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SMALL RUMINANT

COLLABORATIVE RESEARCH

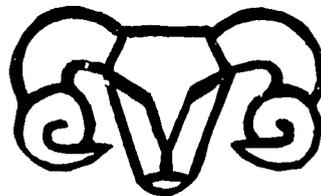
SUPPORT PROGRAM

INTEGRATED PROGRAM PLAN

PART V

KENYA

Prepared by the Management Entity



PART V

REGIONAL SUB PROGRAM

KENYA

TITLE XII

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

BACKGROUND

Kenya has a wide degree of environmental variability. With elevations ranging from sea level to 16,000 feet, its ecozones include, semi-arid rangelands, humid equatorial coastline, the highland slopes of Mt. Kilimanjaro, and the imposing Abedere Mountains. Within this ecological diversity, there is also great diversity in the agricultural production systems, which correspond closely with precipitation zones. Annual rainfall ranges from 200-2,000 mm and generally increases as elevation increases.

Areas of low agricultural potential are those which receive less than 600 mm of rain a year and it is estimated that 76 % of Kenya's total land area is in this category. 80% of Kenya's total rangeland is considered low potential and there are approximately 7.5 million sheep and goats in these dry areas. The predominant livestock husbandry system in the desert scrub range of the north and northeast, is the transhumant migration of pastoralists with their small ruminants and camels. The Masai in the south and south-east share their range and practice community grazing of their cattle.

Ten percent of Kenya's land has medium potential for agricultural production with 600-850 mm of rain per year. Approximately 3 million small ruminants are found in this zone. The high agricultural potential lands account for 14 % of the country's area and here rainfall exceeds 850 mm a year. Two million sheep and goats are in this ecozone. The agricultural production system in these latter two eco-climatic zones (II and III), is generally of the mixed crop/livestock type, with the livestock of secondary importance to cultivation.

Ninety percent of the Kenyan population relies on agriculture for their livelihood.- 80 % of that group live on approximately 1.5 million small, private holdings in the zone II and III areas of the following provinces: Coast, Eastern, Central, Rift Valley, Nyanza and Western. Livestock, although a secondary enterprise, are found on most of these holdings, with cattle on approximately 1 million farms, and sheep and/or goats on .6 million farms. The small ruminants are raised in an intensive "zero grazing" or limited grazing husbandry system and are both consumed by the producer and sold to provide revenue.

The human population is expanding rapidly in these already densely populated areas. This high growth rate is causing farm size to shrink and is diminishing the available resources per capita. Average farm size is now 2.3 hectares and mean household size is 7 persons.

Small ruminants are an important element in the mixed crop/livestock agricultural system in the medium and high potential areas. As land holdings decrease in size, goats and sheep will probably play an even greater role in contributing to rural diets and income, in some cases potentially replacing cows as milk suppliers. In addition, there is a growing world demand for small ruminants and their products to which these high potential agricultural areas may be able to profitably respond.

INTRODUCTION

The government of Kenya has recently emphasized the direct importance of its national sheep and goat flocks to the low income small holder by providing resources for their future development. As the world demand for small ruminants increases, the potential contribution of these animals to the country's economy is becoming important. Research programs like the UNDP/FAO Sheep and Goat Development Project (SDGP) have been initiated to increase sheep and goat productivity and improve the standard of living of the small farmer. The SDGP is active in both extensive range and intensive cropping regions, including investigation of dairy goats in the latter region. The participation of the Small Ruminant CRSP in Kenya will facilitate the continuation of the government's research efforts to improve small ruminant performance.

Research results generated in Kenya could be applied to other high rainfall tropical areas where mixed crop/livestock production systems exist or have the potential to be developed. Research here could also be useful in other areas of East Africa where cropping is the primary activity and livestock enterprises are of secondary importance.

Because the problems of small ruminant productivity in Kenya are multifaceted and interact in a dynamic and complex manner, a multidisciplinary research effort will be required to meet the goals of the SR-CRSP in this region. The Ministry of Agriculture, the Kenyan agency with which the SR-CRSP will collaborate, wishes to emphasize a coordinated approach to the study of the physical, biological, ecological, economic and sociological elements in the agricultural production system. The US scientists working in Kenya intend to collaborate among themselves, and with their Kenyan counterpart scientists in the Ministry of Livestock Development, University of Nairobi, Central Bureau of Statistics and UNDP/FAO SDGP.

The Breeding and Health projects will collaborate to obtain specific information on animal health status and response of different levels or types of disease exposure and health care. This study will provide an opportunity to examine the effect of genotype - environment interaction on productivity and health. The Economics project will cooperate with the Health project to study animal health economics and with the Management and Sociology projects to examine livestock production, farm decision making, marketing and consumption and conduct assessments of marketing potential and other topics which extend beyond the province of any single discipline. The Sociology project will gather field observation data relevant to the Breeding, Nutrition, Health, Manage-

ment, Economics, and Systems projects. All the projects will cooperate to produce a description of the small ruminant production and marketing system including categorization and quantification of production constraints and social and cultural factors.

An important component of the small ruminant collaborative effort will focus on integrating economic and sociological factors with agricultural data obtained at experiment stations and in the field, to both delineate the current small ruminant production systems and develop a coherent series of recommendations for improving animal productivity and marketing efficiency. These recommendations should consider how the elements which comprise the various production systems operate in relationship to each other to influence the functioning of the overall small ruminant production system in Kenya. Towards this end all the project participants will cooperate on a baseline study to characterize the entire small ruminant production system in the high and medium potential areas, the data from which will be useful to each project when they make their recommendations for improvements of the system and will also be made available to Systems Analysis for the Production Systems Simulation Model.

This collective approach to confronting the severe constraints upon animal productivity in this densely populated, intensively cultivated environment should facilitate the development of an integrated research endeavor which views the various agricultural problems of the region from a comprehensive rather than isolated perspective. Table 1 lists the US and Kenyan principal investigators (PI's), participating US and Kenyan institutions, and the research area upon which each individual project will focus.

TABLE 1**PROJECT AREA****PARTICIPATING INSTITUTIONS****PROJECT PARTICIPANTS****Animal Breeding
and Genetics****Ministry of Livestock Development
University of Nairobi
UNDP/FAO
University of California, Davis****W. Odenya

M. Sherafeldin
G. E. Bradford****Nutrition (Forages)****Ministry of Livestock Development
University of Nairobi
Ohio State University****R. W. Van Keuren
T. C. Quick****Animal Health****Ministry of Livestock Development
University of Nairobi
UNDP/FAO
Washington State****E. W. Allonby
W. G. Huber
J. Gorham
F. Abinanti****Management/Production Systems****Ministry of Livestock Development
University of Nairobi

Central Bureau of Statistics
UNDP/FAO
Winrock International Livestock Center****Z. Gathuka
A. M. Said
H. Kayongo-Male

E. W. Allonby
H. A. Fitzhugh
M. W. Sands
J. A. Yazman**

Table 1 (continued)

<u>PROJECT AREA</u>	<u>PARTICIPATING INSTITUTIONS</u>	<u>PROJECT PARTICIPANTS</u>
Economics	Ministry of Livestock Development University of Nairobi Central Bureau of Statistics Winrock International Livestock Center	A. J. DeBoer M. Job
Sociology	University of Nairobi University of Missouri	M. F. Nolan R. Campbell A. Noble
Systems Analysis	Ministry of Livestock Development University of Nairobi Texas A&M University	Z. Gathuka T. C. Cartwright G. M. Smith

PROBLEM

The majority of the small ruminants in Kenya are managed under dry range conditions in pastoral husbandry systems. The problems encountered by both the sedentary and transhumant herders in this environment are currently receiving considerable attention and the Small Ruminant CRSP intends to concentrate its efforts instead, in the densely populated high and medium potential agricultural areas where the potential for small ruminant contributions to the food supply and economy have not yet been fully realized or adequately explored.

The coastal region, an area in which the Ministry of Agriculture is developing a major sheep and goat research center, the heavily populated Northwest, and the limited scale cropping areas northeast of Nairobi are examples of regions where small ruminants, particularly dairy/dual purpose goats, could be more effectively integrated into the mixed crop/livestock production system.

Livestock research in Kenya has been traditionally oriented towards cattle despite the fact that goats could fit well into the land and capital limits of small holder subsistence farmers. Because small stock has not been the focus of active investigation, little is known about their adaptability and productivity under humid, tropical conditions, particularly their responses to climatic and health stresses. The common disease problems of dairy goats in temperate environments, internal parasites, mastitis and brucellosis, are exacerbated by trypanosomiasis, a disease transmitted by the Tse tse fly and a problem of major importance in the humid tropics of Africa.

Among their advantages, goats are small, have short gestation lengths, are multiparous and steadily produce small, readily usable quantities of high quality protein (milk and meat), a nutrient for which there are inadequate intake levels in many small holder households in the humid tropics. As farm sizes continue to decrease, parcels of land too small to support a dairy cow could support several dairy goats. These animals, if properly managed, could augment the protein available for human consumption in areas where current supplies are inadequate particularly among children and pregnant and lactating women. They also could provide needed farm income as the domestic and export demand for sheep and goats and their products increases. Some of the more specific problems the SR-CRSP intend to investigate include:

ANIMAL BREEDING AND GENETICS

If dual purpose goats with reasonable dairy production are to be successfully introduced in Kenya, a goat strain with at least moderate milk production potential that is adapted to humid areas and displays some degree of trypano tolerance is required. There are at present no such types available for distribution through the intensive mixed crop/livestock farming areas in Kenya and it will be necessary to develop such an animal if dairy/dual purpose goats are to be included in the present agricultural production system.

NUTRITION (FORAGES)

Forages constitute the major source of nutrients for livestock in the tropics and their utilization integrates with the utilization of marginal land, crop interstices and crop rotation programs. Even on small parcels, year round forages could supply adequate year round feed if properly developed and managed. There is however, a lack of information on the quality, intake and digestibility of tropical forages and serious gastrointestinal parasitism in tropical livestock that exacerbates this situation.

ANIMAL HEALTH

Disease and parasitism act in concert with other production system constraints to reduce the productive output and profit of small ruminant enterprises. Animal morbidity and mortality compound the problems of small holders raising dual purpose goats on intensive integrated crop/livestock farms in Kenya.

MANAGEMENT/PRODUCTION SYSTEMS

To successfully incorporate dairy/ dual purpose goat production into the existing livestock production system will require that the problems of intensive management in the humid tropics be investigated. These include the on-farm interactions of genetic and nutritional requirements, health problems and husbandry level with the off-farm interactions of dairy and meat processing, marketing and other financial considerations and the socio-cultural framework within which the entire system operates.

ECONOMICS

In addition to the physical and biological constraints on animal productivity in Kenya, the lack of knowledge about various production and marketing mechanisms and

demand characteristics for small ruminant products further limits potential production system improvements. This has been particularly true of goat production systems in the areas of medium to high agricultural potential.

SOCIOLOGY

Social and cultural attitudes are important and play a vital role in determining the overall pattern of small ruminant husbandry. They exert considerable influence on the decision making process of small holders and more research is needed on specifically where and how these factors operate within the total framework of the small holder, small ruminant production system.

SYSTEMS ANALYSIS

Integration of improvements made in individual components of an animal production system by systems analysis techniques is a relatively new field of science which takes into account the interaction of many factors contributing to the function of the production system. Factors having major effects on small ruminant producing systems in Kenya include: disease and parasite stresses interacting with nutrition and breeding which further interact with management, marketing, and other socio-economic effects.

