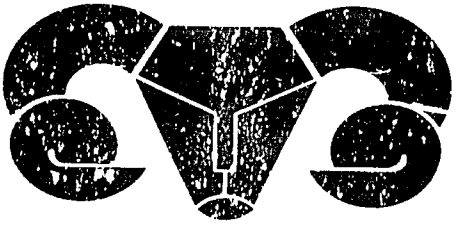
Small Ruminant Collaborative Research Support Program

Annual Report for

Kenya

Program Year Nine
1987-1988



Small Ruminant CRSP
University of California
Davis, California 95616

COLLABORATING ORGANIZATIONS

Federal (U.S.):

United States Agency for International Development
Science and Technology Bureau

Board for International Food and Agricultural Development
Joint Committee on Agricultural Development

Overseas Collaborators:

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

KENYA--Kenya Agricultural Research Institute

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

PERU--Instituto Nacional de Investigacion Agraria y Agroindustrial (INIPA)

Participating Institutions:

University of California, Davis

Colorado State University, Fort Collins

Montana State University, Bozeman

University of Missouri, Columbia

North Carolina State University, Raleigh

Texas A&M University, College Station

Texas Tech University, Lubbock

Utah State University, Logan

Washington State University, Pullman

Winrock International Institute for Agricultural Development, Morrilton, Arkansas

SMALL RUMINANT COLLABORATIVE RESEARCH SUPPORT PROGRAM

ANNUAL REPORT FOR KENYA

1987-1988

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If more information is desired, the Principal Investigator of the specific project may be contacted at his U.S. institution, or by enquiry from the Management Entity, Small Ruminant Collaborative Research Support Program, University of California, Davis, CA 95616. In addition to this series of annual reports by host country, the Management Entity has compiled a complete roster of trainees and a full listing of over 2400 theses, book chapters, scientific journal articles, abstracts of papers presented at meetings, and written and verbal technical presentations that reflect the activity of the SR-CRSP prior to 1989.

1987-1988 ANNUAL REPORT

Introduction

The global research program of the SR-CRSP addresses agricultural systems in which small ruminants are, or can become, an important component. In Kenya, research by SR-CRSP has been focused on a nontraditional role for goats--namely, producing milk and meat on small farms in high agricultural potential regions.

Much of western Kenya is blessed with fertile soils and a bimodal rainfall pattern, which permits two cropping seasons per year. This high agricultural potential has supported rapid population growth, which in turn has caused dimunition of farm size so that the prevailing agricultural systems no longer meet the needs of families for food and income.

Adding a dual-purpose goat (DPG) can increase the productivity of these smallholder systems. For example, DPGs can convert crop residues and browse otherwise lost to milk and meat. Keeping three to five does, instead of a cow can add a small, but consistent, milk protein supplement to family diets year round. Each doe can produce three kids in two years which can substantially increase farm market produce offtake or provide meat for family consumption. Because goat meat is a highly desired product, sales of excess goats have potential as a significant "cash crop."

To meet the needs of smallholders, DPG production systems must be based on low-cost, low-risk technology and be generally complementary to cropping activities. Kenyan and U.S. institutions are collaborating on developing this technology. The Kenya Agricultural Research Institute and the Ministries of Agriculture and Livestock Development are the principal host-country institutions. In addition, the SR-CRSP works with scientists from the University of Nairobi, Egerton University, and other institutions in Kenya.

U.S. institutions participating in the SR-CRSP/Kenya include

Texas A & M University	Breeding, systems analysis
Washington State University	Health
University of Missouri	Sociology
Winrock International	Economics, production systems (goat nutrition/management, feed resources).

The implementation strategy followed by the SR-CRSP in Kenya involves a three-phase process:

Phase 1 (1980-1982). Characterization of social-economic-biological activities of traditional farming systems and on-station component research in breeding health, goat nutrition, and agronomy.

Phase 2 (1983-1985). Monitor limited numbers of DPGs on farms; scientist-managed, on-farm component research (agronomy, goat nutrition, health management); on-farm component research in breeding, health, nutrition, and agronomy; and preliminary cost/benefit and social feasibility analyses.

Phase 3 (1986-1990). Technical, economic, and social evaluation of technology packages and production systems under farmer management. Component research--both on station and farm--continues.

Emphasis has been placed on a farming systems approach to ensure that research results are relevant to the needs and the resources of farmers in western Kenya. In addition, the general principles, and many of the specific technologies for DPGs, can be adapted to farming systems in other parts of the tropics.

Accomplishments during 1987-88 were built upon the results of research in previous years. In general, these accomplishments represent the collaborative efforts of scientists from the multiple disciplines supported by two or more of the projects in Kenya. For example, scientists from sociology, economics, and production systems completed a baseline survey of 120 households in four new clusters. With this baseline established, 250 dual-purpose goats were distributed to farm families to test the technical, social, and economic feasibility of DPG technologies under small farm conditions.

Animal health scientists developed DNA probes for surveillance and epidemiological studies of Anaplasma, and they developed and tested a vaccine for contagious caprine pleuropneumonia (CCPP) that can be stored at room temperature and provides protection for more than one year.

The DPG breed stabilization and improvement phase was implemented. This base generation of the four-breed composite provides an excellent opportunity for segregating the major genes and epistatic combinations associated with genetic immunity to diseases and parasites. Breeding and health scientists collaborated on preliminary research that indicated the existence of genetic resistance to haemonchus infections in DPG.

Feed resources are the major limiting factor to DPG

productivity. An important, if somewhat surprising, use for sweet potato vines was evaluated. These vines were proven to be excellent milk replacers, allowing early weaning of DPG kids and making more milk available for human consumption. Multipurpose trees--leucaena, sesbania, and gliricidia--were evaluated and proved to have important value as sources of protein supplement for goats, of green manure for crops, and of firewood for family use.

With special funding, a short-term project was initiated to collect carcass data from 60 goats to assess edible product yields and to quantify carcass characteristics of intact males, castrates of different breeds, and mature does. Results showed that intact males had a lower percentage of fat than castrates, females were highest in percentage of carcass fat, no significant differences occurred in dressing percentages among the males of the different breeds, and body fat percentages of the females tended to validate the TAMU Goat Simulation Model parameter that was based on meager data. Also, the differences between the fat composition of goats and sheep is striking and emphasizes the different nutrition and management required. As numbers of DPGs permit, further studies will be undertaken to assess meat off-take; this will be an important factor contributing to the value of the goat to the small holder.

SR-CRSP scientists published "Dual-Purpose Goat Technology Package for Smallholders in Kenya," a compilation of more than 30 documented recommendations for management feed production, nutrition, breeding, health care, and management of dual-purpose goats. This publication is written in a style usable by extension workers for transferring technologies to small farmers.

The training of Kenyan scientists has a high priority. During 1987-88, three Kenyans were studying for Ph.D. degrees with support from health, sociology, and economics projects. Non-degree training included four workshops conducted for extension specialists in western Kenya. SR-CRSP scientists from Kenya were invited speakers for international conferences in Brazil, France, U.S.A., Ethiopia, and Zimbabwe.

