1986. Plans now call for the dissertation to consist of three manuscripts ready for submission to journals at the time of the September defense.

Interim progress on this subproject has recently been summarized in the State-of-the-Art Workshop held in Brazil in late March, 1986.

VII. Significance of Findings

We view the findings of the Utah Range project to be significant from two points of view. First, results from a number of our subproject contribute directly to a better understanding of the caatinga ecosystem and its limitations for sheep and goat production in northeastern Brazil. An obvious example might include new knowledge on palatable and unpalatable browse species that can be used in planning caatinga thinning or clearing operations. Another would be our now better knowledge of seasonal dietary nutrient levels for protein and digestible energy which can be used in formulating supplementation programs. The related work involving molasses and urea supplementation points towards possible management alternatives for coping with the annual dry season nutritional limitation. Yet another example that bears mention would be findings on forage production and animal nutrition responses to caatinga thinning and clearing. Such information is critical in any planning for land improvement or wood harvesting projects.

These few examples certainly do not constitute an exhaustive list but illustrate knowledge that would be incorporated into a comprehensive technology testing program for the Northeast. The second point of view from which we see our research results as significant deals with new knowledge that is more general in nature and h . potential for application in situations outside of Brazil. Northeastern Brazil is representative of an eco-climatic zone known as the semi-arid tropics. On a world-wide basis, this zone is large and is important from the standpoint of its representation in less developed countries where sheep and goats are produced. Several of our research findings may be directly applicable to these broader situations. For example, the emerging principles on how to produce and manage coppice growth

from cut trees could be a vitally important contribution in other areas, even though the particular plant species involved may be totally different. In a similar light, the on-going work on plant biochemical responses to soil nutrient limitations could have wide application with many important animal nutrition ramifications.

VIII. Future Directions

Work during the 1986-87 program year will be directed toward completion of studies in Brazil by Amanual Gobena and Scott Kronberg. Follow-up studies to these two projects as well as those of earlier CRSP researchers (Schacht, Kirmse), will be undertaken by EMBRAPA collaborators. Additionally, EMBRAPA collaborator Ederlon Oliveira will be completing his research and his Ph.D. program by December and will be returning to Brazil where he will also activate long-term collaborative studies with the Utah Range project.

The level of involvement and activity past October 1, 1987 is entirely dependent upon funding resources. If the SR-CRSP program is extended for an additional three years at a level of funding comparable to that now received, major projects will be initiated with our Brazilian collaborators. However, if funding is small, we plan to stay involved primarily in an advisory capacity to our EMBRAPA collaborators.

IX. Funding

Subgrant, 1985-86	$168,750
Matching, 1985-86	85,389
Host Country contribution (rough estimate):	25,000

BRAZIL

Range Management - Utah State University

Books and Chapters in Books

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M. S.

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Verbal Presentations (Supporting)

Hardesty, L. H. and T. W. Box. 1982. Developing Women for International Service: A Case Study. Title XII Conf. on Women in Int'l. Dev., Moscow, ID. **Utah-Range**

SR-CRSP

ANNUAL REPORT

1985/86

I. **Project Title:** Improving Reproductive Performance of Small Ruminants

II. **Host Country:** Brazil

III. **Principal Investigator:** Warren D. Foote

IV. **Personnel:** Host Country Co-Workers:
A. Simplicio, EMBRAPA/CNPS
J. Alves, EMBRAPA/CNPC
A. Eloy, EMBRAPA/CNPC,

V. **Research**

Influence of First Suckling on Survivability of Newborn Kids

This study was conducted at the National Center for Goat Research, Sobral, with six genotypes of goats (Caninde, Marota, Moxoto, Nubian, Repartida and SRD). The objective of this study was to establish the influence of the birth weight, sex and type of birth on the interval from parturition to first suckling and the survivability of the kids.

Data were obtained during two kidding seasons. The results show a significant difference ($P < 0.01$) among genotypes, type of birth, and sex for birth weight of kids, and no statistical difference ($P > 0.05$) for the interval from kidding to first suckling. It was expected that kids with heavier birth weights would suckle in a shorter period after parturition than kids with lighter birth weights and that this would also be reflected in survival. However, using pooled data there were no significant ($P > 0.05$) relationships among birth weights, weaning weights and intervals from parturition to first suckling.