OBJECTIVES

The long range objective of the Small Ruminant CRSP in Kenya is to increase the efficiency of production and distribution of small ruminant meat, milk and fiber in order to increase the food supply and raise the income of the small holder. The problems will be addressed by investigating the areas of the production systems which are amenable to modifications leading to improved animal performance and product delivery. All the investigators involved in Kenya will conduct research to further clarify the present conditions in the production systems, explore innovations which could improve them, and produce results applicable to Kenya's medium and high potential agricultural regions as well as other areas with similar conditions.

The projects are designed to be compatible with the Ministry of Agriculture guidelines, interdisciplinary in nature, and have Kenyan and SR-CRSP personnel collaborate closely with each other on their projects and with the personnel of the other projects. The primary focus of the research will be to define the constraining factors limiting small ruminant production in order to increase the population's nutritional levels and optimize productive and economic return. The biological and socio-economic constraints to dairy/dual purpose goat production in the high and medium rainfall areas of Kenya will be identified and alleviated in order to facilitate the development, implementation and strengthening of goat production systems in areas where they are not currently widespread. An adapted technology package designed to be compatible with the small holders technical and socio-economic requirements will be examined to ascertain whether it is suitable for integration with the current mixed crop/livestock production system.

The researchers will train Kenyan graduate students, and increase knowledge and competence of US and Kenyan project participants. The problem of the limited resource farmer engaging in small ruminant production will be better understood, particularly those interactions of the system's components and constraints which are of critical importance to productivity. Finally, it is important that the research results be accessible to the wide range of people who need to understand and implement them. Seminars and short courses will be conducted. Published research papers and technical reports in English and Swahili will be made available in the US and Kenya. In this way a large number of people can derive benefit from the collaborative efforts of the Ministry of Agriculture and the Small Ruminant CRSP.

In addition, to the broad, long range goals, the individual projects of the SR-CRSP will fulfill their short range goals by focusing their research on specific objectives, which are:

ANIMAL BREEDING AND GENETICS

Baseline data on the performance of indigenous goat breeds and crosses under intensive farming conditions will be obtained. The Breeding project will compare the reproduction, growth, milk production and state of health of East African and Galla goats, their F₁ crosses and crosses between these native breeds and two or three dairy breeds in the presence or absence of trypanosomiasis challenge. Using this information, a breeding plan for the improvement of dual purpose goats in small holder production systems will be developed.

NUTRITION (FORAGES)

The Nutrition project will identify and characterize the local forages and feed-stuffs available in tropical Kenya as well as the animal and feed production systems and the genetic types of animals found there. They will use this information to develop forage/animal production systems and evaluate plant/animal response, and the nutritional and microbiological factors associated with forage production systems for small ruminants. They will also determine the implications of the genetic variability of small ruminant resistance to gastrointestinal parasites under intensive grazing systems.

ANIMAL HEALTH

The Animal Health project seeks to implement effective preventive, therapeutic and control practices to reduce mortality and disease among the small ruminants in Kenya. They will adapt and modify control and prevention programs known to be successful, design novel approaches to herd health programs and initiate a pilot program for improved animal health management, chemoprophylaxis and therapeutics for diseases important in Kenya (ie. sheep pox). The information necessary for improving and for expanding herd health delivery systems which incorporate new applications of technology will be disseminated throughout Kenya.

MANAGEMENT/PRODUCTION SYSTEMS

The Management project will develop the facilities to conduct experiments designed to investigate intensive management systems appropriate for dual purpose goats

on small holdings. The agricultural production systems currently in use will be examined in order to determine the major constraints to such production systems and identify research priorities. The work will include the identification of feed resources, health problems, animal resources (genetics) product utilization, markets, labor requirements and small holder attitudes towards goats. This information will be used to establish a baseline data base of production and economic coefficients for use in computer simulations and the assessment of future production system modifications and interventions. Work to be conducted on the Winrock International Livestock Research and Training Center, Arkansas, includes the evaluation of various management systems and nutrient requirements for kids, replacement females and lactating does and a documentation of the quantity and source of phenotypic variation for growth, lactation, fertility and health in five dairy goat breeds: Saanen, Alpine, Toggenberg, Nubian and La Mancha.

ECONOMICS

Using data from all the projects, the Economics project will describe the existing physical, biological, organizational, and socio-economic aspects of the existing small ruminant production system, as part of the general farming system. Using this data they will undertake production economics farm management studies, in order to make a detailed analysis of the constraints influencing small farm, small ruminant production including those associated with introducing or expanding existing small ruminant enterprises in areas where they are currently not widespread. They will also define constraints influencing consumption, marketing, pricing, processing and distribution of small ruminant products in order to initiate research efforts to alleviate these problems. The long term prospects for the production and marketing of small ruminant meat, milk and hides will be identified and the optimal product mix patterned for various target farmer groups will be defined. The Economics project will also provide input into research planning and design and aid in the evaluation and analysis of the SR-CRSP program.

SOCIOLOGY

A general sociological constraint of primary importance is that any proposed technical modifications of the present small ruminant production systems in Kenya do not disturb the cultural fabric of small holder society to the extent that they are harmful rather than beneficial. Such potential dangers will be studied in depth with the objective of defining the small ruminant production systems and then recommending the manner in which needed improvements could be implemented so the changes they bring to the local population remain positive and if possible, within the context of traditional patterns.

SYSTEMS ANALYSIS

Computer simulation models of livestock goat production systems have been successfully used to increase the effectiveness of research efforts by identifying knowledge gaps and establishing research priorities and needs. In addition, validated computer simulations can be used for baseline simulations. Model applications of specific interest include the evaluation of production systems that incorporate dairy and dual purpose goats into agronomic production units in Kenya. This evaluation will include the assessment of traditional and alternative management practices, feed resources and supplementation programs, available breed types and application of research results. As appropriate, small ruminant production systems will be evaluated with primary emphasis on integration of a secondary livestock enterprise into small holder agronomic production units.

APPROACH

A number of approaches taken by the participants are common to the entire group while others are project specific. Good communication among all projects and a high level of cooperation is considered essential to the SR-CRSP. Collaboration among Kenyans and SR-CRSP will be enhanced because projects are designed to intermesh with the Ministry of Agriculture's current priorities.

All the projects will support US and Kenyan graduate students, provide training for in-country Kenyan scientists and technicians, conduct literature searches on topics relevant to their research area, and review the available data in their field for inclusion in the baseline survey.

The following specific approaches will be employed by the component projects.

ANIMAL BREEDING AND GENETICS

An initial small farm survey will be conducted to obtain reproduction, survival and age related weight data which will be summarized by breed or cross and used as a guide for selecting initial stock for breeding studies. Indigenous and F₁ dairy/indigenous crosses will be used in a preliminary evaluation of the effect of genetic potential for milk production on animal performance response to different levels of feeding, management and disease exposure and control. Local breeds and dairy/local crosses will be evaluated in at least two locations other than the one in which they were produced and one of the environments will be an area in which the Tse-tse fly is present. Data to be recorded on the does includes conception rate and numbers of kids born and weaned per doe bred and per doe kidding. All the kids will have their birth and weaning weights recorded. Variables measured in the female progeny include the following characteristics:

- weight at 6, 9, and 12 months
- age at first estrous
- age of first parturition
- number of kids born and weaned
- milk production
- kidding interval
- seasonal kidding distribution

Based on these results, superior animals will be identified in order to continue further breeding and evaluation studies.

NUTRITION (FORAGES)

A preliminary survey and evaluation of forage yield, utilization and preservation and animal adaptation and nutritional requirements in the context of the available forage and animal production system will be made. Forage samples will be collected for laboratory compositional analysis of mineral and nutrient content. Intake and digestability trials, some to be run on fistulated sheep and goats, will be conducted. Laboratory procedures will be devised for the establishment of an in vitro fermentation system to estimate dry matter digestibility of local forages and for chemical analyses of the samples from digestability trials. They will also initiate studies which investigate the association between gastrointestinal parasitism and nutrient availability and establish a cooperative plan for determining the effect of season and husbandry systems on the degree of gastrointestinal parasitism among various genetic types.

ANIMAL HEALTH

A survey instrument for all herd health projects to effectively measure the prevalence and economic significance of major small ruminant diseases and ectoparasites will be developed in order to collect data on: infectious and noninfectious diseases; reproductive performance; weak and dead neonates; diseases of young and growing animals; management practices and nutritional profiles. In their studies of sheep pox, the Health project will concentrate on producing antigens and anti-serums for the viruses associated with the disease and develop methodologies for using reagents to improve diagnostic procedures and control methods. New anthelmintics and coccidiostats will be tested as part of an effort to combat internal parasites. Information on small ruminant health problems will be coordinated with data on nutrition, genetics and animal and land management to aid in the establishment and implementation of successful herd health programs.

MANAGEMENT/PRODUCTION SYSTEMS

Experiments will be conducted to define nutrient requirements and evaluate local feed resources in order to develop feeding standards. Herd health, breeding and management programs will also be evaluated. Comprehensive production system surveys in high potential areas will be initiated to describe the current agricultural system, identify its constraints and establish baseline data for future comparisons. Procedures will be devel-

oped for long term monitoring of typical small farm production systems. Among the characteristics recorded will be:

- individual animal identifications
- periodic assessment of:
 - production traits
 - growth,
 - milk yield
 - fertility
 - health status
- seasonal fluctuations of nutrient quantity and source
- inputs (labor requirements)
- product utilization
- competition for other crop and livestock activities.

At Winrock International, production data will be collected and analyzed to evaluate genetic and environmental sources of variation and four feeding regimes for pre-weaned kids will be compared to initiate management requirement evaluation studies and develop feeding standards.

ECONOMICS

Primary and secondary sources will be used to collect production system description data. Broad based field surveys as well as farm, marketing agent and central market surveys will yield information on consumption patterns and facilitate demand analysis. Survey and experimental data will be used to initiate the development of a physical/financial model of the small farm-crop livestock complex.

SOCIOLOGY

Several types of intensive field work, including in depth observations and survey techniques, will be employed to define small ruminant production systems in the Western, Nyanza and Coastal districts of Kenya. Field studies related to key socio-cultural constraints to increased small ruminant production will be conducted from both a small farmer and structural socio-economic perspective. Special emphasis will be placed on examining small holder risk decision making, the role of women and children and how they influence the function of the system, the role of small ruminants in the rural communities' social fabric, and the role cooperative groups, particularly those formed by women, can play in the production of small ruminants. The social consequences of incor-

porating small ruminants into a predominantly crop based agricultural system will be assessed. Finally, the project will perform evaluation studies on proposed and implemented production system alterations and interventions designed to increase small ruminant productivity.

SYSTEMS ANALYSIS

Dynamic, comprehensive, mathematical models, based on biological functions, will be developed both for sheep and goat production systems with the individual animal as the modeling unit. Production data collected in Kenya will be used to validate model input parameters. Input data specific to each location and management system related to forage qualities through time, growth and lactation parameters and management policies, are required for the validation process. The validated simulation will serve as baseline data. Further simulations with varying inputs will then be used to identify the research required to develop techniques to accomplish specific objectives, synthesize alternative and ecozone specific production systems, and supply biological input-output data of traditional and altered production systems for use by the Economics and Sociology projects in such analyses as production efficiency studies. Specific production system components and alternative practices to be examined include:

- improved supplemental feeding
- use of cultivated forages
- disease control programs
- the optimum breeding season
- the value of exotic breeds and crossbreeding
- weaning, culling and marketing at younger ages
- market conditions and social customs

INDICATORS

The major activities which demonstrate that the investigators are engaged in an on-going research effort include:

1. Searching the literature and available records for information pertinent to each component's needs.
2. Gathering data and observations for inclusion in the baseline survey and computer simulation models.
3. Conducting planned experiments using animals located at the field stations and in the surrounding communities.
4. Surveying and defining the important characteristics of the market structure and the social system.
5. Implementing alternatives in the current production system that their research results indicate could improve productivity and efficiency.