1987-1988 Annual Report

Title:	**Genetic Improvement Of Dual Purpose Goats Under Smallholder Farming System**
Host Country:	Kenya
U.S. Institution:	Texas Agricultural Experiment Station Texas A&M University System
Host Country Institution:	Kenya Agricultural Research Institute
Personnel:	Principal Investigator: T. C. Cartwright, Professor Emeritus, TAES Co-Investigator: H. D. Blackburn, Research Scientist, TAES Resident Scientist: F. Ruvuna, Research Scientist, TAES Host Country Co-Workers: C. O. Ahuya, Research Officer, KARI M. A. Okeyo, Research Officer, KARI S. Mkuu, Technical Officer, KARI P. Shompole, Veterinary Officer, KARI

RESEARCH RESULTS

During the past year the major long-term objectives of this project began coming to fruition on or ahead of schedule: 1) to genetically synthesize a new dual purpose goat breed (DPG) that can thrive, and produce milk and meat in viable amounts, in agriculturally high potential areas of the tropics; 2) to collaborate with other SR-CRSP projects by providing experimental animals and in design, conduct, and analysis of experiments; and 3) to release improved DPG to farmers and breeders, and to design and establish a sound program for breed stabilization, improvement, and multiplication in the private sector. The Ol Magogo flock will evolve as the elite genetic resource flock of the DPG. Since this project was established in 1982, the flock has been dynamic, as planned, and is now in the process of phasing out all purebreds (except for core genetic reference flocks) used for producing F1 and phasing down all F1s (except for genetic reference flocks) in order to build up the flock of the four-breed composite synthetic DPG to approximately 1,000 head of does. The current inventory at

Ol Magogo is approximately 1,500 head, 200 of which are DPG. The DPG will increase to well over 500 by the end of 1988, 800 in 1989, and 1,000 by the end of 1990. Approximately 150 F1 does and 7 F1 bucks were assigned this year to the collaborative experiments based at Maseno. Approximately 50 bucks of suitable genetic diversity were allocated to the collaborative research with the Health Project experiment at the Ukunda Station. A flock of approximately 65 purebred Toggenburg does and followers have been built up at the Ngong Station.

The DPG breed stabilization and improvement phase was implemented. It must be originally based on individual performance and will phase into increasing emphasis on progeny testing. The criteria used for selection are optimal growth (weight/age through lifetime) and lactation (milk production/lactation) established as optimal by the Systems Analysis Project for western Kenya smallholder farms. Growth, a more highly heritable character, is now near the optimal 40 kg doe weight potential at maturity. Milk production, a sex-limited character, is estimated to currently average about 3.5 kg/day potential for a mature doe. Selection to increase this to 4.0 kg/day optimal value was initiated this year based on individual performance records. The first extensive haemonchus tests of over 300 bucks up to 1 year of age was completed toward the end of the current year in collaboration with the Health Project. Before selection for natural genetic immunity to haemonchus can be practiced, the data must be analyzed and evaluated by both projects. This new innovative approach may require some refinement of procedures, but to date the results show very promising indications of genetic segregation. All buck kids were exposed to natural infestation, monitored closely via packed cell volume of red blood cells and fecal egg counts. Eighteen yearling bucks have survived without reaching critical levels that require anthelmintic treatment. These 18 bucks will be further challenged with known quantities of larvae by the Health Project to further verify their immunity level. Selection, based on both individual and progeny test data, will include natural immunity.

The base (or zero) generation of the 4-breed composite and, to an even greater extent, the first generation resulting from inter-mating the base generation, creates a maximally segregating genetic population. This population maximizes the opportunity for segregating out genes and epistatic gene combinations that may be associated with genetic immunity to diseases and parasites and other major gene effects. Also, this population and its preceding generations provide data exceptionally well suited to evaluating heterosis retention (recombination loss). These results will represent major contributions to the scientific literature, as well as provide valuable information to guide development projects in LDCs. These data are currently being analyzed.

The extensive lactation, growth, meat, management, and health data collected on this project are currently being analyzed for

scientific publication and for developing a breeding component of the "Technical Package" for Kenya. The information is nearly complete except for carcass and meat information which will be available from slaughter of intact and castrate males in August/September. Data on goat carcasses and meat, as well as castration effects, are generally lacking. These data will be useful for management decisions but also to the Systems Project. A draft of the "Technical Package" component has been completed and will be revised, as time permits, to include carcass information. A cooperative agreement was made with the Naivasha Dairy Training School to make and evaluate cheese made from the milk from Ol Magogo.

Initially plans for releasing the DPG as a breed have been drafted. Increased competence of AI and MOET with goats will be given emphasis in order to more effectively disseminate superior genetic stock in Kenya and for export (see Training section). Approximately 65 F1 bucks have been released to producers and breeders in order to obtain feedback information. Returned questionnaires uniformly report that kids sired by the F1 bucks are healthier and grow faster. Distribution arrangements have been completed for an additional 65 bucks.

The DPG breed has reached its most critical phase in breed formation: selection and breeding to stabilize the population as a breed and to move it toward optimal production levels.

PUBLICATIONS

Journal Articles, Refereed

Ruvuna, F., T. C. Cartwright, H. D. Blackburn, M. A. Okeyo and S. Chema. 1988. Lactation performance and growth rates of kids under different milking and rearing methods in Kenya. Anim. Prod. 46:237-242.

Manuscripts Submitted or in Press

Bradford, G. E., P. J. Burfening and T. C. Cartwright. 1988. Evaluating of production and reproduction traits of sheep, goat and alpaca genotypes in the Small Ruminant CRSP. J. Anim. Sci. (in press).

Ruvuna, F., T. C. Cartwright, H. D. Blackburn, M. Okeyo and S. Chema. 1987. Gestation length, birth weight and pre and postweaning growth of indigenous tropical goats and their crosses with Toggenburg and Anglo Nubian in Kenya. J. of Agric. Sci. (Camb.) (in press).

Ruvuna, F. and T. C. Cartwright. 1987. Developing a dual purpose

goat breed in Kenya. World Anim. Rev. (submitted).

Ruvuna, F., T. C. Cartwright, H. D. Blackburn, C. O. Ahuya and S. Chema. 1988. Environmental and genetic effects on growth of Galla and East African goats. J. Agric. Sci. (prepared).

Ruvuna, F., T. C. Cartwright, H. D. Blackburn, C. O. Ahuya and S. Chema. 1988. Heterosis, additive and other genetic effects associated with cross-goats up to one year of age. J. Agric. Sci. (prepared).

Abstracts

Ahuya, C., T. C. Cartwright and F. Ruvuna. 1988. Additive and heterotic effects from crossbreeding goats in Kenya. SR CRSP Kenya Proceedings (in press).