Reproduction and Production Performance of Goats at the Producer Level

This study was conducted in five municipalities (Caninde, Independencia, Granja, Sobral and Taua) with two to three flocks in each municipality and a total of 17 farms during a three year period (October 1981 and to September 1984). The type of goats were primarily nondescript SRD, but this varied from flock to flock due to the degree of crossbreeding with Nubian or Bhuj goats. One herd in each municipality served as a control flock, and it was managed traditionally to establish the constraints and the reproduction and production potential of the goats. Management in the other two flocks was altered, imposing one improved management practice. The fourth flock in two municipalities was altered to include a combination of five improved management practices. The improved management practices were: (1) breeding season limited to October-November; (2) navel disinfection in newborn kids (with 10% iodine); (3) directed culling (selection of breeding does, animals discarded based on fertility, health, age, sex and to decrease the stocking

rate); (4) yearly exchange of the same type of breeding males (sires) to reduce inbreeding; and (5) weaning of kids at about 120 days of age.

The data collected were: flock structure, frequency of some congenital defects, frequency of kidding throughout the year, kidding percentage, type of birth, kidding interval, kidding rate, age at first kidding, mortality rate, interval between parturition and the first postpartum estrus.

The information obtained at the initiation of the study from 4,379 animals (3,371 females and 1,008 males) showed 51.4, 19.0 and 6.5% of adults, yearlings and kid females, respectively. In males, the proportion was 4.04, 13.3 and 5.7% for adults, yearlings and kids, respectively. These data show the low proportion of kids, indicating that a high mortality rate or low fertility rate and/or prolificacy in female goats exists in the flocks. Concerning the incidence of two congenital defects, 29.7% of the animals have supplementary teats and 9.4% of the animals are polled. The males showed a lower incidence of supernumerary teats and a higher proportion of polledness. Sixteen color patterns and combinations were found in the goat flocks of this project.

The kiddings in Northeast Brazil occur throughout the year, showing that the goats are continuous breeders. Preliminary and partial information show that 29.2% of the kiddings occur during the wet season and the remaining 70.8% of the kiddings occur during the dry season. The overall prolificacy in the five control farms was 1.29 (1,712 kids born/1,323 kiddings), indicating that 29% and 71% of the kiddings were singles and twins, respectively. No variation in prolificacy was found among years (1.30, 1.29 and 1.29 for the first, second and third years, respectively), but between farms, the variation was from 1.13 to 1.51. The estimated interval between kiddings was 291.8 $\pm$ 78.4 days with a coefficient of variation of 28.6%. This figure indicates that this interval is appropriate and permits the does to kid at least once each year. From this interval, it can also be deduced that the service period is approximately 142 days, and that the postpartum interval is even shorter if repeated matings in some does is expected to occur before conception. The proportion of kiddings varied between years and also between farms. The sex ratio was 50.8 and 49.2% for males and females, respectively, and no differences were found among farms.

No substantial variation in birth weights of kids were found among seasons. However, some farms had heavier birth weights compared to the others. This may be due to the influence to some degree of crossbreeding with a larger breed. The same thing was observed with weight of does at kidding. However, greater parturition weights were recorded from does kidding multiples (31.9 kg) than those kidding singles (27.8 kg).

The overall mortality rate was 21.6%. The mortality varied between farms (9.8 to 36.3%). These differences could probably be due to the differential management used in each particular farm and also the limited feed resources available for a proper stocking rate. The age of kids at which a major loss occurred was 0-7 and 31-180 days. The incidence of mortality throughout the year is not yet available. However, it can be anticipated that the majority of births occurred during the dry season and kid losses occurred due to a deficient lactation of the does. The kid losses at advanced ages (31-180 days of age) might be due to the transition from the dry season, which

is characterized by deficient grazing conditions, to the rainy season with the consequent stress and weak goats.