ASSUMPTIONS THAT OBJECTIVES CAN BE MET

1. That the US and Kenya can establish an effective collaborative research support program.
2. That there are sufficient numbers of trained personnel and potential students interested in pursuing research on small ruminants in the context of the limited resource producer.
3. That there is currently an adequate supply of information to successfully launch the initial baseline survey and that active research programs presently in existence will be continued and strengthened.
4. That research and field stations at which basic and applied research can be conducted will be provided, including the provision of adequate land, laboratory facilities and flocks of reasonable sizes.
5. That good relationships will be maintained between the investigators and the local communities so production data and breeding records can be compiled and broadly based, applied research can be conducted and implemented on large flocks in a practical setting.
6. That there are trained project leaders and personnel to oversee the daily operations of the research projects, maintain records, and insure the continuity of the research effort.
7. That the local farmers with whom the investigators work cooperate with field survey and production data gathering efforts.
8. That those components of the small ruminant production system under investigation are able to respond to alterations in a positive manner.
9. That the necessary cultural adjustments and technology transfers to implement the suggested improvements in the small ruminant system can be made.

10. That once research is completed, all those involved in its implementation support extension efforts to institute changes in the husbandry practices of the small holders.
11. That USAID will continue funding the project over a period of time sufficient for data to be collected and integrated, practical applications implemented, and the net effects of the alterations of the production system analyzed.
12. That inflation be adequately accounted for in the allocation of funds to support the SR-CRSP.
13. That political stability in Kenya and the US government's view of Kenya continue for the duration of the SR-CRSP.

ASSUMPTIONS THAT MEETING THE OBJECTIVES WILL SOLVE THE PROBLEM

1. That the project participants have chosen to investigate, in an integrated manner, appropriate areas of small ruminant production systems. In particular, that the research will be conducted on those points where constraints operate and junctions at which critical components interact. For example, it is assumed that several scientists obtaining information on the seasonal dietary preferences of grazing animals, the nutritive value of feeds, rumen function, and availability of by products, will lead to formulation of appropriate supplementation practices that when implemented will indeed correct nutritional problems.
2. That presently existing and newly SR-CRSP acquired knowledge and technology could, with further research overseas, be placed in a context appropriate for implementation in tropical, semi-arid areas. For example, in other LDC's there are currently improved native breeds of livestock which clearly demonstrate that sound breeding techniques can be applied to many types of native animals to improve productivity.
3. That students and faculty trained in the SR-CRSP in Kenya will remain active in their fields and continue to contribute their expertise in an effort to increase the productivity of limited resource, small ruminant production systems.
4. That the Kenyan government provides adequate funding and incentive to implement changes in the limited resource farmers' production methods by supporting grazing control measures, genetic improvement and preventive flock health programs and the establishment of appropriate economic policies with regard to price supports, marketing institutions and reliable credit.

OUTPUTS

The outputs of the Small Ruminant CRSP will be the accomplishment of the objectives stated in the previous chapters and specifically referred to in the original project plans appended to this report. The results of the research will be made available through the publication of progress reports, documents and journal articles written on several levels to suit the people, the Ministry of Agriculture, scientific researchers, laboratories, extension officers, and local farmers. Extension efforts will include short courses, seminars and discussion, particularly for those people who are directly responsible for transferring new technology and methodology to the limited resource producer. There will be an increase in the number of trained students, and the level of competence of all those involved in the Small Ruminant CRSP.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Genetic Improvement of Dual Purpose Goats for Intensive
Smallholder Farming Systems in Kenya

Status: New Project

Sub-Grantee: University of California, Davis
Davis, California 95616

Principal Investigator: Eric Bradford

Duration: Two year minimum with planned extension of five years.

Background

Small ruminants are an important part of Kenya agriculture, and may become more important as farm size decreases, possibly replacing cows as a source of milk in some cases. Information is needed on the comparative efficiency and suitability of cows and goats as sources of milk under intensive farming systems in Kenya and in other countries with similar resources. At present there are no strains of goats in Kenya with high milk production potential which are also adapted to the more humid areas, particularly those where the tse tse fly is present. There is a need therefore to determine if a trypanotolerant goat with at least moderate milk production potential can be found or developed. There may also be a need in the near future for dairy or dual purpose goats well suited to the intensive farming areas at intermediate and higher elevations.

Long term objectives

1. Obtain base line data on performance of indigenous breeds and crosses of goats under intensive farming conditions in Kenya.
2. Compare reproduction, growth, milk production and health status of East African and Galla breeds of goats and of F_1 's produced by crossing these two breeds with each other and with two or three dairy breeds, in the presence and absence of trypanosomiasis challenge.
3. Provide animals of two or more breeds or crosses differing in milk production potential, for collaborative research among breeding, forage, nutrition and health projects.
4. Develop a breeding plan for the improvement of dual purpose goats for smallholder production systems in Kenya and other tropical countries.
5. Participate in development of genetic improvement plans for other classes of small ruminants in Kenya.

Personnel

G. E. Bradford (UCD), W. Odenya and M. Sharafeldin (Sheep and Goat Development

Project), and B.W. Kennedy and C. Finley (UCD). Participation by a University of Nairobi faculty member or members is also a possibility.

Approach (1980-81)

1. Reproduction, survival and weights at different ages obtained in the initial survey of small farms will be summarized by breed or cross, where this is known, as a guide for choice of stocks for further breeding work.
2. Indigenous (East African, Galla or crossbred) and F_1 (dairy x indigenous) animals of comparable age and prior treatment will be obtained from existing Sheep and Goat Development Project herds or from private breeder, or produced by matings among available stocks, for use in the initial phases of the interdisciplinary project being planned for an Experiment Station in western Kenya. These will enable a preliminary evaluation of the effect of genetic potential for milk production on response to different levels of feeding, management, disease exposure, and control, for use in future planning of work in these areas.
3. A station will be identified where the breeding project outlined below can be carried out, and stocks can be assembled in time for mating in late 1980 or early 1981. The station could be the one designated for the interdisciplinary research project, if the latter is large enough, or another research or multiplication center such as Ol Magogo. if that is more suitable. A unit with feed resources, labor and facilities for a minimum of 300 and preferably 600 breeding females, plus males and replacements, will be needed.

Year 2-5

1981-85. Animals of different breeds and crosses will be produced in one location, and evaluated in two or more locations, at least one of which will represent a high trypanosomiasis challenge. If possible, samples of the different

groups will be placed on small farms and data collected on their performance under those conditions.

Table 1. Phase I Mating Plan to Evaluate Local and Local x Dairy Breed Crosses

<u>Breed of male</u>	A. 300 breeding females		B. 600 breeding females	
	<u>Breed of female</u>		<u>Breed of female</u>	
	<u>E. African</u>	<u>Galla</u>	<u>E. African</u>	<u>Galla</u>
East African	60	30	60	60
Galla	30	60	60	60
Toggenburg	60	--	60	60
Nubian	60	--	60	60
Alpine	<u>60</u>	<u>--</u>	<u>60</u>	<u>60</u>
	210	90	300	300

Some Toggenburg and Nubian males are available in Kenya, through the Sheep and Goat Development Project and possibly from private breeders. Additional males of these two breeds, and Alpine breed males, will be imported if this is at all possible. If not, artificial insemination with imported semen will be attempted.

The mating outlined in table 1 will be continued until 60-80 female progeny per group have been produced.

Data to be recorded will include:

-Conception rate

-numbers of kids born and weaned per doe bred and per doe kidding

-birth and weaning weights - all kids

On female progeny:

-weights at 6, 9 and 12 months of age

-age at first estrus (if labor is available)

- age at first kidding, following exposure to males at a standard age
(10-12 months)
- number of kids born and weaned
- milk production (estimated by hand milking or weigh-suckle-weigh)
- interval between parturitions
- distribution of kiddings by season

Female progeny would be divided and evaluated in at least two environments as described earlier. This division could be done at weaning or at any time up to third kidding, depending on facilities available and other considerations. Allocation to different environments at an early age would provide information on genotype - environment interaction earlier; delay of this step would permit more accurate evaluation of the different groups in the initial environment, and provide Phase II progeny in larger numbers over a shorter period of time. Trypanotolerance of the different groups might be evaluated by placing weaned male kids in a flock such as Matuga.

Phase II.

Assuming early results indicate one or more of the crosses to be superior to the purebred East African and Galla breeds where milk as well as meat production is the goal, the best one or two F_1 's will be backcrossed to both parents to evaluate the effect of level of exotic inheritance on performance of goats in Kenyan environments. For example, if the Toggenburg x East African cross had the best performance in Phase I, the Phase II mating plan would be as shown in table 2.

Table 2. Phase II Mating Plan (Example).

<u>Males</u>	<u>East African</u>	<u>Females</u>	<u>Toggenburg x E. African (F_1)</u>
E. African	60-100	60-100	60-100
Toggenburg	60-100	60-100	60-100

The four progeny groups from the matings outlined in Table 2 would have 0, 25, 50 and 75% exotic (dairy) breed inheritance, from which the optimum proportion of such inheritance could be estimated. The four groups would each be subdivided and evaluated in at least two environments; it is quite possible that the optimum will differ between locations where trypanosomiasis is and is not present.

General

In both Phase I and Phase II, the research will be collaborative with other projects. Close collaboration with the veterinary project will be particularly important, to obtain specific information on health status and response to different levels or types of disease exposure and health care of the different breeds and crosses. There should be an opportunity here for definitive studies on genotype-environment interaction in health status. Evaluation of the different genotypes on different kinds of diets and under different management systems may be equally productive. Observations on behavior and other factors affecting adaptability of the different types to management typical of small farm systems will be made where possible. Recording of complete inputs (feed, labor, etc.) and outputs, on samples of the different breeding groups, will also be made if possible, in collaboration with the economics and systems projects.

Research in the U.S.

The U.S. component of the project during 1980-81 will consist primarily of genetic evaluation based on DHIA records, to aid in selection of males for use in both the U.S. and Kenya. Preliminary analyses of DHIA records have indicated very large effects of parity (lactation sequence) independent of age, on level of milk production; for example, does starting their second lactation at 24 months produce about 20-25% more milk than those with first lactations started at the same age. Factors, e.g. season of birth and breeding season, which might help explain this effect are being investigated from the DHIA records, although a full understanding will no doubt have to await controlled experiments.

Work on genetic evaluation will be undertaken as soon as satisfactory correction factors for age and season have been developed. At this time it is not known how useful the existing DHIA data will be for this purpose, but as much information as possible will be extracted.

Two areas where the combination of research in the U.S. and in Kenya should provide valuable information on factors affecting production in dairy goats are:

- 1) The effect of latitude on seasonality of breeding in different breeds
- 2) Genotype - environment interaction, e.g. is the ranking of breeds or of sire groups within breeds for important production traits the same in the different environments.