Bogui, N. S., T. C. Cartwright and J. M. Shelton. 1987. Reproductive performance and preweaning growth of meat goats in Texas. Proc. IV Int'l Conf. on Goats II:448.

Cartwright, T. C., F. Ruvuna, P. J. Howard and H. D. Blackburn. 1987. Designing breeding strategy for a synthetic dual purpose goat. J. Anim. Sci. Abst. 65(Suppl. 1):202.

Cartwright, T. C., E. L. Lentz, H. D. Blackburn, S. K. Tallam and F. Ruvuna. 1988. The potential productivity of intensive smallholder goat dairies in Western Kenya. Proc. 5th Small Ruminant CRSP Workshop, Kabete (in press).

Ruvuna, F., T. C. Cartwright, M. Okeyo and S. K. Tallam. 1988. Appraisal of mating strategy and selection criteria for evolving a dual purpose goat breed for Kenya. SR CRSP Kenya Proceedings (in press).

Shavulimo, S. R., F. R. Rurangirwa, F. Ruvuna, A. D. James, P. R. Ellis, T. C. McGuire. 1986. An evaluation for resistance against Haemonchus contortus in three goat breeds: East African, Galla and East African x Toggenburg. Proc. 5th SR CRSP Kenya Workshop, Kabete (pp 113).

Tallam, S., M. Onim, F. Ruvuna and T. C. Cartwright. 1988. Management options for increased animal productivity: simulated meat and offtake potentials. SR CRSP Proceedings (in press).

Training

Degree Oriented

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

P. J. Howard, U. S. citizen, is working toward a Ph.D. She received minor Breeding Project funding. Expected date of completion is September, 1988. Howard received an M.S. at the Univ. of Florida under Sr CRSP Economics Project graduate assistantship). (Also listed under Systems Project.)

Non-degree Oriented

An AI short course for goats was completed utilizing funds obtained outside but utilized SR CRSP Breeding Project goats and facilities. Approximately 25 technicians participated representing KARI, SR CRSP, private breeders, farm managers and other funding agencies. Funds to reinforce this short course and extend it to MOET for research purposes were obtained again for the coming year. Recent AI success rate on the Breeding Project have been about 50% or less and the specific goat AI expertise obtained for these short courses has been extremely useful to the Project. New success rates will be available for kiddings beginning in October 1988.

1987-1988 Annual Report

Title:	**Economic Analysis of Small Ruminant Production and Marketing Systems**
Host Country:	Kenya
U. S. Institution:	Winrock International
Host Country Institution:	Kenya Agricultural Research Institute (KARI)
Personnel:	Principal Investigator: H. C. Knipscheer Collaborating Scientist: F. Nyaribo (Ph.D. student)

RESEARCH RESULTS

The general project goals are 1) to develop useful whole-farm economic model of western Kenya small farms to assist in ex ante evaluation of dual-purpose goat acceptance, and 2) to conduct economic feasibility analysis of selected component technologies and management practices being developed for use by small farmers. These include forage production, feed production from modification of existing cropping systems, dipping, drenching, alternative confinement systems, and evaluation of economic success achieved with goats distributed to farmers.

Because of the sudden departure of the key host country economist, Mr. Luke Oyugi, the implementation of the economics program was seriously interrupted. In two areas, however, steady progress was made. First, Ms. Fanny Nyaribo, as part of her Ph.D. thesis research, visited Kenya to collect field data, and has subsequently made good progress in the development of national farm plans for the adoption of DPGs in western Kenya. Second, a sound start has been made in the on-farm evaluation of DPGs on small-scale farms in the same region.

Optimal Farm Plans

These preliminary farm plans will help in the testing and evaluation of DPG technologies under on-farm, farmer-managed trials. To date, the relevant biological and socioeconomic data has been compiled and summarized. A whole-farm mathematics model, incorporating household risk preferences and seasonal variations, has been developed, although not yet tested. The publication of results is pending on the completion of Ms. Nyaribo's thesis. The

following activities and constraints are the basic variables of the model:

Crop and Livestock/forage activities

1) Maize-sudangrass intercrop (ha)
2) Maize-bean-pigeon pea intercrop (ha)
3) Cassava growing (ha)
4) Land preparation (hoeing) (ha)
5) Land preparation (owned oxen) (ha)
6) Land preparation (hired oxen) (ha)
7) Fallow range (ha)
8) Off-farm range (ha)
9) Hay silage (kg)
10) Buy hybrid maize seed (kg)
11) Use own hybrid maize seed (kg)
12) Buy bean seed (kg)
13) Use own bean seed (kg)
14) Keep 1 DPG units (1 unit = 1 doe + 2 kids) on a November kidding schedule
15) Keep 1 DPG unit on April kidding schedule
16) Fence row forage production (ha)
17) Maize selling (kg)
18) Bean selling (kg)
19) Cassava selling (kg)
20) Hay silage selling (kg)
21) DPG kid selling (female)
22) DPG kid selling (male)
23) Maize buying (kg)
24) Bean buying (kg)
25) Cassava buying (kg)
26) Hay silage buying (kg)
27) DPG doe growing and breeding for replacement of culled DPG
28) Lactating doe feeding (1 doe)
29) Dry doe feeding (1 doe)
30) DPG weaner feeding (1 kid)
31) Buck feeding (1 buck)
32) DPG doe (cull) selling
33) DPG buck (cull) selling
34) Feb-Mar-April-May hired labor (1 manday (md))
35) Sept-Oct-Nov hired labor (1 md)
36) June-July-Aug off-farm employment (1 md)
37) Dec-Jan off-farm employment (1 md)
38) Feb-Mar-April-May off-farm employment (1 md)
39) Maize consumption (kg)
40) Bean consumption (kg)
41) Meat consumption (kg)
42) Cassava consumption (kg)
43) Income (Kshs)
44) Borrow cash (Kshs)