Additional information has shown that some management practices improved reproductive and productive performance. When a restricted breeding period (October - November) was imposed on the goats at the private farm, 95.7% of the does were bred with 83% of fertility at parturition, 1.1% abortion rate and 3.2% mortality rate from birth up to six months of age compared to 92.2, 5.9 and 25.7% fertility, abortion and mortality rates, respectively, in the control farm. The prolificacy was similar in both farms (1.61 vs. 1.59). Weaning practice is one which showed difficulties in establishing and adoption by the producer because of its limitations in cost and labor. In flocks with some degree of improvement by crossbreeding with dairy goats, the weaning practice induced mastitis, especially during the wet season, characterized by good forage availability and when milk production was the highest. When weaning practice was applied during the dry season, the problem reversed, then the weaning practice was accepted. This observation truly proves that not all technological recommendations are accepted by the producer, and it requires a technical and economical validation before the innovative management practices are implemented through an outreach system.

The navel disinfection of newborn kids was completely adopted because of its simplicity and low cost to apply with a surprising efficiency to save kids, reducing the mortality especially during the first 30 days of life.

Brazilian Somali Semen Characteristics During the Dry and Wet Seasons

During the dry and wet seasons in the years 1982 and 1983, five rams were used to study the fresh and incubated (at 37°C) semen characteristics. The data show that ram semen is fertile in both seasons. The mating behavior and libido were not different among seasons, indicating breeding and semen collections can be performed at any time of the year. However, statistically higher ($P < 0.05$) values were obtained for ejaculate volume (0.5 ml) and mass motility score (3.74) during the dry season compared to those obtained during the wet season (0.3 ml and 2.70, respectively). The sperm concentration during the wet season (4.25×10^9/ml) was significantly greater ($P < 0.05$) than during the dry season, indicating that an inverse relationship exists between ejaculate volume and concentration and is a result of changes in volume.

The forward sperm motility and the individual sperm motility in semen incubated at 37°C for 5 or 120 minutes were statistically greater ($P < 0.05$) in semen collected during the dry season compared to semen collected during the rainy season.

In conclusion, the semen of Brazilian Somali sheep is fertile and usable throughout the year. However, the fresh semen characteristics and the thermo-stress test indicate that the semen obtained during the dry season is much better than semen collected during the rainy season. This information provides a means for better management of rams for improved reproductive efficiency based on the knowledge of the semen characteristics and breeding performance of rams.

Semen Characteristics of Santa Ines and Brazilian Somali Sheep

A one year study was conducted with ten rams (5 Santa Ines and 5 Somali) to evaluate and compare the semen characteristics of these two breeds during the dry and wet seasons. Results demonstrate that the Santa Ines sheep showed statistically higher ($P < 0.05$) fresh semen quality than the Brazilian Somali sheep in almost all characteristics observed except mass motility. No significant differences ($P > 0.05$) were found among breeds for forward and individual sperm motility in semen incubated at 37°C for 5 and 120 minutes. When the data were pooled by dry and wet seasons, statistical differences ($P < 0.05$) were found for ejaculated volume and sperm concentration, except mass sperm motility, among seasons. The dry season showed greater ejaculated volume and lower sperm concentration compared to the wet season. No statistical differences ($P > 0.05$) were found for forward and individual sperm motility among breeds or seasons.

In conclusion, the fresh semen of the Santa Ines was higher overall than the Somali breed. Both breeds during both seasons produced semen with good fertilizing capability based on the thermostress test at 37°C incubation for 5 and 120 minutes.

Reproductive Capabilities of Three Genotypesof Sheep Under Two Nutrition-Management Systems

This study was conducted with 72 ewe lambs beginning at weaning (24 each Morada Nova, Santa Ines and Brazilian Somali breeds) equally assigned to two nutrition-management systems (fed in confinement and native pasture). In confinement, the ewe lambs received chopped elephant grass ad libitum plus one percent of their body weight in concentrate mixture (cottonseed meal and chopped corn)/day containing 16% crude protein and 75% TDN. The feed intake was measured only for the confinement group.

The overall mean age and weight at puberty, regardless of breed and nutrition-management, was 303.5 days and 25.2 kg, respectively. A significant effect of nutrition-management on puberty was found. For the three breeds combined, the lambs in confinement reached puberty at 250.? days of age and 28.2 kg body weight compared to 356.8 days of age and 22.2 kg body weight for ewes on native pasture ($P < 0.01$). The Brazilian Somali and Morada Nova sheep showed lighter weights than the Santa Ines. The Brazilian Somali attained puberty at an older age than both Morada Nova and Santa Ines. The ovulation rate at puberty tended to be higher ($P < 0.05$) in ewes fed on native range (1.17) compared to confinement (1.09). The Morada Nova breed showed a higher ovulation rate (1.23) than Brazilian Somali and Santa Ines (1.14 and 1.04).