Answers to these questions will be very valuable in developing future breeding plans for improvement of production in this species in other developing countries, in the tropics and elsewhere. These investigations represent a long term goal of the project, but work towards them will be initiated in the coming year.

Expected 1980-81 activities and achievements

1. Support of the farming systems survey, and preliminary summary of survey data relevant to breeding project goals.
2. Initial matings of East African and Galla females to dairy breed males, using Toggenburg and Nubian males available in Kenya.
3. Importation into Kenya of bucks (or semen) of 3 dairy breeds.
4. Assembly of East African and Galla females for Phase I, and completion of the first matings for Phase I.
5. Recruitment of a full-time graduate student or postdoctoral person to work on the Kenya breeding project.
6. Estimation of accurate age and season correction factors for dairy goat records in the U.S., and use of corrected records for genetic evaluation.

Assumptions

1. Funding for the project in the amounts requested.
2. Availability of experiment station facilities adequate for at least Phase I Plan A.
3. Provision of East African and Galla females by the Sheep and Goat Development Project.
4. Permission to import bucks into Kenya, and partial support of cost of doing so from Site Development funds or funds from collaborating projects.

Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Intensive Forage Production Systems for Smallholder Sheep
and Goat Producers in Kenya

Status: New Project

Sub-Grantee: Ohio Agricultural Research & Development Center
Wooster, Ohio 44691

Principal Investigator: Robert W. Van Keuren

Duration: Two year minimum with planned extension of five years.

II. Project Proposal

A. Description of Problems

Improved forage production systems for smallholder mixed crop/livestock production are needed to increase animal productivity in the tropics. Forages are the only or major source of nutrients for small ruminants in this region and involve the utilization of marginal land, crop interstices and crop rotation programs. Frequently, smallholders have a small number of animals and control a limited amount of land, but the availability of year-round forage could supply adequate feed if properly developed and utilized. Compounding the problem of forages in the tropics is the lack of information on the quality, intake and digestibility of the tropical forages and serious gastrointestinal parasitism, resulting from intensive grazing. Gastro-intestinal parasite infestation is recognized as a major production constraint to most grazing sheep populations in the temperate and tropical zones throughout the world. Utilization of genetic variation for parasite resistance provides a basic approach for establishing genotypes with permanent inherent protection against parasitic infestation. Genetic resistance to gastrointestinal parasites is of potential importance for intensifying animal grazing systems in the developing countries of the world.

B. Objectives:

1. To identify and characterize the forages available in the tropics.
2. To develop forage/animal production systems and evaluate plant/animal response.
3. To evaluate the nutritional and microbiological factors of tropical forage production systems for small ruminants.
4. To determine the importance of animal genetic variation for resistance to gastrointestinal parasites under intensive grazing systems.

C. Project Approach: First Year

1. General:

- a. Establish in Kenya working relations with the personnel.

- b. Become familiar with local forages and feedstuff, animal and feed production systems, and genetic types of animals available.
 - c. Locate laboratory and field facilities.
 - d. Obtain and train support personnel for on-site and Ohio locations.
2. Objective I (forage agronomic evaluation):
- a. Review literature on tropical forages and small ruminant production systems in the tropics.
 - b. Collect forage samples on-site and initiate laboratory analysis on-site and in Ohio for determining mineral and nutrient composition.
 - c. Preliminary survey and evaluation of forages in terms of yield, utilization, and preservation.
3. Objective 2 (forage/animal production systems, all on-site):
- a. Preliminary evaluation of forage and animal production systems in terms of availability, adaption, and animal nutritional needs as currently known.
 - b. Plan production systems based on information obtained under "a".
4. Objective 3 (nutritional and microbiological factors):
- a. Kenya
 - (1) Run intake and digestibility trials (if possible) with sheep and goats on available forages.
 - (2) Surgically prepare fistulated sheep and goats.
 - (3) Establish laboratory set up for in vitro fermentation system to estimate dry matter digestibility (DMD) of local forages, and for chemical analyses of digestibility trial samples.
 - b. Ohio:
 - (1) Begin studies on association between gastrointestinal parasitism and nutrient availability.
 - (2) Using the same forages, compare in vitro (DMD) obtained with

rumen contents from Ohio and Kenya.

5. Objective 4 (utilizing genetic variation for resistance to gastrointestinal parasites):

a. Kenya:

- (1) Establish a cooperative plan with other PIs and on-site personnel for determining the degree of gastrointestinal parasitism among genetic types across season and type of husbandry.

b. Ohio:

- (1) Complete an in-depth literature review on the genetic resistance to internal parasites, consult with researchers in the areas of physiological and immunological components of parasite resistance.
- (2) Initiate experimental methods and strategy for collecting parameter measurements.
- (3) Introduce population samples of sheep with inherent ability to resist gastrointestinal parasitism.
- (4) Continue matings for the expansion of existing hair sheep populations and their crosses with indigenous groups.

D. Indicators and Outputs

1. Indicators

- a. Identification of potential forage/animal systems.
- b. Evaluation of importance of gastrointestinal parasitism as a production constraint.
- c. Establishment of laboratory and field site working conditions.

2. Outputs

- a. Literature reviews on forages and small ruminant production in tropics.
- b. Development of cooperative plans with collaborators at site locations.
- c. Collection of on-site forage and rumen samples and animal data on

parasitism.

d. Survey data on forages.

E. Assumptions:

Host countries will collaborate in developing and implementing projects and that the necessary laboratory, animal, and field facilities and experimental animals are available.

F. Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Herd/Flock Health Program in Kenya

Status: New Project

Sub-Grantee: Washington State University
Pullman, Washington 99164

Principal Investigator: William G. Huber

Duration: Two year minimum with planned extension of five years.

PLAN OF WORK - YEAR ONE

SUBGRANT ON HERD/FLOCK HEALTH PROGRAM

Washington State University, as one component of the AID Herd/Flock Health Program, seeks to implement effective preventive, therapeutic and control measures to reduce mortality and disease prevalence among small ruminants, especially dual purpose goats on intensive small farms with integrated crop and livestock programs in Kenya. Six objectives have been stated as a means to achieve these goals under the five-year plan. The specific steps to be achieved during the first year are detailed below by objective.

Objective One

To develop a prioritized list of activities by assessing the prevalence and economic significance of major small ruminant diseases, parasite infections, and health delivery deficiencies.

During months one through six, Washington State University (WSU) research workers will collaborate with the survey instrument designers at the University of California-Davis, Colorado State University, and Tuskegee Institute. Together they will prepare a commonly designed survey instrument for all herd health projects to effectively measure the prevalence and economic significance of major small ruminant diseases and ectoparasites in Kenya. During months 6 through 18, the survey will be in progress, with a preliminary report of findings due in month 12, and a final report due in month 18. We expect that the survey will collect such data as information on infectious and non-infectious diseases; reproductive performance; weak and dead neonates; diseases of young, growing animals; management practices; and a nutritional profile. These findings will provide additional insights on interdigitating our activities with other components of CRSP.

During months one through three, Drs. John Gorham and Francis Abinanti will prepare a preliminary report containing information on small ruminant diseases prevalent in Kenya by literature perusal.

In months one through seven, Drs. Abinanti and Huber will make a site visit to Kenya to select, and establish working relationships with, Dr. Allonby and his colleagues. They will also tentatively identify those scientists who have the interest and technical background to work collaboratively with WSU faculty on the delivery of herd health systems. The WSU scientists will also prepare preliminary reports on diseases, manpower, and other areas critical to the success of this objective.

Objective Two

- a) To adapt and modify known successful control and prevention programs.
- b) To design new development approaches for herd health programs for small ruminant diseases.
- c) To initiate a pilot or demonstration program of improved animal health management, chemoprophylaxis, and therapeutics.

Beginning with month nine and continuing through the fourth year of this study, sub-objectives a and b will be accomplished at WSU. The adaptation, modification, and development phases will be based initially on the preliminary data gathered early in year one by Drs. Abinanti and Huber, and on data prepared by Dr. Gorham. During the first year, we will expand these ongoing studies at WSU so that we may obtain information useful for herd health delivery in Kenya in collaboration with Dr. Allonby's program. For example, in our studies of sheep pox, we will concentrate on producing antigens and antiserums for viruses associated with the disease, and will develop methodologies for using reagents to enable better diagnostic procedures and methods of control. Also, we will continue ongoing research on internal parasites, including testing of new anthelmintics and coccidiostats. WSU scientists will focus on diagnostics, and will test diagnostic reagents and develop and test control measures. Approaches will be explored to effectively carry this information and technology to flock owners.

Sub-objective C of Objective two will occupy the second and third years of this

grant after the survey is complete and an effective herd health delivery system is determined for Kenya.

Objective Three

To coordinate information regarding small ruminant diseases, nutrition, genetics, animal husbandry, and land management in the establishment and implementation of HHPs.

Coordination with other United States and with Kenya components will begin in the first year of this grant and continue with frequent meetings, exchanges of documents, joint reports, and so forth, until the conclusion of the five-year project. Specifically, in one example, we will work with the University of California-Davis genetic study, under the direction of Dr. Eric Bradford, to provide herd health monitoring systems.

Arrangements have been made to collaborate on the Kenyan project with Ohio State University on feed resources, University of California-Davis - breeding, Winrock - economics, University of Missouri - sociology, Winrock - production systems, and Texas Tech - system analysis.

Objective Four

- a) To expand the technologies within Kenya through interaction with their scientists for expanding herd health delivery systems.
- b) To investigate needs for graduate education for selected students from Kenya.

During months 10 through 12 of the first year, WSU scientists will contact Kenyan scientists through site visits. Future years of the grant will build upon these contacts to improve herd health delivery (sub-objective a).

Sub-objective b will be accomplished after year one, and will build upon the contacts made by WSU scientists in the first year.

Objective Five

To assist Kenya in training existing personnel as animal health technicians

(paraprofessionals) in herd health delivery programs and in diagnostic, extension, and research techniques important to HHPs.

During the first year, WSU scientists will identify audio-visual and other aids that will assist the training program. By the end of the second year, the actual training program will begin in Kenya.

Objective Six

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

By the end of the first year of the grant, WSU scientists can take specific action, with their Kenyan and FAO counterparts, to strengthen the ALLONBY health care delivery system based upon knowledge gained through objectives one through four, stated above. During the first year of this grant, WSU scientists, through accumulation of data, personal contacts and research, will build a solid foundation on which to establish a successful program for the remaining four years of the grant.

We believe that the establishment of this small ruminant herd health delivery program will result in the accumulation of a critical body of knowledge to address disease control problems of small ruminants. Expanded and improved communications programs between the United States and Kenya will develop, to effect the most efficacious and economically feasible herd health program in consort with the other 12 participating institutions. We expect that the improved disease prevention and control methods developed under this study will eventually dominate disease treatment. Thus, this program will result in more food and fiber becoming available through an improvement in production efficiency.

Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Dairy Goat Production Systems for Smallholder Agriculturalists
in Kenya

Status: New Project

Sub-Grantee: Winrock International Livestock Research and Training Center
Morrilton, Arkansas 72110

Principal Investigator: Henry A, Fitzhugh

Duration: Two year minimum with planned extension of five years.

II. Project Objectives

Project Objectives to be accomplished in collaboration with other SR-CRSP projects (forage, health, breeding, economics, sociology and systems) and with Government of Kenya and UNDP/FAO Sheep and Goat Development Project.