Constraints

1) On-farm land constraint (ha)
2) Off-farm land constraint (ha)
3) On-farm range land (ha)
4) Off-farm range land (ha)
5) Feb-Mar-April-May labor (md)
6) Sept-Oct-Nov labor (md)
7) June-July-Aug labor (md)
8) Dec-Jan labor (md)
9) Feb-Mar-April-May hired labor (md)
10) Sept-Oct-Nov hired labor (md)
11) Maize transfer row (kg)
12) Beans transfer row (kg)
13) Cassava transfer row (kg)
14) Sudan-grass transfer row (kg)
15) Pasture transfer row (kg)
16) Maize stover transfer row (kg)
17) Hay silage transfer row (kg)
18) Maximum number of does kept (1 unit)
19) Maximum number of male weaners kept (1 male)
20) Maximum number of female weaners kept (1 female)
21) Maximum number of bucks kept (1 buck)
22) Maximum number of suckling kids kept (1 kid)
23) Goat milk transfer row (1 liter)
24) Cow milk transfer row (1 liter)
25) Female kid transfer row (1 doe)
26) Male kid transfer row (1 doe)
27) Female cull transfer row (1 doe)
28) Male cull transfer row (1 buck)
29) Replacement female transfer row (1 doe)
30) Buck replacement transfer row (1 buck)
31) Maximum does milking - April kidding schedule (1 doe)
32) Maximum does milking - November kidding schedule (1 doe)
33) Minimum subsistence level requirement (maize consumption)
34) Minimum subsistence level requirement (beans consumption)
35) Minimum subsistence level goat milk consumption (liters)
36) Minimum subsistence level cow milk consumption (liters)
37) Minimum subsistence level meat consumption (kg)
38) Minimum level of digestible energy (DE) per doe (%DE)
39) Minimum level of DE per lactating doe (%DE)
40) Minimum level of DE per weaner (%DE)
41) Minimum level of DE per buck (%DE)
42) Minimum level of DE per lactating cow (%DE)
43) Minimum level of DE per dry cow (%DE)
44) Minimum level of crude protein/dry doe (%CP)
45) Minimum level of crude protein/lactating doe (%CP)
46) Minimum level of crude protein/weaner (%CP)
47) Minimum level of crude protein/buck (%CP)
48) Minimum level of crude protein/lactating cow (%CP)
49) Minimum level of crude protein/dry cow (%CP)
50) 38-48 based on number of days in dry season

51) Credit limit constraint (Kshs)
52) Borrow cash transfer row (Kshs)

On-farm DPG Evaluations

The SR-CRSP Kenya has completed almost 8 years of farming systems research (FSR) through station and on-farm scientist managed trials. A considerable amount of biosocioeconomic data has been collected and analyzed, and prototype technological packages developed for the introduction of dual-purpose goats into small-scale farming systems in western Kenya. By mid-1988, the next phase of the FSR in the development of DPG technologies, namely, conducting on-farm farmer-managed trials of the prototype packages was started. The major goal of this trial is to test and evaluate whether the prototype packages are feasible under, or how they can be modified to fit, farmer-managed conditions with minimal input from research scientists.

The organization and planning of this on-farm DPG evaluation was discussed extensively during a multidisciplinary workshop at Masenc, February 22-25, 1988. Issues addressed included 1) identification of evaluation site, 2) choice of participating farmers, 3) identification and training of field enumerators, 4) evaluation protocols, 5) placement of DPGs, 6) pregnancy status of DPGs, 7) health protocols, and 8) linkages with extension, PVOs, and local authorities.

The first step in the process of selecting participating farmers for the 1988 DPG distribution was in holding public meetings (barazas) in conjunction with the extension staff of the Ministry of Agriculture. These meetings were held in each of the sublocations to inform people of our intentions and to elicit the support of local officials.

The selection of participating farm households was done by drawing a random sample of land parcels listed for each sublocation to the District Land Registries. The land adjudication process is complete in the area and all land parcels have been registered and given a number. Each landholder, therefore, will theoretically have an equal chance of being selected. In cases where unofficial transfers of land ownership or subdivision have occurred (that are not reflected in the land registry), the current user of the parcel was chosen.

The selected farmers have been contacted with the assistance of the area subchief. The goals of the trial were discussed with them and each farmer was asked if he/she was willing to participate. Those who agreed to accept the DPGs were then interviewed in a rapid survey to take place just prior to the distribution. This selection procedure was successfully employed during the 1986 F1 distribution.

A rapid farm characterization survey was conducted just prior to the distribution of the goats. This survey was intended to provide basic information on each household needed for evaluating the performance of the DPGs. The information collected includes: land size, crop enterprises, current livestock holdings, household size, and labor availability. Results are reported under the sociological subprogram.

PUBLICATIONS

Technical Communications

Conelly, W. T., A. W. Mukhebi, L. Oyugi, and H. C. Knipscheer. 1987. Household Labor Allocation in an Intensive Crop/Livestock Farming System in Western Kenya. FSR/E Symposium, University of Arkansas, Fayetteville. October 18-21.

Training

Ms. Fanny Nyaribo passed all her preliminary exams for her Ph.D. degree in agricultural economics at Washington State University and continues working on her Ph.D. dissertation.

1987-1988 Annual Report

Title:	**Kenya Animal Health Research Component**
Host Country:	Kenya
U.S. Institution:	Washington State University
Host Country Institution:	Ministry of Livestock Development, Government of Kenya
Personnel:	Principal Investigator: Travis C. McGuire Collaborating Personnel: Listed with each experiment

Research Results

1. Identification and prevalence of goat Anaplasma in Kenya.

Personnel: S. Shompole,
S. Waghela,
F. Rurangirwa,
T. McGuire

Anaplasma spp. have been observed in erythrocytes from goats which are anemic and in poor body condition from various sheep and goat rearing regions in Kenya. Since three Anaplasma spp. cause parasitemia in goats, and only A. ovis causes disease, identification and determination of the prevalence of the Anaplasma spp. was done. To detect Anaplasma ovis, a 9.6 kilobase pair DNA probe TP-AC12A) was developed and used in conjunction with an A. marginale DNA probe previously derived from a portion of a gene coding for a 105,000 (Am105L) molecular weight surface protein of A. marginale. The 9.6 kilobase pair A. ovis DNA probe did not hybridize to Babesia bovis genomic DNA and goat leukocyte DNA. In Southern blotting, pA012A DNA hybridized to homologous sequences present in A. ovis and A. marginale genomic DNA. Anaplasma spp. infecting goats in Kenya were identified as A. ovis by (i) DNA hybridization reactions with pA012A DNA and failure to react with a 2 kilobase pair A. marginale probe, (ii) intraerythrocytic location of the Anaplasma organisms in infected goat blood, and (iii) host specificity of Anaplasma organisms for goats, but not for cattle. Also, using two Anaplasma DNA probes, the prevalence of A. ovis in goats from seven regions in Kenya was found to range from 22-g7%. The pA012A DNA probe detected a 0.0035% A. ovis parasitemia in infected blood. This level of sensitivity makes the

DNA probe suitable for use in surveillance and epidemiological studies.

2. Identification of antigens for the diagnosis and prevention of heartwater in goats.

Personnel:

S. Waghela,
F. Rurangirwa,
T. McGuire

Heartwater, caused by the rickettsia Cowdria ruminantium, infects goats, sheep and cattle. In goats, the disease causes very high mortality and can be devastating in susceptible populations. Transmission is by ticks, primarily Amblyoma variegatum, that are widely distributed in Kenya. Currently, diagnosis is made by postmortem examination of brain tissue. A more convenient method of diagnosis is needed as well as a method of prevention. Our objectives are directed toward developing a subunit vaccine and diagnostic test for heartwater.

This year we expanded the C. ruminantium DNA libraries by making lambda-gt11 (phage) and pUC19 (plasmid) expression libraries. These were immunoscreened with sera from C. ruminatium immune goats. Several colonies making protein were identified and are being evaluated for specificity. We expect that one of the genes or the expressed proteins can be used as a basis for a diagnostic test.