Preliminary information shows that the Morada Nova sheep have a higher ovulation rate (1.4 and 1.7) compared to the Santa Ines (1.3 and 1.1) and Brazilian Somali (1.3 and 1.5) under confinement and native pasture, respectively. No seasonal effect was found for ovulation rate, incidence of ovulation and incidence of estrus. The higher ovulation rate was found in sheep grazed on native pasture than sheep fed in confinement. These findings indicate that the feed quality and availability in native pasture is as good as in confinement when proper stocking rate is provided. The monthly mean incidence of ovulation was similar in sheep fed in confinement (81%) and in native pasture (80.8%). However, the incidence of estrus in the confined

group of sheep was higher than in sheep fed on native pasture. More information will be provided when all postpubertal experimental data is released by the Center and statistically analyzed. However, the following conclusions can be anticipated:

a. There is a significant effect of the level of nutrition on puberty, showing a negative relationship among live body-weight and age.

b. Ewe lambs (breeds combined) fed in confinement attained puberty 106.6 days younger and 6 kg live body weight heavier than ewe lambs fed in native pasture.

c. Ovulation rate in ewes grazed on native pasture was unexpectedly higher than in ewes fed in confinement.

d. The Morada Nova and Santa Ines breeds attained puberty at a younger age than the Somali breed. The Morada Nova and Somali sheep had similar body weights at puberty, but both were lighter than the Santa Ines breed.

e. Observations during the first post-pubertal year showed that the Morada Nova breed had a higher ovulation rate followed by Brazilian Somali and Santa Ines.

f. Ewes maintained in native pasture showed higher ovulation rate than ewes in confinement, as it was also shown at puberal ovulation.

g. No seasonal effect was detected on the monthly incidence of estrus and ovulation, indicating that the sheep in Northeast Brazil have the potential to be bred at any time of the year if proper management is provided.

Influence of First Suckling on Survivability of Newborn Lambs

This study was conducted at the EMBRAPA/CNPC in Sobral with three breeds of hair sheep (Morada Nova, Santa Ines and Somalis) during two lambing seasons. The main objective of this study was to measure the influence of breed, birth weight, type of birth and sex of lamb on the interval from lambing to first suckling and their influence on survivability.

The analysis of data showed that there is a significant difference ($P < 0.01$) among breeds for body weight at birth and the interval from lambing to first suckling. The mean interval from parturition to first suckling was significantly shorter in Morada Nova (22.2 min) compared to brazilian Somali (28 min) and Santa Ines (41.2 min).

The Morada Nova breed had a higher proportion of twinning (1.47) compared to Santa Ines (1.21) and Brazilian Somali (1.23). Even though the interval from lambing to first suckling in Morada Nova was shorter, the proportion of lamb losses was higher compared to Brazilian Somali and Santa Ines. This was considered to be due to the higher incidence of twins and the resulting lower birth weight in the Morada Nova. Within breeds, lamb losses were observed in a higher proportion shortly after birth or at a younger age when the first suckling was delayed, compared to those lambs suckled within a shorter interval after birth. Consequently, this information provides a practical

application in terms of newborn lamb management to increase the level of survivability and to increase lamb production per ewe lambing.

The relationship between birth weight and the interval from birth to first suckling ($r = -.231$, $n = 226$, $P < 0.01$) and the relationship between the interval to suckling and the weaning weight was negative and significant ($r = -.142$, $n = 226$, P 0.05).

BRAZIL

Reproduction--Utah State University

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Theses--(SR-CRSP)

PhD

Simplicio, A. A. 1985. Reproduction in Three Native Genotypes of Goats under Two Feeding-management Systems in Northeast Brazil; and Progesterone and Luteinizing Hormone Profiles during the Estrous Cycle and Seasonal Anestrus in Spanish Goats in the United States. Utah State University, Logan. **Utah/CNPC-Reproduction**

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