General Objective:

To develop and adapt goat production systems to the needs of smallholder agriculturalists in the humid/sub-humid tropics, emphasizing dual purpose utilization of goats for production of milk and meat.

Successful accomplishment of this general objective will require coordinated, collaborative efforts to accomplish the following specific objectives:

1. Identify and amend biological constraints to dairy goat production.
 - a. Evaluation of nutrient requirements and development of general feeding standards with emphasis on use of locally available, low cost feed sources, including forage crops.
 - b. Characterization of health problems of goat under intensive management, development and implementation of effective herd health programs.
 - c. Characterization of genetic resources, estimation of genetic parameters and development of improvement programs with emphasis on fertility, milk yield, growth rate and survivability.
2. Identify and amend social and economic constraints to production.
 - a. Evaluation of social aspects of dairy goat production - taste and preference, social status, political attitudes and policies.
 - b. Evaluation of financial costs and returns to all components of dairy goat production, including benefits and costs of new or adapted technology.
 - c. Evaluation of current and potential markets for milk and meat from dairy goat systems including local and export markets for improved products.
3. Develop facilities and management techniques to improve productivity of dairy goats and the harvesting, processing and preservation of milk and meat products.

4. Develop and test appropriate materials and methodology for training scientists, extension personnel and producers in the techniques required for successful implementation of improved dairy goat production and marketing systems.

III. First Year Objectives:

A. Foreign site - Kenya

1. Design experiments and develop facilities for research on management systems appropriate to dual purpose goats on small farms, including evaluation of nutrient requirements.
2. Survey production systems in current use.
 - a. Identify feed resources, health problems, animal resources, product utilization, markets, labor requirements and attitudes of small farmers to goats.
 - b. Establish baseline data base of production and economic coefficients for use in systems simulation and assessment of the impact of future interventions.
 - c. Determine major constraints on production systems and identify research priorities.

B. U.S. site - Petit Jean Goat Dairy/Winrock International

1. Evaluate management systems and nutrient requirements for kids, replacement females and lactating does.
2. Document amount and sources of phenotypic variation for growth, lactation, fertility and health traits for five dairy breeds (Saanen, Alpine, Toggenberg, Nubian and La Mancha).
3. Review and summarize published information on dairy goat production systems emphasizing those reports appropriate to humid/sub-humid tropical regions.

IV. Project Approach (First Year)

A. Foreign Site Research

1. The Sheep and Goat Development Project (SCDP) station at Mutuga,

- near Mombasa, Coast Province has been identified as an appropriate site to initiate research on goat production systems. In collaboration with scientists from SGDP and SR-CRSP, experiments will be designed to develop feeding standards; evaluate locally available feeding resources; evaluate herd health breeding and management programs.
2. The current importance of goats, especially milk goats, in local small farm systems is not well known; however, potential for their utilization appears good on the small farms in the Coast; Nyanza and Western Provinces and in the dryland farming areas of the eastern Central Highlands. Comprehensive surveys of production systems in the high potential regions will be initiated to describe systems, identify constraints and establish baseline data for future comparisons. Surveys will be made by teams of enumerators (principally Kenyans). Design of survey instruments and supervision of the data gathering will be coordinated with scientists from SGDP and SR-CRSP. Surveys should start by May, 1980.
 3. Procedures will be developed for longer term monitoring of typical small farm production systems operated by small farmers willing to cooperate in the program. Procedures will include individual identification of animals; periodic assessment of production traits (growth, milk yield, fertility and health); recording of seasonal fluctuations in quantity and source of nutrients, labor requirements and other inputs; products utilization and competition from other crop and livestock activities.
 4. Results relevant to small ruminant production systems from previous experiments and surveys by SGDP and other working in Kenya will be reviewed. If requested, assistance will be provided in the analysis of data, appropriate to the objectives of the SR-CRSP project.

B. U.S. Based Research

1. Animal and facilities at the 150-doe, Grade A Petit Jean Goat Dairy will be utilized to evaluate management requirements and develop feeding standards. An experiment will begin in February, 1980 to compare four feeding regimes for preweaned kids: whole goat milk and milk replacer dispensed from nursettes, multiple kids suckling foster does, kids suckling does after machine milking.
2. Production data (growth, lactation, fertility and health) will be collected and analyzed to evaluate genetic and environmental sources of variation.
3. A comprehensive review and summarization of literature on dairy goat production will be done to establish the current state of the art. Other institutions and investigators throughout the world will be contacted to identify their current research objectives, procedures and accomplishment.

V. Indicators and Outputs (First Year):

A. Foreign Based Research

1. Experimental design for research to evaluate feeding standards and other aspects of research or management systems appropriate to Mutuga station.
2. Survey instruments and team of enumerators for evaluation of production systems currently functioning in the Coast Province.
3. Detailed plan of work for second and subsequent years activities in Kenya, including identification of Kenya counterparts, cooperating small farmers for long term monitoring activities.

B. U.S. Based Research

1. Progress reports.
 - a. Preliminary results from kid rearing management experiment.

b. Summary of growth, lactation, fertility and health traits
(means, standard deviations and other statistics).

2. Computerized program for recording performance data.
3. Annotated bibliography of dairy goat research literature.
4. Directory of institutions and individuals involved in dairy goat research, including summary of current research activities.

VI. Assumptions (First Year):

- A. Final agreement among collaborating institutions (SR-CRSP, GOK, UNDP/FAO) on terms of program for Kenya is reached by February, 1980; that these terms are sufficient to the requirements of the projected research or can be appropriately modified to be sufficient; and that terms of agreement are not cancelled or unfavorably altered by actions of the collaborating institutions.
- B. Logistical support arrangements for project establishment and operation in Kenya (site coordination, housing, transportation, fund transfers, etc) are completed by February, 1980.
- C. Financial support available for research activities in Kenya and U.S. is adequate or additional support is obtained from SR-CRSP or other sources.
- D. Dual purpose goats are suitable for integration with smallholder cropping systems in humid/sub-humid tropics or that the constraints which limit their availability may be resolved through proposed research.

VII. Inputs (See Budget Section)

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Economic Analysis of Small Ruminant Production and Marketing Systems in Kenya

Status: New Project

Sub-Grantee: Winrock International Livestock Research and Training Center
Morrilton, Arkansas 72110

Principal Investigator: A John De Boer

Duration: Two year minimum with planned extension of five years.

II. Scientific Program in Kenya

The long-term program in Kenya will concentrate its efforts on three major areas of research. The first efforts will describe small ruminant production as part of general farming systems through multi-disciplinary surveys supplemented by the Kenyan Government's Integrated Rural Survey Unit. The second area of research will focus on production economics, farm management and consumption/marketing/price behavior to provide a broad range of economic information to the Government of Kenya and the Small Ruminant CRSP. The third area will establish specific interdisciplinary studies in close collaboration with the other Small Ruminant research teams. A project in animal health economics is already planned for mid-1980. As the full program of scientific activity develops, economic analysis will be fully integrated into the biologically oriented projects, including forage production, animal health, animal breeding, and animal nutrition. Training of Kenyan staff will be an integral part of the Economics program and the project offers excellent potential for field training of Kenyan staff as well as economists from other African countries with small ruminant research and development programs.

At this stage the chief collaborating institutions have been identified as the UNDP/FAO Sheep and Goat Development Project, the International Livestock Centre for Africa, the University of Nairobi, and the Kenyan Ministries of Agriculture and Animal Production. It is anticipated that experience gained from ILCA's monitoring program in Kenya will be valuable to the Economics and Rural Sociology projects.

III. Cross Collaboration With Other Title XII Small Ruminant CRSP Principal

Investigators

1. Description of small ruminant production and marketing systems - Winrock dairy goat project, Rural Sociology (Missouri), Systems Analysis (Texas A&M), Animal Health (Wash. St. U.).
2. Marketing studies and assessment of market potential - Rural Sociology (Missouri), Winrock dairy goat project.

3. Description, categorization, and quantification of production constraints, including social and cultural factors - Rural Sociology (Missouri), Animal Health (Wash. St. U.), Forage Production (Ohio State), Animal Productivity (Winrock Dairy goats), and Systems Analysis (Texas A&M).

IV. Regional Applicability of the Research Beyond Kenya

Direct application for medium to high potential areas of Africa where crop-livestock production exists or is technically feasible. Cultural factors need careful assessment, however, even where technical feasibility looks promising.

V. Project Description

A. The Problem

In Kenya, animal production is a diverse enterprise and small ruminants are no exception. Most research efforts have been devoted to beef cattle and, more recently, to dairying. What little small ruminant research that has been carried out has been directed towards the semi-arid rangelands and high altitude sheep production. The goat is now receiving recognition as an animal with potential to enhance human diets and family income on small farms with limited resources. The economic research program will concentrate on the above objectives for small farm systems in Kenya in an effort to improve the overall nutritional status and income position of small Kenyan farms in the areas of higher agricultural potential.

B. Project Objectives

1. Describe existing small ruminant production systems in physical, cultural, sociological and economic aspects using multidisciplinary research teams.
2. Using information from (1) above, make a detailed analysis of the constraints influencing small ruminant production on small farms, including constraints to introducing small ruminant enterprises or to expanding existing small ruminant enterprises.
3. Define constraints influencing the consumption, marketing, processing and distribution of small ruminant products and initiate research efforts to

overcome these problems.

4. Identify the long-term prospects of the various small ruminant products - meat, milk, and hides - and define optimal product mix patterns for target farmer groups.

C. Research Approach

Description of production systems will require data collected from both primary and secondary sources. Broad-based field surveys will be used. Preliminary modelling of the small farm crop-livestock complex may also begin, based on this survey data. Work on consumption and demand analysis will probably have to be based exclusively on survey work at the farm, marketing agent, and central market levels given the lack of adequate secondary data on small ruminant products. Some information on marketing and production practices of small ruminant producers is currently being obtained by the Integrated Rural Survey Unit of the Government of Kenya and the research program will utilize their existing system of data collection to the fullest extent.

D. Indicators That Objectives Have Been Achieved

1. A description of existing product systems that can help identify major researchable problems for CRSP projects and identify regions where project implementation would have the greatest benefits.
2. Completed development of a physical/financial model based on farm survey data and the collection of experimental data appropriate for running in the model.
3. Establishment of an interdisciplinary research program in sheep and goat production which incorporates economic analysis as a vital component of research planning, design and analysis.

E. Assumptions That Objectives Can Be Met

1. Suitable researcher can be identified in Kenya and the U.S. to initiate the economic research project in Kenya and maintain program continuity in

the core areas of production economics and marketing.

2. Host government and collaborating institutions will allow researchers reasonable access to small ruminant producers and assist in getting producers cooperation.
3. The collaborating institution and other Small Ruminant CRSP projects will cooperate fully on field survey work to allow all necessary physical and socioeconomic information to be gathered.
4. Adequate availability of an access to counterpart staff to assist with the economic research program, to interact with other research programs, and help design and test improved production technologies at the farm level.

F. Assumptions That Meeting The Objectives Will Solve The Problem

1. The Government of Kenya will support the research and implementation of research results.
2. That implementation of improved systems of production and marketing practices does not prove impossible from a social, legal, administrative or political standpoint.
3. The research capability developed by counterpart staff and other Kenyan collaborating institutions will be recognized and utilized for practical problem solving and the development of investment programs to raise income generated by small ruminants in Kenya.