3. Contagious caprine pleuropheumonia (CCPP) vaccine development

Personnel:

F. Rurangirwa
S. Chema
T. McGuire

CCPP is the most serious disease of goats in Kenya, causing high mortality and great economic loss. The disease occurs in epidemics in all areas of the country, including western Kenya. The inactivated CCPP vaccine developed with MLD and SR-CRSP scientists is very effective and practical. These conclusions are based on data that demonstrate that a single injection can induce an immune response that completely protects goats against challenge for at least one year. Also, the vaccine can be stored in lyophilized form at room temperature for at least one year. These experiments have been done under controlled conditions. To show the utility of the vaccine under more natural conditions we did a limited, but controlled field trial. This experiment used larger numbers of goats than past experiments and used management similar to that used in the field.

One hundred goats from a CCPP-free area and free of antibodies to CCPP were obtained. One group of 50 goats was given a single injection of CCPP vaccine; another group of 50 goats was given an

injection of adjuvant without CCPP antigen. The goats were maintained on pasture as a group during the day and were enclosed at night. After 6 weeks, 4 goats with clinical signs of CCPP were introduced into the herd. The experiment is ongoing and the 50 immunized and 50 control goats are being evaluated weekly.

4. Evaluation of possible genetic resistance to Haemonchus contortus.

Personnel:

F. Rurangirwa,
F. Ruvuna,
T. Cartwright,
D. Jasmer,
T. McGuire

Data from the original small farm health survey and from evaluation of dual-purpose goats placed on farms in western Kenya indicate that infections with Haemonchus contortus are a major problem. The infections are severe enough to require some drenching to keep parasite numbers down. Since the drugs to control parasites are an expensive intervention, studies to evaluate genetic resistance to Haemonchus are being done. Preliminary data from R. Shavulimo's M.S. thesis indicated that breed differences in susceptibility to Haemonchus occur. If genetic resistance can be demonstrated and exploited, then placing a more resistant animal on farms is the best long term control method for Haemonchus infections.

Genetic resistance to Haemonchus infections was evaluated in preliminary experiments using kid goats whose infections were acquired by natural pasture transmission. Fecal egg counts and packed cell volumes were obtained for 1987 kids on a biweekly basis through August, 1988. Those kids with fecal egg counts over 1,000/gm feces or with PCVS of 20% or less were treated with anthelmintics to reduce worm burdens. Kids that demonstrated possible resistance to Haemonchus infections by completing the study period on pasture without requiring anthelmintic treatment were identified for further evaluation. Eighteen of the approximately 140 kids born in 1937 demonstrated possible resistance to Haemonchus. Eight of these were males and 10 were females. Nubian sires accounted for 7 of these, galla sires for 7, East African sires for 2, and four-way crosses for 2. Interestingly, five of the kids involving nubian crosses originated from the same sire, providing optimism that genetic factors may explain this apparent resistance. These 18 kids will provide important stock for more critical investigations into genetic resistance to Haemonchus.

PUBLICATIONS

Journal Articles, Refereed

Rurangirwa, F.R., McGuire, T.C., Kibor, A. and Chema, S. A latex agglutination test for field diagnosis of contagious caprine pleuropneumonia. Veterinary Record. 121:191-193, 1987. (Previously reported as in press.)

Rurangirwa, F.R., McGuire, T.C., Kibor, A. and Chema, S. An inactivated vaccine for contagious caprine pleuropneumonia. Veterinary Record. 121:397-402, 1987. (Previously reported as in press.)

Garmendia, A.E. and McGuire, T.C. The mechanism and isotypes involved in passive immunoglobulin transfer to the newborn alpaca. American Journal of Veterinary Research. 48:1465-1471, 1987. (Previously reported as in press.)

Garmendia, A.E., Palmer, G.H., Demartini, J.G. and McGuire, T.C. Failure of passive immunoglobulin transfer: A major determinant of mortality in newborn alpacas. American Journal of Veterinary Research. 48:1472-1476, 1987. (Previously reported as in press.)

Rurangirwa, F.R., McGuire, T.C., Chema, S. and Kibor, A. Vaccination against contagious caprine pleuropneumonia caused by F-38. Israeli Journal of Medical Sciences. 23:641-643, 1987. (Previously reported as in press.)

Rurangirwa, F.R., McGuire, T.C., Musoke, A.J. and Kibor, A. Differentiation of F38 mycoplasmas causing contagious caprine pleuropneumonia with a growth-inhibiting monoclonal antibody. Infection and Immunity. 55:3219-3220, 1987.

Palmer, G.H., Barbet, A.F., Musoke, A.J., Katende, J.M., Rurangirwa, F.R., Shkap, V., Pipano, E., Davis, W.C. and Mcguire, T.C. Recognition of conserved surface protein epitopes on Anaplasma centrale and Anaplasma marginale isolates from Israel, Kenya and the United States. International Journal of Parasitology. 18:33-38, 1988.

Manuscripts Submitted or in Press

Shavulimo, R.S., Rurangirwa, F.R., Ruvuna, F., James, A.D., Ellis, P.R. and McGuire, T.C. Genetic resistance to g strointestinal nematodes, with special reference to Haemonchu contortus, in three breeds of goats in Kenya. Bulletin of Animal Health and Production in Africa. In press.

Oluoch, E.A., Magnuson, N.S., McGuire, T.C. and Barbet, A.F.

Comparison of surface exposed peptides of antigenically related trypanosomes. Submitted for review.

Mwamachi, D.M., Rurangirwa, F.R., Musoke, A.J. and McGuire, T.C. Immune colostrum induces trypanotolerance in goat kids challenged with Trypanosoma congolense. Submitted for review.

Training

Degree oriented:

All students are Kenyan; all are working toward degrees awarded by Washington State University.

Patrick Shompole completed an M.S. degree October 1988. Thesis title: Cloned DNA probes identify pathogenic Anaplasma in goats as Anaplasma ovis.

Suryakant Waghela is working toward completion of a Ph.D. with an expected completion date of May 1989.

Stanley Kihara began working toward an M.S. in January 1988; his expected completion date is March 1990.

Non-degree oriented:

We have had no non-degree oriented training in this period.

1987-1988 Annual Report

Title:	**Dual Purpose Goat Production Systems for Smallholder Agriculturists**
Host Country:	Kenya
U.S. Institution:	Winrock International Institute for Agricultural Development
Host Country Institution:	Kenya Agricultural Research Institute, Ministry of Science and Technology
Personnel:	Principal Investigator: H. A. Fitzhugh Resident Scientists: J.F.M. Onim, Agronomist P.P. Semenye, Animal Scientist Host Collaborating Scientists: L. Musalia, Nutrition-Health Mgmt. M. Mathuva, Agronomy K. Otieno, Agronomy Host Country Co-Workers: W. Ochieng, Farm Manager J. Odour, Laboratory Manager Winrock Staff in U. S.

RESEARCH RESULTS

The rapidly growing human population in western Kenya places great pressure on farmers to produce food and generate income from their small holdings. Thus, any intervention to production systems must be based on low-cost, low-risk technologies which fit limited land, labor, and capital resources of local farming systems.

Dual-purpose goats have many potential advantages under these conditions. They eat by-products from food crops and browse from marginal lands. Keeping three to five does can provide a small but consistent milk-protein supplement to the family diet year-round. Litters of two to three kids at intervals of less than a year can increase family meat supplies and cash income.

Goals of the dual-purpose goat (DPG) production systems project are to develop and adapt production systems to the needs

of the smallholder agriculturist in the humid and semihumid tropics utilizing dual-purpose goats to produce milk and meat. Specific objectives include 1) to develop appropriate feed-production and preservation techniques, 2) to develop nutritional and management strategies to match the feed resources with DPG, and 3) to determine through on-farm evaluation, under farmer management, that production technologies are technically and economically feasible for small-scale farmers in the high-potential tropics.

Research has been implemented in three stages. 1980-1982: Characterizing the social, economic, and biological activities of traditional farming systems and on-station research in management and nutrition of goats and in agronomy. 1983-1985: Monitoring performance of dual-purpose goats on farms; scientist-managed, on-farm research in agronomy and goat nutrition management; and on-station research in goat nutrition and agronomy. 1986-1990: Evaluating technical, economic, and social feasibility of dual-purpose goat production systems under farmer management. The farming systems approach is emphasized to ensure relevance to the needs and resources of farmers in western Kenya.

Nutrition-Management (NM) and Feed Resources (FR) activities during 1987/88 have included:

On-farm surveys to establish baseline for large scale evaluation. The new clusters will be Muhanda in Kakamega district, Rabour between Emuhaya in Kakamega district and Yala in Siaya district, and Lela in Kisumu district. Surveys were conducted during the month of March, 1988. Farmers were randomly selected. Approximately 30 households in each cluster were interviewed. Of farmers interviewed, the proportion interested in participating in DPG evaluation were Muhanda, 87%; Rabour, 73%; and Lela, 60%. Reasons for refusing included fear of financial loss and shortage of labor to care for goats.

Milk replacers for kid rearing. Sweet potato vines (SPV) have proven to be an excellent milk "replacer," high in protein (20%) and digestibility (70%). FR has screened forty sweet potato cultivars from western Kenya for forage and tuber yields and nutrient value. Tuber yields ranged from 0 - 21 t/ha per year for human consumption. In addition to SPV, on-station research continues with another milk "replacer," Tylossema spp, an indigenous legume with protein and digestibility of 14% and 69%, respectively.

Multipurpose trees (MPTs) for forage, fuelwood, and improving soil fertility. Continuing research with Sesbania sesban var nubica, Leucaena leucocephala, Gliricidia sepium and Cajanus cajan on Maseno Station and on farms in western Kenya has been expanded to include: Acacia polyacantha subs. calophylla, A. calothyrus and Mimosa scabrella. A sesbania germplasm collection comprising 200 accessions from Tanzania and Western Kenya with 14 sesbania species

(of which S. sesban var nubica and S. macrantha constitute 75%) was established at Maseno in August, 1988. This material constitutes the largest sesbania genebank in Kenya, Uganda and Tanzania.

On-Farm Performance. An outbreak of brucellosis and reduced funding sharply reduced goat multiplication activities in 1987. However 200 does will be available for on-farm placement in 1988. Performance of DPGs already on farm continues to be monitored. Average milk offtake per doe for household use is half a litre per day for a lactation period of 100 days. Mortality rate of kids born on farms was 13%. To the age of six months there was no significant difference in weight gain between male and female kids. At seven months mean liveweights were 13.1 and 13.6 kg and, at 12 months, 16.6 and 20.0 kg for females and males, respectively.

On-farm feed development. Individual farmers in the clusters are raising their own forage crop seedlings. The six major forages have been sesbania, leucaena, pigeon pea and napier derivatives (Clone 13, Pakistan hybrid and Bana). About 80% of the seedlings transplanted into the field disappeared because of 1) destruction by free grazing or tethered livestock after harvesting food crop fields; 2) poor seedling management; and 3) lack of watering after transplanting during dry periods. The ranking order for ease of establishing the various forages was: napier derivatives, sesbania and leucaena. High soil acidity and high altitude are the two main factors that suppress leucaena growth at establishment stage. Thereafter leucaena grows well and produces more forage than sesbania, pigeon pea, and gliricidia.

DM and green manure yields of pigeon pea, sesbania, and leucaena were compared to maize and fallow. Pigeon pea, sesbania, and leucaena were cut once every two months for a period of one year. The cumulative DM yields were: pigeon pea - 4806 kg/ha, leucaena - 16659 kg/ha and sesbania -13603 kg/ha. Cumulative yields of CP and N were pigeon pea - 1007 and 161, leucaena - 4105 and 643, and sesbania - 2803 and 448 kg/ha, respectively. Leucaena and sesbania had the best feed production profile throughout the year with pigeon pea the poorest. Biomass from these legumes was incorporated into the soil as green manure. After one year, a test crop of maize intercropped with beans was planted at the beginning of long rains. Maize grain yields in the legume plots 2.5 t/ha higher than from fallow plots. Biomass DM yields were: pigeon pea - 16.5, sesbania -18.5, leucaena - 18.9, and fallow - 10.5 t/ha, while that from continuous maize plots was 14.0 t/ha.

Tech-Packs. NM prepared eleven, and FR nine, technical guides for the SR-CRSP project field staff and agriculture and livestock extension officers. Titles of the FR tech-packs include: Pastures/fallow lands; Improving soil and conservation and fertility; Feed production from maize-based cropping systems; Feed production from cassava-based cropping systems; Sweet potato as a food and feed crop; Legume fodder crops and tree nurseries; Grass

fodder crops; Feed conservation as hay and silage; and Feed storage.

Titles of NM tech-packs include: Nursing strategy: Sweet potato vines as a milk replacer for kids; Appropriate utilization of crop residues as feedstuffs; How to feed a doe for production of milk and kids; Tethering; Mating schedule; Feedstuffs presentation; Milk and milk hygiene; Housing; Gradual weaning; and Know your goat.

During 1987/88, project scientists were involved in collaborative research with the following: PANESA (Pasture Network for Eastern and Southern Africa) - sesbania germplasm collection and screening; AFRENA (ICRAF Agroforestry Network) - joint development and screening of multi-purpose trees; CARE/Kenya - development of multiple purpose tree nurseries in rural areas; and University of California at Davis (Dept. of Animal Science) - Sesbania toxicity.

PUBLICATIONS

Journal Articles, Refereed

Brown, D. L., M. Salim, E. Chavalimu, and H. A. Fitzhugh. 1988. Intake selection, apparent digestibility, and chemical composition of Pennisetum purpureum and Cajanus cajan foliage utilized by lactating goats. Small Ruminant Research 1:59-66.