G. The Outputs

1. Development or modification of existing field survey instruments.
2. Publications covering the areas of work described in I above.
3. A functioning farm management and product marketing data collection system.
4. Trained Kenyan staff who can continue to service small ruminant research and small ruminant producers in Kenya.

VI. Technical Feasibility

The production and marketing studies planned for Kenya make use of known

research techniques used with small farmers in developing countries. Counterpart staff must assist in gaining local farmer acceptance and cooperation. Collaboration among participating Kenyan institutions will be required to carry out the full list of planned research activities. The strong support promised by the Government of Kenya, the UNDP/FAO Sheep and Goat Development Project and ILCA gives a good indication that inter-institutional cooperation will be excellent.

VII. Inputs (See Budget Section)

VIII. Implementation

Dr. Fitzhugh is scheduled to spend several months in Kenya in early 1980 to prepare the groundwork for the project. Following his visit, it is anticipated that a graduate research assistant in economics would be able to begin a 14-16 month period in residence to carry out fieldwork related to several of the project objectives stated earlier. The Principal Investigator, John De Boer, would spend several weeks in residence at that time to initiate the research project. A student is slated for a 6 month project in animal health economics during 1980-1981. In addition, De Boer anticipates spending June-August, 1981 in Kenya.

IX. Annual Review and Planning

A 5-year program plan is being prepared. Progress reports will be prepared each year and recommendations made regarding research objectives, staffing and budgetary support. Close liaison will be maintained with ILCA, UNDP/FAO SGDP, Ministry of Agriculture and the Planning Unit within the Ministry of Agriculture.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Sociological Analysis of Small Ruminant Production Systems
in Kenya

Status: New Project

Sub-Grantee: University of Missouri
Columbia, Missouri 65211

Principal Investigators: Michael F. Nolan

Duration: Two year minimum with planned extension of five years.

II. Scientific Program in Kenya

The sociology program in Kenya has the general objectives of (1) describing goat and sheep production systems in the intensive farming areas of Western, Nyanza and Coastal Provinces of Kenya; (2) conduct field studies related to the key socio-cultural constraints to increased small ruminant (SR) production in Kenya and (3) performing evaluation studies of production interventions.

The program's initial thrusts are oriented toward the descriptive objective above which should establish a framework for initiating subsequent studies under objective II. The establishment of priorities for later projects will be joint responsibility of the U.S. project staff and Kenyan counterparts.

III. Cross-Collaboration With Other SR-CRSP Projects

A. System Description:

Field observation will include data relevant to nutrition, feeding and forages (Ohio State University, OSU); animal health (Washington State University, WSU); genetics (University of California at Davis, UCD); economics (Winrock International Livestock Research and Training Center, WI); production systems (Winrock International Livestock Research, WI) and systems analysis (TAMU).

B. Close collaboration is expected with the economics and the production systems project in the areas of livestock production, marketing, consumption, farm decision making and similar variables which overlap. Joint field work is likely in many instances.

IV. Regional Applicability Beyond Kenya

Although there are local differences, much of the socio-cultural studies done in Kenya would have some applicability to other areas of East Africa where crop farming predominates and animals are a secondary activity. The usefulness to other areas elsewhere in the world is uncertain.

Project Description

The Problem

There is a well established axiom in agricultural development that changes in

agricultural production systems have wide ranging impacts on the societies as a whole. The history of the Green Revolution suggests that the burden of change falls disproportionately on small producers, often to the extent of making it impossible for them to stay on the land. Simply put technological solutions to production problems have often worsened rather than improved the lot of the small farmer. The overriding objective of this project is to try to prevent that situation from occurring in Kenya.

In Kenya most small ruminants production is carried out by small producers on private land holdings. In order for production interventions to succeed, the differences and interrelationships between the components of the production system will have to be taken into account. The current system combines elements of "zero grazing" along with limited grazing. Animals are apparently both consumed by the producing unit and sold for cash. In addition, there is a great potential for incorporating dairy animals into areas which now have substantial protein deficiencies. In western Kenya, in particular, effort will be given to evaluating the incorporation of SR into a system in which they do not now play a major role.

Throughout, two broad questions will guide our activities: (1) who will benefit from proposed production intervention?; and (2) what are the likely problems one can anticipate in trying to implement the intervention?

Objectives

- I. Obtain an accurate description of the current system of small ruminant production in the Western, Nyanza and Coastal districts of Kenya.
- II. Determine the key constraints to increased productivity both from the perspective of the small farmers and from a structural socio-economic perspective. In addition, examine the potential for increased consumption of SR products - particularly milk.
- III. Initiate a number of intensive field projects designed to provide in depth understanding of the precise nature of the key social constraints

to production. Early studies will focus on decision making; role of various family members (especially women and children) in SR production; assessing the social consequences of incorporating SR into a predominately crop based agriculture; and, documenting the role that cooperative groups can play in the production of SR. The selection of later topic areas will be made following the completion of Objectives I & II and in collaboration with our Kenyan counterparts.

- IV. Develop, or participate in the development of alternative strategies for increasing productivity in accord with the local socio-cultural patterns. This will probably not occur until after year three, at the earliest.
- V. Through graduate training, enhance the ability of Kenyan institutions to perform social assessments of new agricultural technologies.

Project Approach

During the life of the project in Kenya we propose to utilize a variety of approaches to accomplish our stated objectives. Initially we intend to send a rural sociologist to Kenya for six months to provide us with a description of the current system of production in West Kenya with particular emphasis on the areas which have started women's goat cooperatives. The individual charged with this task will prepare a report for distribution to all involved in the Kenya project. We will also participate in the baseline production systems survey currently planned for Kenya.

Prior to and during the time this work is being done, we will be conducting an extensive review of the literature relevant to a project on SR production. The results of this literature review, along with the descriptive account of the current production system will form the basis for setting priorities for future research activities.

Data collection methods will include both in-depth field observations and survey techniques. The choice will depend on the nature of the problem to be

studied and the type of data desired. It is our intention that the two methods will interface with each other in the sense that the observational reports may guide the development of survey instruments and surveys may suggest areas for future field observations.

Throughout our intent will be to work closely with Kenyan social scientists. It is our intention to actively involve them in the project but as they are already heavily committed to other responsibilities, it will take some time to develop these relationships. Nevertheless, we are hopeful that ways can be found to obtain their input as soon as possible.

In addition to working closely with Kenyan social scientists we anticipate continuing to build on the close relationship we enjoy with other projects which anticipate working in Kenya. We expect to collaborate closely with the economics project on our interests and their overlap in several areas. In the production area we will work closely with the production systems project, and reinforce close lines of communication with the health and breeding projects. Throughout we will try to accommodate their requests for information.

Indicators and Outputs

For the first year of effort in Kenya we expect the following outputs:

1. Establish a project reference center composed of published and unpublished reports related to the role of socio-cultural factors in livestock production.
2. Initiate a study of the current system of SR production in Kenya. This will include both quantitative and qualitative components of the current production situation. The report of this study should be available in the summer of 1981.
3. Begin the development of studies on risk taking/decision making.
4. Establish firm counterpart relations with Kenyan social scientists by involving them in project planning activities and identifying candidates for graduate training.

Assumptions For This Time Table

1. That a site coordinator is hired and working by April 1, 1980.
2. That sufficient logistical support (e.g., Vehicles) is available to allow field work to begin by June 1, 1980.
3. That no difficulties are encountered at any level in establishing scientist to scientist contacts.
4. That the current political system in Kenya don't change to the point that work becomes impossible.
5. That sociological research activities are not restructured through official action.

Assumptions That Achieving The Objectives Will Solve The Problem

This project is unique in that it is a non-production component of what is at the core of production oriented research programs. As such, the achievement of its objectives will in no way guarantee the success of the total program. At the same time, failure to meet the objectives may well doom the entire program.

One of our principal goals is to determine the appropriateness of production intervention to the socio-cultural situation and institutional arrangement in Kenyan society. It is assumed this kind of analysis will provide guidance in the selection of a strategy from among the alternatives available.

While the goal of SR-CRSP is to increase SR production and productivity, it is only to be done if large numbers of small producers can benefit. Thus, the beneficiaries of the SR-CRSP are people. It goes without saying that increased SR production will ultimately effect people. Whether that effect in Kenya is positive, rather than negligible or negative, will hinge largely on the abilities of the "people sciences" (sociology and economics) to meet their stated objectives.

Technical Feasibility

This project makes use of established observational and survey techniques. Field enumerators will be hired on a short term basis from communities and/or institutions near the study site.

Inputs (See Budget Section)

Personnel

University of Missouri

Michael F. Nolan, Principal Investigator

Rex R. Campbell, Co-PI

Graduate Research Assistant

Research Assistant

Collaborating Kenyan scientists

The project will work closely with the sheep and goat development project of the Animal Production Division of the Ministry of Livestock Development.

We are also in the process of discussions with faculty in the Department of Sociology at the University of Nairobi regarding their interest in collaborating on research projects at some future date. We anticipate their early cooperation in helping us identify students with an interest in and capability for graduate training under the auspices of the project.

Implementation

The Principal investigator has visited Kenya twice. Another member of the project staff will return in the Spring of 1980 to continue discussions of future studies with the collaborating scientists mentioned earlier and to work with the other CRSP projects in the design of the production systems survey. By July 1, 1980 we expect to place a social scientist in the field to begin to collect descriptive data for one aspect of the study. This will take approximately six months to complete.

Annual Review and Planning

The first planning session with Kenyan collaborators was held in February, 1980. It is our intention to involve the key U.S. staff in meetings with the Kenyans who will participate in the project so that the next period of work can be planned with as broad a base of input as possible.

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM (SR-CRSP)

TITLE XII

I. Face Sheet

Project Title: Systems Analysis and Synthesis of Small Ruminant Production
in Kenya

Status: New Project

Sub-Grantee: Texas A&M University
College Station, Texas 77843

Principal Investigator: Thomas C. Cartwright

Duration: Two year minimum with planned extension of five years.

Proposal Abstract

Systems Analysis And Synthesis Of Small Ruminant Production

Generalized, comprehensive, biologically based, mathematical models for simulating sheep production provide a systematic method for bringing knowledge relating to isolated production components together for the entire production system. These models, and simulations from them, organize available knowledge, identify knowledge voids, and provide a basis for determining critical research needs and for establishing priorities for technical assistance and development. Also, model simulations provide a method for examining or predicting the effect of new practices and determining optimal combinations and sequences of implementing practices and especially to avoid implementing practices which would be counter productive in production systems of a particular area.

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

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems.
2. To characterize production systems in Nyanza and Western providences and other appropriate ecozones of Kenya; to validate the model and input parameters; and to use these validated simulations as baseline simulations.
3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures which more effectively accomplish specific objective functions of the CRSP in Kenya.

4. To supply input-output data of dairy and dual-purpose goat production systems for use in economic analysis and sociological assessment.
5. To evaluate, through simulations, the response of dairy and dual-purpose goat production systems to alterations or interventions requested or agreed upon by the Kenya Ministry of Livestock Development.

II. Project Description

A. Description Of Problem

Generalized, comprehensive, biologically based, mathematical models for simulating sheep production provide a systematic method for bringing knowledge relating to isolated production components together for the entire producing unit in an equilibrium or dynamic state (Joandet and Cartwright, 1975). These models organize available information, identify knowledge voids, and provide a basis for determining critical research needs and for establishing priorities for technical assistance and development (Cartwright, 1978; Spedding, 1978).