Fitzhugh, H. A. 1988. Relevance of animal research: an international perspective. Journal of Animal Science 66: 2110-2116.

Manuscripts Submitted or in Press

Musalia, L.M., P. P. Semenye and H. Fitzhugh. 1988. Mineral status of dual-purpose goats and forage in Western Kenya. Small Ruminant Research (in press).

Semenye, P. P., J. F. M. Onim, W. T. Conelly, and H. A. Fitzhugh. 1989. On-farm evaluation of dual-purpose goat production systems in Kenya. J. Anim. Science 67 (in press).

Technical Communications

Mathuva, M., M. Onim, K. Otieno and H. A. Fitzhugh. 1987. Forage potential of fodder grass/sesbania intercrop as compared to fodder grass/nitrogen interaction. Proc. 6th SR-CRSP Workshop, Kabete.

Onim, J.F.M. 1987. Alternative uses of sesbania - A proposal to collect sesbania germplasm in the PANESA region. Proc. PANESA Workshop, 27-30 April, 1987, Arusha Tanzania. (In press).

Onim, J.F.M. 1987. Multiple uses of pigeon pea. Proc. of Research on Grain Legumes in Eastern and Central Africa, ILCA/ICRISAT, 1987. p. 115-120.

Onim, J.F.M., P. Ochola, M. Mathuva, K. Otieno and H. A. Fitzhugh. 1987. Dry matter, nitrogen and green manure yields of leucaena, sesbania and pigeon pea in a cutting frequency study at Maseno. Proc. 6th SR-CRSP Workshop, Kabete.

Otieno, K., M. Onim, J. Kategile, S. Mengitsu and M. Mathuva. 1987. Sesbania germplasm collection in Tanzania and Western Kenya. Proc. 6th SR-CRSP Workshop, Kabete.

Semenye, P.P. and L. Musalia. 1987. Improving reproduction in sheep and goats. Proc. Anim. Prod. Society of Kenya. (In press) Semenye, P.P., L. Musalia and H. Fitzhugh. 1986. Small ruminant nutrition on small farms in Kenya. Proc. of Workshop on Improvement of Small Ruminants in Eastern and Southern Africa. OAU/IDRC. p. 127-134.

Semenye, P.P., L. Musalia, M. Onim and H. Fitzhugh. 1987. Leucaena Leucocephala and Sesbania sesban as sole diets for bucklings. Proc. 6th Annual SR-CRSP Workshop, Kabete.

Verbal Presentations

Four workshops were organized to introduce NM and FR tech-packs. These workshops involved farmers, field staff, extension staff, as well as primary and secondary schoolteachers who teach agriculture.

Moses Mathuva, collaborating scientist, attended a five-day workshop (September, 1987) hosted by the Pasture Network for Eastern and Southern Africa (PANESA) of the International Livestock Centre for Africa (ILCA). He presented a proposal for collaborative research with PANESA and funding from the Italian Government through the Special Programme for African Agricultural Research (SPAAR).

Kenneth Otieno participated in sesbania germplasm collection in Tanzania; and was team leader for two western Kenya collections.

Tanzanian collection included 156 accessions and 14 species while the W. Kenyan collections included 71 accessions and 4 species.

Moses Onim participated in the following regional conferences during 1987-88: Small Ruminant Thrust Planning Conference, ILCA, Addis Ababa, Ethiopia, (31 August to 4 September, 1987); International Conference on "Utilization of Crop Residues as Livestock Feed", ILCA, Addis Ababa, Ethiopia (5-11 December, 1987); Regional Workshop on "Crop Livestock Interactions in On-Farm Research", CIMMYT, Harare, Zimbabwe (June 27 - 1 July, 1988); and Pasture Network for Eastern and Southern Africa (PANESA) collaborators coordination meeting, ILCA, Addis Ababa, Ethiopia (11 - 17 September, 1988).

Training

Nondegree Oriented

Lectures, talks and demonstrations on goat nutrition and management were given at Maseno Farmers Training Centre and at the station for the following groups: 20-21 July 87 - Director of Animal Production, The Gambia; 21 Aug. 87 - Trainees from International Centre of Insect Physiology and Ecology (ICIPE), Nairobi; 25 Aug. 87 - 60 members of the Church Province of Kenya; 13 Nov. 87 - Scientists from ICIPE, Nairobi; 2 Dec. 87 - Dr. G. B. Singh, a scientist from ICRAF; 11 March 88 - Students from Olembo Secondary School; 12 March 88 - Students from Jera's Secondary School; 23 March 88 - Teacher from Ekwanda Secondary School; 23 March 88 - Students from Ebusakami Secondary School; 11 April 88 - Agricultural class from Lwak Girls High School; 14 April 88 - Students from Ekwanda Secondary School; 20 May 88 - Students from Kisumu Girls School; 22 June 88 - Students from Siriba Teachers College; and 20 July 88 - Students from Emmanuel School.

1987-1988 Annual Report

Title:	**Sociological Analysis of Small Ruminant Production Systems**
Host Country:	Kenya
U.S. Institution:	University of Missouri-Columbia
Host Country Institution:	Ministry of Livestock Development Kenya Agricultural Research Institute
Personnel:	Principal Investigator: Michael F. Nolan Resident Scientist: W. Thomas Conelly Collaborating Scientist: Nkonge Mbabu Field Assistants: Joseph Atichi George Ambogo Peter Amuhinda

RESEARCH RESULTS

Evaluation of DPG Impacts on Household Nutrition and Economy. This was a continuation of previous research for a second year (June 1987-May 1988) to provide a longterm perspective on DPG ownership. The study entailed a 24-hour dietary recall survey with a sample of 25 households in each research cluster. In bimonthly interviews, female heads of household were asked about family food consumption patterns and the utilization and purchase of milk products.

This study generally confirmed trends identified during the first year of research. Milk remained an essential source of protein, especially in areas where other sources of protein (e.g. fish, meat, beans) were not regularly consumed. Although on-farm production of cow milk was somewhat higher than in 1986-87, the supply was still unreliable, thus most households continued to spend considerable portions of their income on expensive commercial milk.

The second year of data on milk consumption and purchases confirmed that dairy goats have a strong potential for improving the nutritional and economic welfare of smallholders in western Kenya. Demand for milk is high, while on-farm production is

generally low and/or irregular. Commercial milk is prohibitively expensive for many families. As a result, milk consumption is low, averaging only about .5 liters per day for a family of six or seven. Ownership of a few dairy goats, especially by poorer households who lack cattle, should make possible a small but steady supply of milk throughout the year. Thus DPGs can provide a reliable source of high-quality protein and reduce costly purchases of milk.

Survey Coordination. The Sociology Project coordinated the multidisciplinary rapid survey designed to identify household characteristics and resource constraints of 90 farm households that will participate in the 1988-89 farmer-managed DPG on-farm trials. Sociology also participated in the selection of new research clusters.