Since the possible number of combinations for production practices is greater than can be studied experimentally, simulations provide a method for examining the effect of new practices and determining optimal combinations and sequences of implementing practices (ILCA, 1978). With complex input-output animal interactions, it is important to examine the effects of an intervention throughout the entire production system in order to avoid unanticipated effects which could be counterproductive on final biological or economic efficiency (Cartwright, 1970)

Factors having major effects on small ruminant producing systems in Kenya include disease and parasite stresses interacting with nutrition and breeding which further interact with management, marketing and other socio-economic effects. Techniques developed in operations research are designed to systematically organize and describe the dynamics of such complex systems through mathematical models (Van Dyne, 1978). These models may be constructed at various levels of refinement and generality (Joandet and Cartwright, 1975). The models, which will be developed as a component of this project, will be based on biological functions, applicable to each species in general, so that sets of input coefficients peculiar to a geographical area, breed or type of goat, management procedure or feed resource can be conveniently applied to the general model. Thus, these models are adaptable for simulating production systems in Kenya as well as the U.S.

Model applications of specific interest include the evaluation of production systems that incorporate dairy and dual-purpose goats into agronomic production units in the West of Kenya. This evaluation will include the assessment of alternative management practices, feed resources and supplementation programs, and available breedtypes. As appropriate, production systems will be evaluated with primary emphasis on the integration of secondary livestock enterprises into small-holder agronomic production units.

B. Objectives Of Project

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

The specific objectives are:

1. To develop a dynamic, comprehensive, mathematical model, based on biological functions, for sheep production systems with the individual animal as the modeling unit; and to develop a similar model for goat production systems.
2. To characterize production systems in the Nyanza and Western provinces and other appropriate ecozones of Kenya; to validate the models and input parameters using these data and information; and to use the validated simulations as the baseline simulations.
3. To examine, through modeling and simulations, research needs and priorities required to develop technologies and procedures, which more effectively accomplish specific objective functions of the CRSP in Kenya.
4. To supply simulated input-output data of dairy and dual-purpose goat

production systems for use in economic analysis and sociological assessment.

5. To evaluate, through simulations, the response of dairy and dual-purpose goat production systems to alterations or interventions requested or agreed upon by the Kenya Ministry of Livestock Development.

C. Project Approach

Building the required models will be an active process involving interaction with all collaborating projects for gaining input information and for feedback to them concerning information which is needed but is lacking or poorly understood and which the other CRSP projects can direct their efforts toward determining. That is, to aid in direction of research and setting priorities. The feedback process will begin early during the first year; the goat model is expected to be ready for preliminary runs during the second year.

Objective B1

The models will be developed similar to the TAMU Cattle Production Systems Model (Sanders and Cartwright, 1979a,b).

1. The first step in the development of a sheep production systems model is to search out and evaluate available data and research results relevant to model construction, including consultation with experienced specialists. The uniqueness and utility of the cattle model results from its conceptual structure: the driving variables are quantity and quality of nutrient resources; biological responses are conditioned by animal genotype, management practices and other environmental variables; this simulation model closely emulates real world processes.
2. The information is then described by appropriate mathematical functions, fit into the model structure using difference equations and programmed for computer processing (Van Dyne, 1978). The mathematical functions are based on biological processes and are not simply curves fitted to a set of input-output data as is the case with normative models (Cartwright, 1978).

3. A similar model of goat production will be initiated following development of the sheep model. The goat model is expected to follow comparable stages of the sheep model at about a one-year interval.
4. Even though the proposed form of the model has proven useful with beef cattle, major additional components are needed. One is an interacting, dynamic forage component; a second is a quantitative interacting disease-parasite component. Inputs from these areas are essential from the outset even though they will not initially be modeled as interacting components; that is, there will be no feedback of animal performance to forage or to disease-parasite components. This extension of the models would be anticipated to begin about the fourth year when more information has become available and wide experience obtained throughout the CRSP.

Objective B2

1. The available feed resources and breedtypes of goats will be characterized through the use of data collected through the efforts of other CRSP projects. Because there is little current dairy goat production in Kenya, the data collected at the anticipated dairy goat research station in the West of Kenya will be the primary source of information necessary to characterize these production systems and to refine and validate the goat model.
2. After the working model is completed, it will be subjected to validation tests which will consist of simulation of the production systems introduced at the dairy goat research station and, perhaps, the women's cooperative near Busia. Sequences of simulation, validation, model modification and new simulation are necessary. This recurrent process is tedious and time consuming but absolutely essential. These validation runs also serve as baseline documentation against which recommended changes are to be compared. The goat model is expected to be validated during the third year and production simulations initiated. Simulations would

continue during successive years.

3. Once the sheep and goat models have been validated and refined, they will be available for examining production systems in other ecozones of Kenya. In each case, information about feed resources, genetic potential of available breedtypes and productivity of existing (traditional) systems will be required. This information may come from CRSP projects and/or other projects in Kenya.

Objective B3

1. The process of gathering, organizing and collating existing information and modeling production systems will identify knowledge voids or deficiencies. The model can also be used to examine the importance of these parameters by varying them through a logical range and determining if these changes have important effects on the predicted outcome of a production system. This type of sensitivity analyses will help establish research priorities. Thus, by identifying knowledge voids or deficiencies and their importance, the systems analysis project will assist the collaborating projects in coordinating their research activities (Byerly, 1977). This coordinating process and the function of bringing information from other CRSP project together to fit into the total production system will be continued throughout the project tenure.

Objective B4

1. This objective, which is closely collaborative with the economic and sociology projects, will be to simulate dairy and dual-purpose goat production systems for the West of Kenya utilizing the baseline (validation) simulations to compare against simulations with some changes imposed. The changes imposed will consist of practices recommended from collaborating projects, practices suggested by detailed examination of the simulation outputs to determine at what point production efficiency

suffers the greatest, practices suggested by Kenyan livestock researchers, and other types of changes. The changes examined would include such practices as supplemental feeding, disease control, marketing at younger ages, breeding seasons of different lengths at different times of the year, introduction of exotic breeds and crossing.

2. These simulations would include effects on the total production systems and the input-output data would provide the base data required for economic analysis and for analysis for sociological feasibility and impact. These analyses will begin during the third year, intensify during the fourth, and continue throughout the project.

Objective B5

1. This objective will emphasize working cooperatively with Kenya counterparts to examine bottle necks and constraints to present production systems and to formulate logical interventions and eventually synthesize technologies and/or production systems for settings in various Kenyan locations. Simulations will be designed to examine the effect of various interventions such as altered management practices, drought, quarantines or new government policies on specific production systems and will begin after the models are completed and validated. The close consultation of Ministry of Livestock Development officials, planning officers, livestock officers and Kenyan personnel will be essential. Input data peculiar to each location and management system are required; these data relate to forage qualities through time growth and lactation parameters, and management policies. Existing conditions will be simulated for validation, to instill confidence, and to serve as baseline. Biological efficiency will be evaluated through examination of effects on each production component across time. In this manner the constraints to efficiency can be more readily detected and analyzed,

and prescriptive measures developed (Cartwright et al., 1977; Davis et al., 1976). These simulations will begin after validation during the third year.

D. The Indicators

The major conditions, in sequence, that will indicate objectives have been achieved are:

- i. Development of sheep and goat models which are comprehensive, general, biologically based, dynamic and programmed for computer use.
2. Validation of these models against data collected at the dairy goat research station and other Kenyan locations; those data may be collected by other CRSP projects and/or other projects in Kenya.
3. Synthesis of sheep and goat production systems which meet objective functions specified by the Ministry of Livestock Development officials, planning officers and livestock officers in consultation with other CRSP project leaders.

A number of additional, less critical or less objective criteria, include development of feedback information and research priorities to help coordinate collaborative projects; interfacing economic and production systems models; and extending the production systems model to include feedback interactions with forage and veterinary components. The latter two objectives are long term, depend on development of information from collaborative projects and are not expected to be completed during the five year period.

E. Assumptions That Objective Can Be Met

The major assumption is that sufficient knowledge exists in the world, and is available to the project, to permit construction of quantitative models of sheep and goat production systems. Another assumption is that the available knowledge can be incorporated into adequate models and that these models will closely predict the outcome of production systems alternatives. A large-

ruminant model has been developed (Sanders and Cartwright, 1979a,b) and successfully applied in LDCs (Cartwright et al., 1977; Davis et al., 1976; ILCA, 1978). This success suggests that similar small-ruminant models can be developed; however, research data for small ruminants are not as extensive and sensitivity, especially in earlier versions, may be reduced. Data for consumption of browse and for high milk yield by goats are probably the areas of least knowledge.

F. Assumptions That Achieving Objectives Will Solve Problem

The modeling objective can be attained and will be available for use in Kenya and the U.S. regardless of the participation or capabilities of Kenya. However, application to specific locations by synthesizing systems and conducting economic analysis depends on the cooperation of key Kenya personnel. Requirements of expertise level and personnel commitment from Kenya are minimal. Data will be collected by project personnel if not already available. No physical requirements are essential although transportation and guides to remote areas would be helpful; it is assumed that transportation can be obtained by hire through project funds if necessary. Personnel from the Sheep and Goat Development Project have devoted their time to explain their perception of constraints and of their plans for development. Their continued cooperation is anticipated and will be essential; their willingness to utilize simulation results as appropriate to improve their decision and policy making process is also anticipated.

G. Outputs Of Project

Scientific agricultural knowledge has been said to be exportable from the U.S. to Kenya and other LDCs, but effective application of such knowledge to livestock production (that is, the development of viable technologies) have been minimal and at times counterproductive. A principal, general objective of this project is to make use of available research knowledge, optimally integrated into production systems where physical, financial and sociological constraints may be formidable. After model development, there will be two principal applications or outputs:

1. To simulate production systems incorporating anticipated research results for the cost/benefit analyses and other uses in guiding research priorities.
2. To simulate production systems for specific areas in order to predict the effects of implementation of new practices on various components of the system, or to determine optimal order and timing for establishing a series of proven practices.

The objective function, or goal, or small-ruminant production systems may vary among locations. Goals may be examined through model simulation in terms of biological efficiency, economic efficiency, energy, protein and hide production, export potential, financial returns to producer and other criteria. Thus, information critical to decisions of producers and policy makers will be more readily available.

The general models and the techniques and expertise developed will be applicable and available for use in any LDC and the U.S.

III. Technical Feasibility

The technical feasibility of this project is divided into two phases: (1) model development and validation and (2) simulation of Kenyan production systems and synthesis and examination of new systems.

The first phase consists of organizing knowledge about small ruminant into comprehensive, biologically based, dynamic, mathematical models and validating the accuracy of the model against real life experience. The techniques of modeling have been adapted to livestock production systems by the Texas A&M systems analysis group and widely validated and used in LDCs (Cartwright et al., 1978; Davis et al., 1976; ILCA, 1978; Ordonez, 1978). Therefore the techniques, methods, and expertise are available.

Two basic models will be developed; one for sheep and one for goats will include functions for accommodating parameters associated with fiber production (or lack thereof) and milk production (or lack thereof for uses other than

suckling young) by various breeds and types in various environmental settings. All of the data and understandings required for model development are not presently available. Some of this information which is lacking will be developed by other projects of the Title XII Small Ruminants CRSP. Other information will have to come from estimation by experienced ruminant nutritionists, physiologists, and other scientists. Regardless of this incomplete nature of available information, the models will be developed and are expected to represent the best understanding of total small-ruminant producing systems possible at this time.