Transformation of Kenya's Agrarian Sector: The Case of western Kenya. As part of dissertation research, Mbabu conducted archival and field investigations in Kenya during 1987. The thrust of this study is to identify the social forces that have influenced the transformation of western Kenya's agrarian social structure. The study links transformation processes to European expansionism which expropriated high-potential agricultural lands, made a labor reserve out of western Kenya, and thus stifled agricultural development in the region. Enterprising western Kenyans therefore invested in commerce rather than agriculture. Due to the deprivation of capital for agriculture, the primary response to increasing population density in the region has been massive male out-migration instead of agricultural intensification. This perspective helps explain the predominance of female-headed households in western Kenya.

Synthesis of a Decade of Research on the Sociology Project. Survey data on time allocation, dietary intake, milk utilization, and farmers' responses to SR-CRSP management recommendations were analyzed. Papers were presented at the 1987 Farming Systems Research & Extension Symposium and the American Anthropological Association meetings (see "Publications"). A special session on SR-CRSP Sociology work in Kenya will be presented at the 1988 AAA meetings. Sociology/Kenya research is also well-represented in the "Plants, Animals, and People" anthology in progress.

PUBLICATIONS*

*Due to confusion arising from asystematic omissions of Sociology publications in last year's annual report, it is necessary to list both 1986-87 and 1987-88 communications in this report.

Manuscripts Submitted or In Press

Mbabu, N. The Transformation of the Kenyan Agrarian Sector: The Case of Western Kenya. Submitted to Review of African Political Economy.

Noble, A.L. Why Development Policies for Women Fail: A Case Study of Goat Raising in Kenya. Submitted to World Development.

Technical Communications

Conelly, W.T. and M.S. Chaiken. 1987. Land, Labor, and Livestock: The Impact of Intense Population Pressure on Food Security in Western Kenya. American Anthropological Association, Chicago.

Conelly, W.T., A.W. Mukhebi, L. Oyugi, and H.C. Knipscheer. 1987. Household Labor Allocation in an Intensive Crop/Livestock Farming System in Western Kenya. Farming Systems Research & Extension Symposium, U. of Arkansas, Fayetteville.

Conelly, W.T. and M.F. Nolan. 1986. Time Allocation and the Organization of Household Labour in Smallholder Farming Systems in Western Kenya. Proceedings of the Fifth Small Ruminant CRSP Workshop, Nairobi. Pp. 213-114.

Mukhebi, A.W., E. Reynolds, H. Knipscheer, and A.J. DeBoer. 1985. Socioeconomic Methodologies in the Dual-Purpose Goat Farming Systems Research in Western Kenya. Proceedings of the Regional Workshop on Livestock in Mixed Farming Systems: Research Methodologies and Priorities. ILCA, Addis Ababa, Ethiopia. Pp. 71-94.

Nadzura, W.C. and A.N. Mbabu. 1986. Agricultural Food Production "Crisis" in Africa: A Historical Contextualization. African Studies Symposium, University of Illinois, Urbana-Champaign.

Noble, A.L. 1985. When Is a Women's Project Not a Women's Project? Association for Women in Development Conference, Washington, DC. (Winner of 1985 AWID Best Student Paper Award.)

Nolan, M.F. 1986. Overview of CRSPs and the World of Social Sciences Therein. The Cross-CRSP Conference, "Bringing People In: Social Research in International Agricultural Development." University of Missouri-Columbia (supporting).

Verbal Presentations

Conelly, W.T., M. Chaiken, and N. Mbabu. 1988. Living and Working

in Kenya. The Kenya National Agricultural Research Project Orientation Program. University of Missouri, MIAC.

Mbabu, N. 1988. Kenya Since Independence. The Kenya National Agricultural Research Project Orientation Program. University of Missouri, MIAC.

Noble, A.L. 1986. Why Development Policies for Women Fail. Graduate Seminar in International Agricultural Development, University of California-Davis.

Training

Degree Oriented

- Nkonge Mbabu, Kenyan, PhD Rural Sociology, UMC, on-going.

MAJOR ACCOMPLISHMENTS

1. A baseline survey of 120 households was completed and 250 dual-purpose goats (DPGs) were distributed to farm families to test the technical, social, and economic feasibility of DPG technologies.

2. DNA probes for surveillance and epidemiological studies of Anaplasma were developed. Also, a vaccine was developed and tested for contagious caprine pleuropneumonia (CCP) that can be stored at room temperature and that provides protection for more than a year.

3. DPG breed stabilization and improvement was initiated, thus paving the way for the gene segregation that could lead to genetic immunity to diseases and parasites. Early research indicates that there is genetic resistance to haemonchus infections in DPG.

4. Sweet potato vines fed to DPG kids show promise as a partial replacement for dam's milk. This could result in early weaning and more milk available for human consumption.

5. The testing of leguminous, multi-purpose trees--leucaena, sesbania, and gliricidia--has shown their importance as sources of protein for goats, green manure for crops, and firewood for family use.

6. A completion of more than 30 recommendations for feed production, nutrition, breeding, health care, and management of DPGs, in the form of a tech pack, was published and made available to extension workers.

7. Carcass data from intact males, castrates, and mature does show intact males to have a lower percentage body fat than of castrates and females, the latter having the highest. However, the difference in dressing percentages were not significant among the breeds of males tested.

8. Four workshops were conducted for extension specialists in western Kenya.

9. Three Kenyans were studying for Ph.D. degrees in the U.S.

10. Over 40 publications were published during the year.

COUNTRY	SR-CRSP DISCIPLINE	PRINCIPAL INVESTIGATOR	COLLABORATING SCIENTIST
Indonesia:	Animal Nutrition	K. Pond	B. Haryanto
	Economics	H. Knipscheer	T. Soadjana
	Breeding	E. Bradford	B. Gunawan
	Sociology	M. Nolan J. Gilles	K. Suradisastra
Kenya:	Breeding/ Systems Analysis	T. Cartwright	C. Ahyua B. Mwandotto
	Animal Health	T. McGuire	S. Chema S. Waghela
	Economics	H. Knipscheer	F. Nyaribo
	Production Systems Feed Resources Nutrition Management	H. Fitzhugh	K. Otieno M. Mathuva M. Simba
	Sociology	M. Nolan J. Gilles	A.N. Mbabu
Morocco:	Genetics	E. Bradford	A. Lahlou-Kassi
	Nutrition	K. Pond	F. Guessous
	Range	J. Malechek	H. Narjisse
	Sociology	M. Nolan J. Gilles	A. Hammoudi
Peru:	Animal Health	J. DeMartini	E. Ameghino
	Breeding	P. Burfening	J. Chavez
	Economics	H. Knipscheer	D. Martinez
	Range Management Sociology	F. Bryant M. Nolan K. Jamtgaard C. McCorkle	A. Florez M. Abuhadba M. Estafonero

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