Validation of this model remains the only point of doubtful outcome. That is, restructuring and refining the model may have to continue for two or three years in order to obtain satisfactory correspondence between simulations of production systems and outcome of the actual production systems. The probability of attaining this first phase of the project at least in substantial amounts is almost certain.

The second phase is that of simulating and synthesizing production systems in Kenya, that is, examining present systems and new recommended practices or methods. Since this phase depends on data collection and/or data already collected in Kenya and cooperation of Kenyan research collaborators and Ministry of Livestock Development personnel, the probability of accomplishing these objectives is good because of the expressed interest and support of these parties. However, minimal cooperation would still yield useful studies or reports. The level of attainment of this second phase depends on the interest and cooperation of the Ministry of Livestock Development and planning and livestock officers and on inputs generated by the other projects of the CRSP. Because of the interest and the expected good data base from the dairy goat research station and other locations, the outputs of this project should help form the basis for development of policies and programs of the Ministry of Livestock Development.

IV. Inputs (See Budget Section)

V. Personnel

1. Texas Agricultural Experiment Station

T.C. Cartwright, Professor

J.W. Bassett, Professor

G.M. Smith, Visiting Associate Professor

C.R. Long, Associate Professor

J.O. Sanders, Assistant Professor

T.C. Nelsen, Research Scientist

H.D. Blackburn, Research Associate

G.W. Hawariat, Graduate Assistant

G.L. Brenni, Graduate Assistant

2. Kenya Ministry of Livestock Development Sheep and Goat Development Project

Z. Gathuka

3. FAO/UNDP Sheep and Goat Development Project

E. Allonby

4. University of Nairobi College of Agriculture

A.B. Carles

VI. Implementation

The implementation of this project occurs in three phases:

1. Model development, validation, and refinement.
2. Simulation of dairy and dual-purpose goat production systems for the West of Kenya.
3. Applications of systems analysis to small ruminant production systems for Kenyan locations.

The first phase will actually continue throughout the project and require input from other collaborating projects as well as data and information collected on the projects in Kenya and in other LDCs.

The second phase is the application phase and depends heavily on data collected at the dairy goat research station and the cooperation of the collaborating projects

and the Kenyan counterparts. The simulations will be the basis for examining alternative production practices and synthesizing production systems to most effectively integrate dairy and dual-purpose goat production into small holder agronomic enterprises.

The final phase will involve utilization of data from other projects in Kenya as well as from the dairy goat research station. The interests and desires of the Ministry of Livestock Development and livestock and planning officers will determine the scope and direction of these efforts which could be initiated as soon as the sheep and/or goat models were developed and appropriate input data identified.

VII. Annual Review And Planning Processes

This project is somewhat unique in that progress or status is clearly indicated by stage of model development, degree of closeness of validation between actual and simulated production, and of the production systems synthesized. Also, this systems analysis project contributes to the coordination of the biotechnical aspects of the other collaborating projects. An annual report will be written for review. The annual report will be reviewed by the Head of the Animal Science Department, the Committee of Professors of the Animal Science Department, the Office of the Director of the Texas Agricultural Experiment Station, the Small Ruminant CRSP Program Director, the PI's of the Small Ruminant CRSP, and the cooperating Kenyan scientists.

A model of production systems is an organization of knowledge and provides a logical basis for planning each step in systems analysis and synthesis. The review feedback is the primary basis for planning.

Specific planning with respect to Kenya will be coordinated with the Program Director of the CRSP, the Technical Committee of PI's and the Ministry of Livestock Development.

VIII. Literature Cited

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MEMORANDUM OF UNDERSTANDING
ON
THE ADMINISTRATIVE ARRANGEMENTS
BETWEEN
THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
AND
THE MINISTRY OF LIVESTOCK DEVELOPMENT,
GOVERNMENT OF KENYA

WITH REGARD TO THE ESTABLISHMENT OF A
COLLABORATIVE RESEARCH SUPPORT PROGRAMME
ON SMALL RUMINANTS

MEMORANDUM OF UNDERSTANDING
ON THE ADMINISTRATIVE ARRANGEMENTS
BETWEEN THE REGENTS OF THE UNIVERSITY OF CALIFORNIA
AND
THE MINISTRY OF LIVESTOCK DEVELOPMENT
GOVERNMENT OF KENYA
WITH REGARD TO THE ESTABLISHMENT OF A
SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAMME

Within the framework of Title XII, International Food and Agricultural Development Act of 1975, the University of California, Davis (UCD), acting for and on behalf of the Regents of California and being the competent United States authority under the provisions of Grant No. AID/DSAN/XII-G-0049, and the Ministry of Livestock Development, Government of Kenya, (GOK), have entered into the following understanding:

I. DEFINITIONS - For purposes of this understanding, the following definition shall apply:

A. "CRSP" means the Title XII Small Ruminant Collaborative Research Support Programme established by joint action of the Agency for International Development (AID) and the Board for International Food and Agricultural Development (BIFAD), and funded by a grant from AID to the Regents of the University of California.

B. "Participating Institution" means a university or other research institution which has been awarded an active subgrant by the Regents of the University of California under the authority and provisions of the referenced AID grant to conduct a component project of the CRSP.

C. "Management Entity", or "ME", means the University of California at Davis which has been designated by AID and BIFAD as the legal and responsible institution for conducting the fiscal affairs and programme of the CRSP.

D. "Program Director" means the person appointed by the University of California at Davis to serve as the chief executive officer of the CRSP.

E. "Host Country" means Kenya, represented by Ministry of Livestock Development,
GOK

II. THE SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

A. The major understanding shall be the intention to establish a CRSP the goals of which shall be to conduct a research development and training programme in support of small ruminant production by the most limited resource producers and small holders and thereby to:

1. expand the body of knowledge and extend its application to the solution of specific problems;
2. expand the level of competence of US-CRSP and Host Country scientists to conduct research;
3. develop and test appropriate technologies to improve food, fiber and hide production;
4. improve small ruminant food, fiber and hide production capabilities by smallholders in the Host Country.

To assist in program planning, the Parties wish to set forth a brief statement of their intention to undertake collaborative work as part of the CRSP sponsored by the United States of America through its Agency for International Development (AID) pursuant to Title XII of the International Development and Food Assistance Act of 1975. Title XII has as one of its major objectives developing programs to attack the problems of food production

and food utilization in developing countries by bringing together the resources and expertise of universities and other research institutions in the United States and developing countries.

B. The current Plan of Operation of the research program is described in Annex 1. The plan will be revised from time to time.

C. The agreement shall commence on the date of the signing of this Memorandum of Understanding and shall continue to remain in force for as long as the aforementioned grant is provided to the ME by AID.

III. THE UNITED STATES' CONTRIBUTION

The ME shall extend to Ministry of Livestock Development, GOK, manpower and resources in accordance with the mutually agreed program plan as described in Annex I and as revised and extended from time to time. The costs of resources and manpower will be met by CRSP funds awarded to the Participating Institutions for the component projects of the CRSP, expended by or under the authority of the Program Director.

A. Direct Costs: The United States' contribution shall include funds with which to pay the following direct costs incurred under this understanding:

1. Salaries, Wages, benefits of CRSP administrative personnel in the Host Country; scientific and supplies and expenses; and equipment necessary to conduct the work of the CRSP.

2. US travel of all US and Host Country persons for the work of the CRSP.

3. ME-approved international travel by CRSP staff for the work of the CRSP, and of Host Country trainees and scientific and administrative staff working in the US for the CRSP.

4. Costs of training and traineeships.

5. Other ME-approved direct costs, including a possible Program Coordinator in Host Country.

All requisitions for purchase of supplies, equipment, travel of any kind and other expenses must be approved and signed by the Program Director at UCD or his designee regardless of whether the cost is incurred in the US or in the Host Country.

B. Manpower: UCD shall make available through the Participating Institutions the following manpower resources to Ministry of Livestock Development, GOK.

1. Scientists who shall be the principal investigators and co-investigators from the institutions with which the ME has sub-grant agreements under this CRSP.

2. Advanced personnel at the post-doctoral or pre-doctoral level for work in Kenya on the problems of small ruminants.

3. Technicians with particular skills to solve specific problems as the need arises.

C. Training: The following kinds of traineeships for Kenyan students may be made available:

1. Financial support to study for academic degrees.

2. Financial support for short-term training as deemed necessary for accomplishment of program objectives.

D. Administration: The chief executive officer of the CRSP shall be the Program Director appointed by the ME. The Program Director shall provide direction to the program in the US and the Host Country.

IV. HOST COUNTRY CONTRIBUTION

Ministry of Livestock Development, GOK, being the competent authority in the Host Country shall provide:

A. Office and laboratory space and facilities, and land and agricultural facilities for both Host Country scientists and CRSP scientists to do their work.

B. All the direct costs associated with this work in Host Country, including: the costs of electricity, water, secretarial staff, local technicians, cleaning and maintenance of facilities, procurement of livestock and their husbandry.

V. DUTIES, TAXES, AND EXEMPTIONS

A. Exemption from Host Country duties, taxes, or like charges of all materials solely for use of the CRSP whether purchased locally, in the US or in other countries. These exemptions may be acquired through the bilateral agreement between the United States Government and the government of the Host Country.

B. Exemption for all US Staff from Host Country taxation and provision to such staff the same conditions, privileges, and other exemptions as are applicable under the bilateral agreement between the United States Government and the government of the Host Country.

VI. PROGRAM FUNDS

A. As stated in Article III hereof, direct expenditures in support of CRSP work in the Host Country will be made by or under the authority of the Program Director from funds awarded in subgrants to the Participating Institutions.

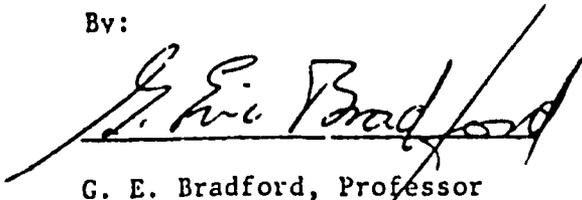
B. If mutually deemed to be desirable by the ME and Ministry of Livestock Development, GOK, CRSP funds may be provided to Ministry of Livestock Development, GOK, to be expended in support of CRSP work by or on behalf of one or more US Principal Investigators, or to be expended in support of work conducted by Ministry of Livestock Development, GOK, as part of the CRSP. Any such funding shall be through a separate agreement between the ME and Ministry of Livestock Development, GOK, executed as a subcontract under the AID grant for the CRSP. Such a subcontract shall specify the work to be conducted and the terms and conditions for the use of the funds.

VII. INTERPRETATION AND MODIFICATION

This Memorandum of Understanding in English constitutes the full agreement of the Parties hereto with respect to the CRSP and supercedes any and all prior agreements or understandings of the Parties regarding the CRSP and no modification of this memorandum unless in writing and signed by authorized representatives of each of the Parties shall be valid.

Approved for the Regents of the
University of California

By:



G. E. Bradford, Professor
College of Agriculture and Environmental
Sciences
University of California, Davis, Calif

Date:

28 February, 1980

By:

Allen G. Marr
Dean, Graduate Studies and Research
University of California
275 Mrak Hall
Davis, California 95616

Date:

Approved for the Government of Kenya

By:



Ministry of Livestock Development

Date:

28th February 1980

By:

Ministry of Finance

Date:
