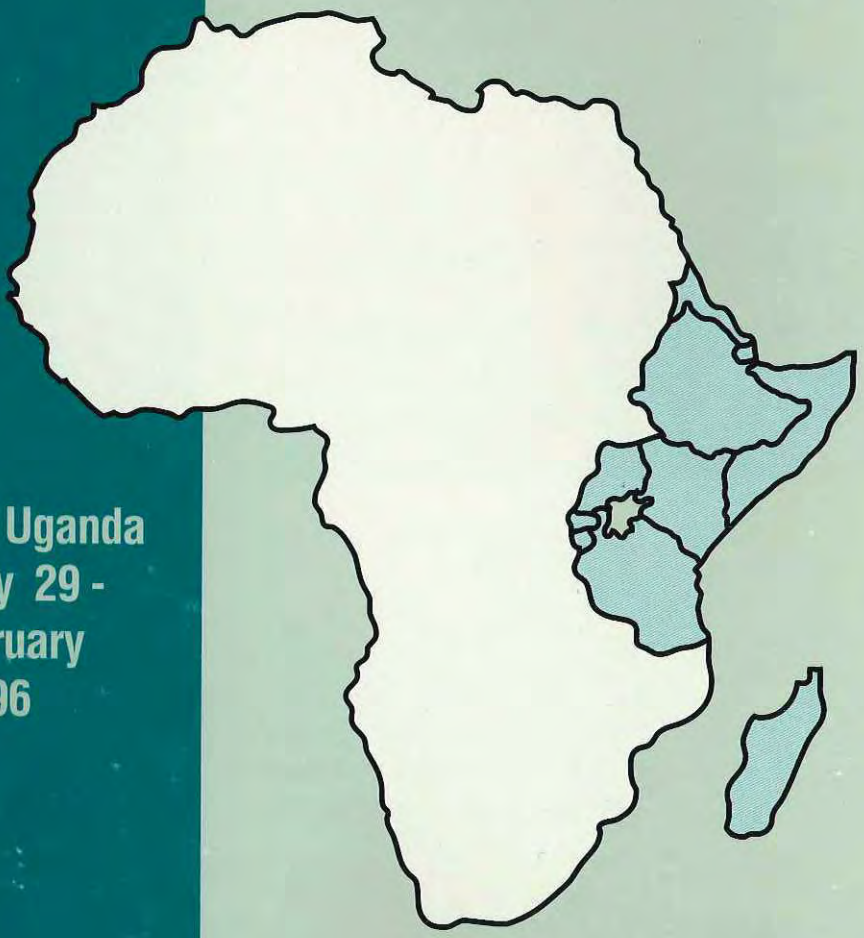
Small Ruminant CRSP

EAST AFRICA
LIVESTOCK ASSESSMENT

WORKSHOP PROCEEDINGS



Entebbe, Uganda
January 29 - 1 February 1996

ASARECA

East Africa Livestock Assessment Workshop

Entebbe, Uganda

January 29 - February 1, 1996

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Small Ruminant CRSP Program Director

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FOREWORD

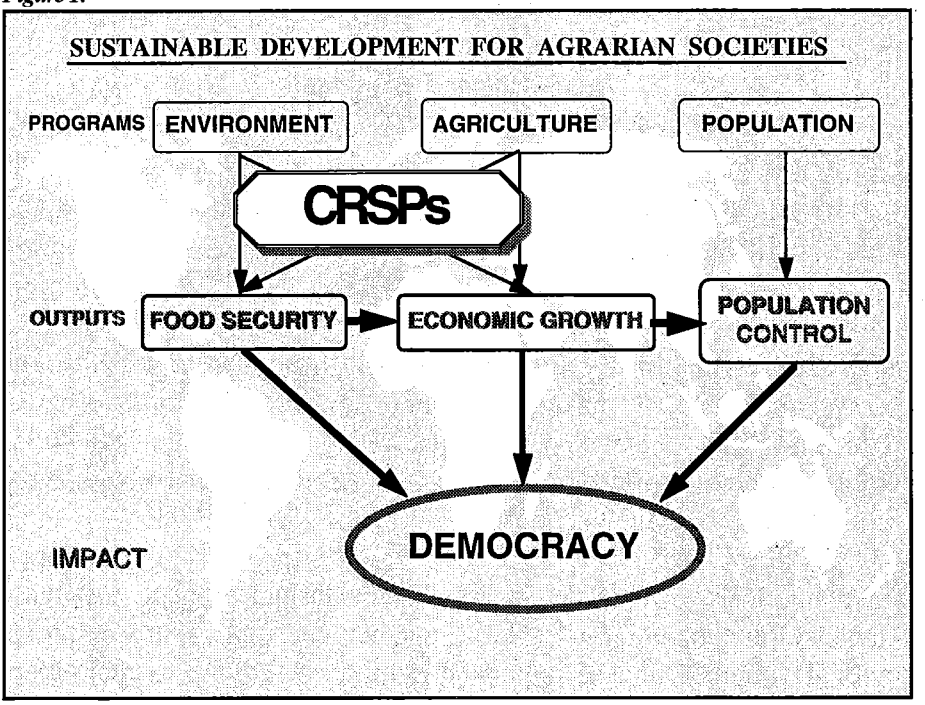
By Montague W. Demment
Small Ruminant CRSP Program Director

In 1995 Dr. John Lewis, the Director of the Office of Agriculture and Food Security at USAID, asked the SR-CRSP to reengineer our program and its structure to respond to USAID's new vision. We initiated the process at Winrock in May of 1995. By convening some of the best people in the field of livestock development from US Universities, the CG system, NARS and the private sector to develop a plan for the renewal of the SR-CRSP. At that meeting we decided to take some new directions requiring a broader focus on more than just small ruminants, hence the SR-CRSP will become the Global Livestock CRSP in 1998.

The reengineering proceeded at a rapid pace through the year, involving Advisory Panel meetings to set broad agendas and approve process, three regional workshops that set regional priorities, a call for Assessment Team (AT) proposals, the selection of ten ATs and one continuing team, an AT workshop at University of California, Davis and the initiation of AT field work. The details of the process I describe below, but the impact is that our CRSP is now active in Central Asia, East Africa and Latin American with sixteen US universities, six foreign universities, ten foreign research institutes, five IARCs, five NGOs, two NARs, six private sector companies, three other CRSPs and the USDA. We are taking on livestock to address economic growth, impact on the environment and the role of animal products in the development of children.

With growing concern about the environment and population, the importance of agriculture to the developing countries increases. This view is reflected in Figure 1. The assumption of this conceptual model is that for democracy to develop and be maintained, three elements must be in place. First, economic growth must provide the majority of people with the aspiration of reward for work and the security that the future is worth the work. Second, the environment and agriculture must be productive and sustainable to insure that food is available and nutritious enough for children to develop into productive adults. Third, when economic growth and food security are in place, people reduce their reproductive rates and do so faster when population control mechanisms are available to them. Economic growth, food security and reduced population growth combine to form a context for democracy.

Figure 1:



The Collaborative Research Support Programs (CRSP) are strategically focused to address the issues of economic growth, food security and environment. The central role of agriculture in food production, the economic growth of most developing countries and the impact of production practices on the environment, place the CRSPs in a key position to have a major development impact. With a shrinking USAID portfolio in agriculture in the 1990s, the CRSPs have become a major component of the Agency's activity in agricultural research in developing countries and the major linkage between USAID and the US Land Grant University System. However, they now operate on budgets that in real terms are 40% of their original allocation 10 years ago.

TITLE XII

The CRSPs were created under the International Development and Food Assistance Act of 1975. The intent of the act was to use the resources in the US Land Grant University system to improve the US Government's efforts to bring food security to the developing countries of the world. The US Land Grant system has a proven capability to transfer the benefits of basic science to application and in doing so has been a major reason for the remarkable capabilities of US agriculture. The US Land Grant

system has great scientific depth and diversity. For example, there are more soil scientists at UC Davis than in the entire CG system. The US Land Grants are deep in disciplinary expertise that not only spans the traditional agricultural sciences but also includes the social sciences, the environmental sciences, ecology, demography and human health and nutrition.

The other intent of the legislation was to have a domestic impact. By engaging US Universities in the Title XII Act the federal government was influencing the focus of university activities. The Act built an international capability that developed connections to train and focus US scientists in international issues, open new markets overseas, provide genetic material and new more global scientific insights. In a more diffuse but equally important way, the program would help develop countries that would share a common ideal of free markets, democracies, and global responsibilities. These shared values would reduce the requirements for US foreign interventions and allow all to reap the benefits of a safer global society.

Title XII: Famine Prevention and Freedom from Hunger

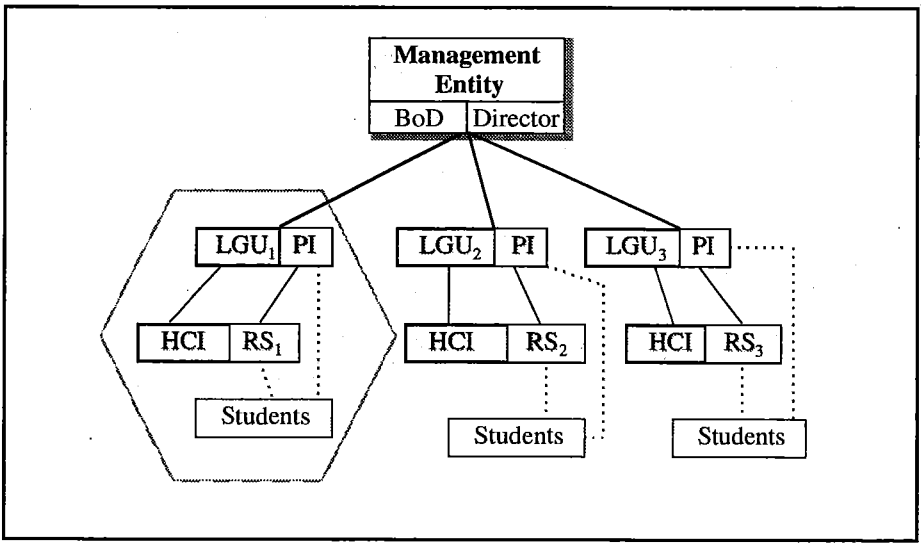
"...in order to prevent famine and establish freedom from hunger the U.S. should strenthen the capacities of U.S. land grant...universities to improve their participation in the U.S. government's international efforts to apply more effective agricultural sciences to the goal of increasing world food production and...support the application of science to solving food and nutritional problems of developing countries."

GENERIC STRUCTURE AND ORGANIZATION OF THE CRSP

Advantages to the CRSP model

The CRSPs have developed two images in their 19 years of existence. The first, perhaps the more wide spread image, is that of entitlement programs. The development community, familiar with the politics that have supported the CRSPs sees them as an instrument of Congress that binds the Agency to US Land Grant Universities. This view is partially correct in fact but not in spirit. There is indeed a benefit to US Universities from this linkage but hardly without some logic about either the magnitude of the problem being addressed and the capability of the institutions enlisted. Much of what is done by the government has political roots, be

Figure 2:



it in environment, population or agriculture. In the truest sense, politics should reflect the collective will of the people expressed through the legislative process. That said, programs also need mechanisms for change and renewal.

The second image is less well known and appreciated. This image is the one of a creative set of time tested structures that have evolved among the CRSPs to optimize the collaborative process between universities and NARs. This research/development model (Fig. 2) links US universities through Principal Investigators (PIs), NARs and their resident scientists (RSs). The programs have research problems as their focus and traditional activities of development such as training, institution building, and technology development all flow naturally from the research theme.

The CRSP model is cost effective. Because of the PI/ RS linkage there is little need to base expatriates overseas. The cost to maintain expatriates and their families is a major expense in overseas development programs. The CRSP legislation also incorporates a requirement for the US Universities to match 25% of the USAID contribution to the grant. Furthermore, all the CRSPs have been very successful in attracting additional funds from host countries and other funding agencies. On average the CRSPs have added $.74 for each dollar contributed by USAID and the SR-CRSP has led all other CRSPs by more than matching USAID's contribution over the life of the CRSP. This level of outside matching contribution is unprecedented in USAID programs.

As mentioned above, the developing countries have access to the world's most powerful agricultural research institutions through the CRSPs. The quality and extent of this contact is dependent on the quantity of funding available and the effectiveness of the development mechanisms that make the connections. The CRSP mechanism is flexible, allowing constant adaptation of missions and objectives to changing research and development needs; personal, fostering close relationships between US scientists and host countries that persist and enhance the careers of both parties; and responsive, making connections between the varied research requirements for development, host country scientists and appropriate disciplinary scientists in US universities.

The CRSP model has an innovative training role. First, it has internationalized US Land Grant institutions by providing overseas research opportunities for US students. In a culture as powerful and pervasive as America's, it is easy to spend ones entire scientific life within its boundaries and have a complete and fulfilling career. If we are to be active in global problems, solutions and markets we must have scientific participation overseas. CRSPs use what might be termed a "Peace Corps" model. US students establish a research project in the host country in the context of the program's research agenda. They must function within the country in the same way host country scientists operate. In the process they learn to conduct research in an international setting, respond to cross cultural differences and solve problems of both science and society simultaneously. In the end they are scientists ready to conduct research in other cultures, inclined to have an international perspective as teachers and educators and usually remain active collaborators on the international scene.

Second, the CRSP is a very effective training mechanism for foreign students. Most foreign students in other programs received their graduate training wholly in the US. The contacts that a graduate student makes during their graduate student tenure are some of the most important in their careers. They establish scientific networks with other researchers in their field that serve to enhance the quality of their science. Then, upon completion they are required to return to their home countries where they have few if any professional contacts. This situation places them in a major disadvantage in their community of scientists. The CRSP model allows a certain amount of course training to occur in the US, but, because the program has a research project in the host country, the students spend most of their graduate education completing their degree research in their

own country. They develop and maintain the contacts with their compatriots and this network is an attractive and supportive framework to which they return at the end of their training. For this reason, CRSP programs have very high rates of return of foreign students.

The long-term nature of the CRSP programs has built strong bridges between the cooperating institutions and their scientists. Within this culture, students and young scientists benefit from the trust that has built up over time and this atmosphere allows US scientists to continue to assist and support young host country scientists as they advance through the early years of their careers.

CURRENT ENVIRONMENT

The current development environment is characterized by shrinking funding, and shifting focus and influence from the sustainable agriculture movement. The last 10 years have seen the agricultural research budget of the agency decline from about $225M in 1985 to about $50M presently. The funding for CRSPs have remained at about $15-17M but the number of CRSPs has increased. In real dollars the SR-CRSP operating budget is 25% of what it was 10 years ago. While these numbers are bleak and reflect a major programmatic shift to de-emphasize agriculture within the Agency, the Administrator has made recent statements that this trend will be reversed. The reconstitution of BIFAD, with its advisory role, has assisted greatly as a voice for agriculture at USAID. I see considerable other activity in Washington to increase funding for international agriculture and a greater understanding of the importance of this sector to our own national interests.

The Clinton administration's vision for a development agenda included a strong emphasis on population control and environment. These areas have received increased funding in USAID in the last four years. Unfortunately, while conceptually linked to agriculture, they are administratively separated. This separation means that some of the most important topics in environmental sciences and agriculture, which lie at the intersection of these fields, have institutional barriers that prevent creative approaches.

The maturing issues of sustainable agriculture have had a major impact on the field of international development. The sustainable agriculture movement has a strong base in grass roots farmer organization and, as such, has championed the view that the end customer should have a major

role in setting agendas. This concept is fundamental to USAID reengineering.

Two issues were the central themes of the sustainable agriculture movement: long-term performance of systems and environmental impact. The word sustainability indicates a concern with time. Clearly one of the most important issues in agriculture is the long-term performance of agricultural systems, how we measure it and predict it. The importance of this topic for development is the introduction of the long-term concept of performance into the development context. The other issue is the elevation of the importance of environmental impact. Many of the impacts are slow, almost unnoticed, degradation in the environment that have insidious consequences for the food production system and the natural resource base. Because many of these processes occur slowly and are chronic, the joining of environmental issues and a long-term timeframe is a critical conceptual link for international agricultural development and the environmental sciences.

By raising these topics, sustainable agriculture has had other impacts on our field. The problems of environment, agricultural systems and long-term performance are all aggregated problems. They are large in time and space and therefore require interdisciplinary teams with the capacity to integrate lower level process to understand system function. Interestingly, the CRSPs have used this model for close to 20 years.

CHARACTERISTICS OF THE NEW CRSP

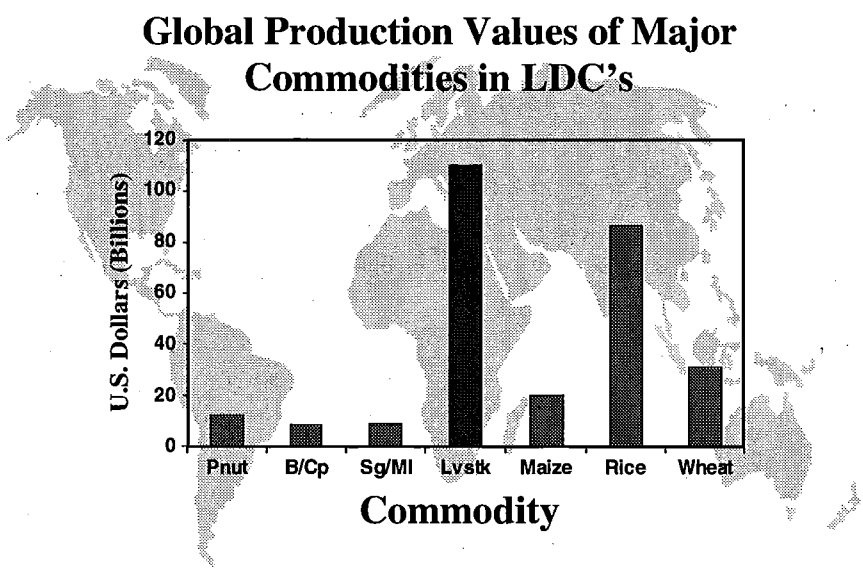
A series of meetings and discussions, initiated at Winrock International in May 1995, produced an agenda of change for the SR-CRSP. The new characteristics were developed in response to identified weaknesses in the present CRSP program, to new visions for the operations of federal programs (Vice President Al Gore's National Performance Review), and to the reengineering effort at USAID. A number of issues were raised in this discussion and they were distilled into the following major characteristics:

Reduce Transaction Costs. The amount of reporting and governing bureaucracy in the CRSP were viewed by most researchers and administrators as excessive to the point where the very best scientists were not interested in participating. The mandate was to streamline operations.

Diversify Granting Mechanisms. The SR-CRSP, partly because of the nature of the program's research agenda, has used about all of its funds in major grants to lead universities. These grants and the governing structure were important in maintaining continuity but were not as responsive or open as necessary to meet new needs and recruit new scientists. Because of the nature of the CRSP research, which has involved long-term breeding projects, the grant renewal process (every five years) has not been an opportunity for major changes in direction. Now that the agenda has changed, the Winrock meeting produced a consensus that new mechanisms should be incorporated that would allow more open access to CRSP funds, provide the ability to respond rapidly to changing development issues and expand opportunities to attract young faculty into the international arena.

Effective Assessment and Problem Resolution. The reengineering approach places considerable emphasis on team building and results orientation. The initial results of the Agency's experience in reengineering is that, although planning and team building require considerable time and resources, the outcome is quite positive. The CRSP planning process was designed to devote considerably more effort to the assessment and team building stages. Moreover, a problem/results orientation was developed from the onset.

Figure 3: Source, CGIAR 1992



Diversify Partnerships. The clear lesson, learned from a survey of past collaborations across all CRSPs, is that collaborations that succeed are those where the partners participate in the early stages of the collaborative process. The assessment process provides an excellent entry point for the collaboration, as well as an efficient mechanism by which partners in collaboration are identified based on the problem instead of the collaboration defining the problem. The assessment phase allows sufficient time for partnerships to be developed in the region with IARCs, NARs, NGOs and farmer organizations.

Regionalization. With the number of countries having USAID missions declining, USAID has taken a regional approach to development. Regionalization is an effective tactic as countries open markets and borders, develop regional associations in research, trade and politics, and have similar problems of environment, pastoral people, animal disease, human nutrition and policy. The regional approach was adopted also to encourage broad views of research application, a diversity of institutional contacts and a compatible match with USAID organization structure in the field.

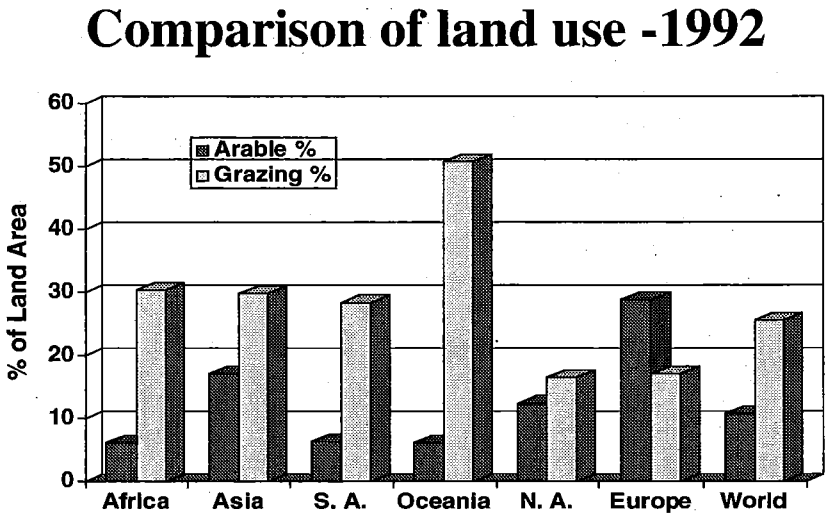
Customer Oriented. A major emphasis of the reengineering effort has been to provide more grass roots input into the identification of research/ development problems. In our planning process we attempted to have input at all levels, but gave considerable resources to middle level and grass roots. By combining regional conferences and a considerable assessment phase, input into the problems models, team formation and implementation of the project has been achieved.

THE MAJOR RESEARCH AREAS

The meeting at Winrock and the Advisory Panel Meeting in Washington DC in October 1995 provided the input into the choice of research issues. The issues identified were economic growth, environmental impact and human nutrition. An overriding theme of inquiry, in addition to those of biology and social sciences, was to be a policy focus.

In terms of economic growth, livestock is the single largest component of agricultural GDP (Fig. 3). In most of the developing countries, agriculture is the largest single sector of the economy, usually accounting for 30-70% of all revenues. Of that, livestock represents from 30-50% of agricultural GDP. Clearly if economic growth is to proceed in these

Figure 4: Source, FAO Production Yearbook, Vol. 47



agrarian based economies, even if they are to become more industrial based, agriculture must be more productive and profitable. The impact of improved economic growth from the agricultural sector has benefits beyond just profits. The security of that growth and the increases in human nutrition affect the ability of these societies to develop human capital.

Livestock is the single greatest anthropogenic use of the land (Fig. 4). While there is considerable debate about the positive and negative impacts of grazing animals, there is no question that they change the landscape and in doing so are major factors in the functioning of many of the ecosystems of the world. In Africa, for example, the competition between land for grazing and food production, on the one hand, and conservation of biodiversity and the economic importance of tourism, on the other, sit in juxtaposition in many countries. This complex relationship requires approaches that cross the traditionally strong boundaries that separate livestock and wildlife administrative and research entities.

Perhaps one of the most important and positive issues in the livestock research and development agenda is the role of animal products in child development. Animal products have a critical role to play in providing the micronutrients required by children for normal cognitive and physical development (the key points in this argument are summarized in Fig. 5). The critical point is that as many as 50% of the children in sub-Saharan Africa may suffer from these deficiencies and this malnutrition has an

Figure 5: Source, Nutrition CRSP

Livestock, Nutrients & Child Development

- Shortages in calories and protein are not as serious a problem as has been assumed.
- Shortage of suite of micro-nutrients implicated in growth stunting and irreversible problems in cognition, behavioral and physical development.
- Animal products in diet are only dietary variable that predicted child development.
- Cereal diets are associated with micro-nutrient deficiencies, especially Fe.
- Children 6 - 24 months cannot meet nutritional requirements for normal development without supplementation or fortification when animal products are not in diet (WHO).

insidious impact because it lowers the overall creative capacity of the population to develop, compete and live normal lives. In essence it takes away their ability to develop themselves. Animal products appear to be a very effective mechanism to introduce critical micronutrients into the diet, and do it in a sustainable and profitable way.

In the past, livestock development research, while not ignoring policy, strongly emphasized the biological and physical environment. Several authors, including Dr. Kevin Cleaver of the World Bank, have argued that the policy environment is at least as important, if not more, than the others because the implementation and adoption of technological knowledge requires an enabling policy/economic environment. For this reason, where appropriate for the problem chosen, policy study will be a component of the research agenda.

SHIFTING THE FOCUS TO LIVESTOCK

Why shift the focus from small ruminants to livestock? The broad topics chosen by the Advisory Panel represent a subtle, but important response to the changing development agenda of the Agency. The Administrators emphasis on economic growth, environment and human populations and their health is strongly reflected in the Advisory Panels selection of topics for the CRSP. The characteristics of these topics are that they are broad, taking in large scales of time and space, and highly aggregated, combining many lower level processes and disciplines. Because of these

characteristics, the problems can not be considered solely from the study of small ruminants. Issues of environment, human nutrition, economic growth and policy cut across species making the appropriate research focus animal agriculture.

The CRSP, like many programs and agendas, within USAID is conducted at the will of the Congress. Support, direction and funding flow from Congress dependent on the perceived value of the program. Recently Congress has shifted from supporting programs for purely humanitarian reasons to those where foreign assistance has an important domestic impact. Because small ruminants are relatively unimportant in our national economy relative to other species of livestock, the CRSP is placed at a major disadvantage in this regard if it is to be judged on its domestic impact. Clearly related to this issue is the fact that the SR-CRSP was developed in the late 1970s when cattle research was strongly supported by donors. The design of the SR-CRSP was a clear attempt to differentiate the program and address other needs outside cattle research. During the 1980s cattle research support declined precipitously (and with it research activity) but is presently on the rebound, presenting an opportunity to expand into areas presently not addressed in this major livestock species.

Perhaps there is no more compelling a reason for the more general portfolio than the link between animal products and human nutrition. In development circles the emphasis of research and intervention has been through supplemental pills or plant breeding for enhanced nutrient composition. Animal products are likely to provide a very effective, efficient and sustainable way to supply some of the most important and limiting micronutrients. Yet, which animals and which products, in which situations (economically feasible, environmental producable, socially acceptable) is a research question. Small ruminants will likely supply part, but not all, of the answer.

DESIGN OF THE GLOBAL LIVESTOCK CRSP

Customer Orientation

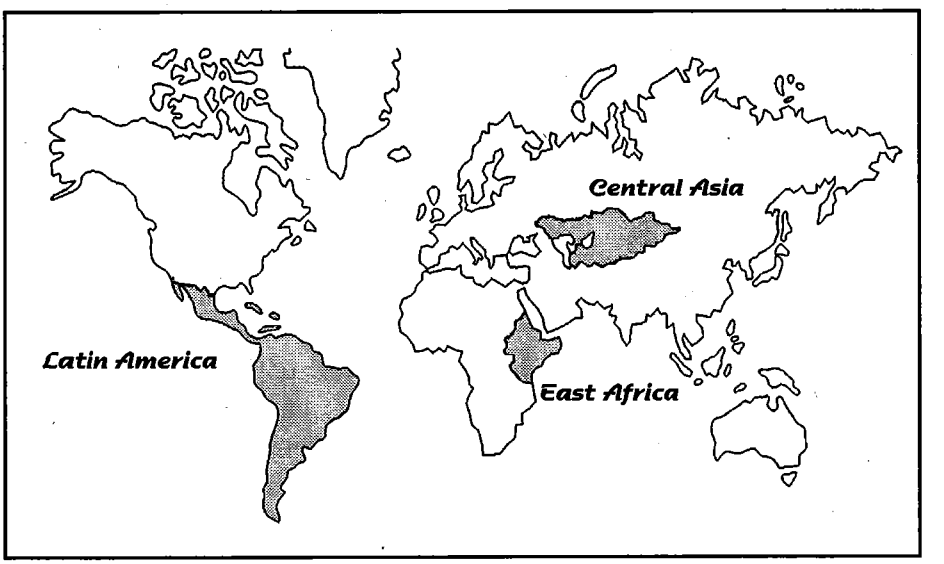
The first step in involving the customer is to identify the customers. In the CRSP we have three sets of customers: programmatic level customers, the first is the Agency itself, Congress and the domestic livestock industry; the next level are the national research institutes in the developing countries, the NARs, governmental agencies, and national universities;

third are the users of the research products in the field, the farmers, households, and consumers. We planned the modification of the CRSP to have input at all three levels.

First, the Winrock and the Advisory Panel Meetings provided a forum for level one input. In this forum wide ranging discussions occurred and consensus was reached on the broad agenda that would satisfy interests of USAID, Congress, and the domestic private sector, and the University research community. This top down approach represents a planning exercise common to many CRSPs.

Second, the level one agenda served to direct the three workshops that were held in regions (Figure 6) identified as critical for CRSP participation and to allow level two participation. These workshops held in early 1996 were conducted with a regional organization as a cosponsor and regional representatives of the countries to provide a prioritized list of problems for the CRSP to address. The four day meetings developed problem models, which were analogous in form to a research model, providing a working hypothesis, a conceptual model of the processes influencing the problem, a set of activities that would be engaged in to solve the problem and a list of the institutions and individuals active in this problem in the region. In general, ten or so of these problem models were developed and they formed the basis for RFAs for Assessment Teams.

Figure 6: In 1996, the SR-CRSP sponsored workshops in Central Asia, East Africa and Latin America.



The third level of input is being addressed through the assessment process. Once the assessment teams were chosen (ten new plus one from continuing activity), they received a budget and about nine months to work closely with their regional partners to redefine the problem model, identify new team members and provide mechanisms for grass root input. This process allows considerable activity in the region to fully explore possible linkages and garner a diversity of inputs from which to design the project before submission for the final competition in 1997.

Reduce Transaction Costs

The Management Entity (ME) is working closely with administrators at USAID to reduce the reporting load on the project scientists. The present reporting requirements for USAID are far greater than for other federal funding agencies, such as NSF (National Science Foundation) or USDA (US Department of Agriculture). Since we compete for many of the same scientists it is critical that Agency funding not be disadvantaged. Furthermore, the recent unpredictability of funding, above and beyond the macro-funding problems, have given USAID, in general, and the CRSP programs, in particular, a image of a risky place to invest scientific capital.

In an attempt to reduce management costs and remove conflicts of interest, the functions of the Board of Directors and the Technical Advisory Committee have been amalgamated in the responsibilities of the Advisory Panel. This panel draws from all sectors of the development community (World Bank, IARCs, US Universities, NGOs, Private Sector, USAID) and provides a broad perspective about the development field while removing the inherent conflicting interests of the member institutions. The Panel will provide technical advice, as well as an organizational structure of the PIs and Resident Scientists that will be formed when the composition of the CRSP members is determined in the final proposal selection.

Diversify Granting Mechanisms

In the past, the SR-CRSP has been characterized by relatively stable research components that have been funded for long periods. This stability has been a very valuable characteristic for the small ruminant research that required considerable time for completion such as the breeding programs in Kenya and Indonesia. However with a refocusing of the

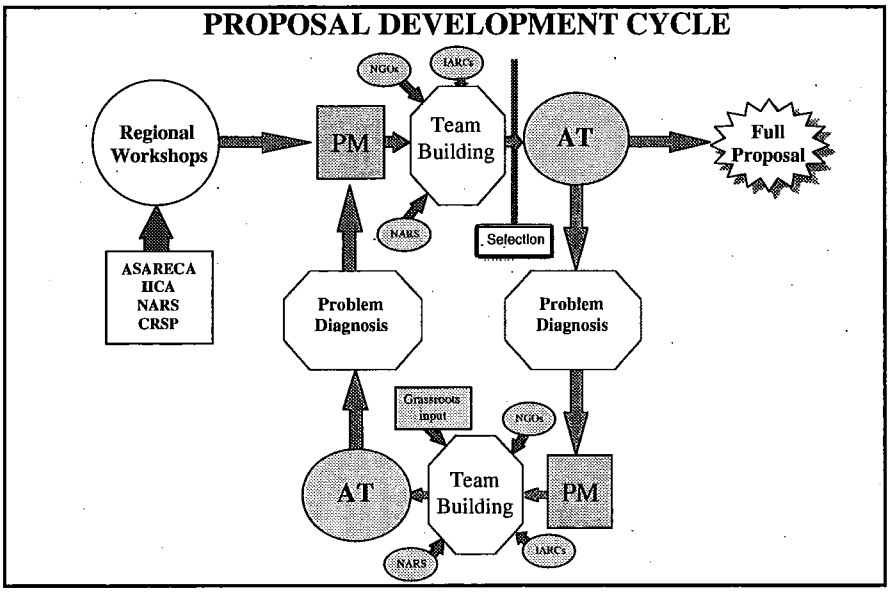
program to topics with shorter time horizons, the CRSP needs to develop mechanisms that provide both continuity for long-term research and also the opportunity for attracting new participants. To achieve this goal, sub-contracts will be restructured to make the relationship between the ME and US Land Grant Institution dependent on the participation of the original PI. Grants will run for 3 years and be renewed in an open competition.

A small grants program will be instituted that will be used to respond to new issues that develop within the framework of the grant that requires scientists of new expertise and focus. These grants would also be used to attract young scientists into international work and allow the CRSP to identify capable faculty that show an aptitude for international science.

Effective Assessment and Problem Identification

The commitment of resources and time in the problem identification and assessment process is unprecedented in the CRSP. From the Advisory Panel to the regional workshops to the assessment team regional conferences, there is a demonstrated attempt to have quality input from all our customers. The problem models are the central component of the process. With research areas broadly defined by the Advisory Panel, the problem models were developed by the regional workshop participants and then modified and refined in the assessment phase (Fig. 7). The

Figure 7:



problem model development was designed to be an iterative process with team building. The initial model served as the basis for the RFAs to which potential US Universities responded. The leadership role for the universities was to develop an AT that fit the problem model and present a plan for assessment to the CRSP in competition with other ATs. The ATs then had selected the resources to begin an in-depth analysis of the model and the regional situation. As they conducted this analysis with particular emphasis on regional grass roots input (usually through a series of regional workshops and meetings) they would likely modify the model. With changes in the model, additions and subtractions to the AT would occur and these new points of view would require adjustments to the model. Because the iterative process was initiated by identifying the problem, projects would develop that likely have a problem oriented focus.

Diversify Partnerships

The assessment process and the regional workshops were specifically designed to allow collaborators to be identified early in the planing process to achieve real and effective collaborations. The regional workshops were a first step since they were a means of informing the regional players of the CRSP's program. The assessment phase served to further diversify collaborations with the involvement of more institutions than ever before. However the goal is not diversity for diversity's sake. The problem model and team building principles encourage the formation of meaningful collaborations. Every attempt will be made to identify and reward those ATs that successfully achieve that goal.

Regionalization

The workshops accomplished several goals related to regionalization. First, they demonstrated that the CRSP was and would be actively involved in the region. Given the recent funding history, it was important for the CRSP to be seen as an active player and a program with a viable future. Second, in Central Asia the workshop educated the participants about the CRSP and strengthened their contact with the US. Third, the workshops provided a strong message that the CRSP program would involve regional and grass roots participants. In both East Africa and Latin American where the CRSP has been active in a single country over a long period, the workshops signified the change to a regional program with projects that would be active in several countries. Workshop

participants also recognized that the regional approach would be a flexible and dynamic one that would allow country focus to change as necessary with the maturity of the individual projects.

The assessment process also was a catalyst for regionalization. It provided the time required to make multiple alliances with institutions and researchers within the region. The regionalization model is conceptually simple but operationally complex. Time is a critical resource to develop each linkage and ensure that all collaborations fit with the problem model. The benefits are that ATs have a greater pool of institutions from which to choose and therefore a greater ability to select those with the greatest comparative advantage. For the region this approach has the obvious benefit of making linkages between regional centers of excellence, allowing regional connections to drive a strategy for effective institution building and strengthen the newly formed regional organizational endeavors.

GRANT RENEWAL PROCESS

The SR-CRSP will be applying to USAID for a renewal of the overall grant for the CRSP to occur in 1998. The proposal that will be submitted will represent the culmination of the assessment process, selection of full proposals and the writing of a new proposal to USAID based on the full proposals selected. The process is presented in Figure 8. There are two mechanisms by which projects can be funded in the renewal. The first is the assessment process, described above, that has gone through the priority setting at the regional workshops, selection of assessment teams and selection of the full proposal. The second is the continuation of ongoing work, redesigned to fit the criteria of the Global Livestock CRSP.

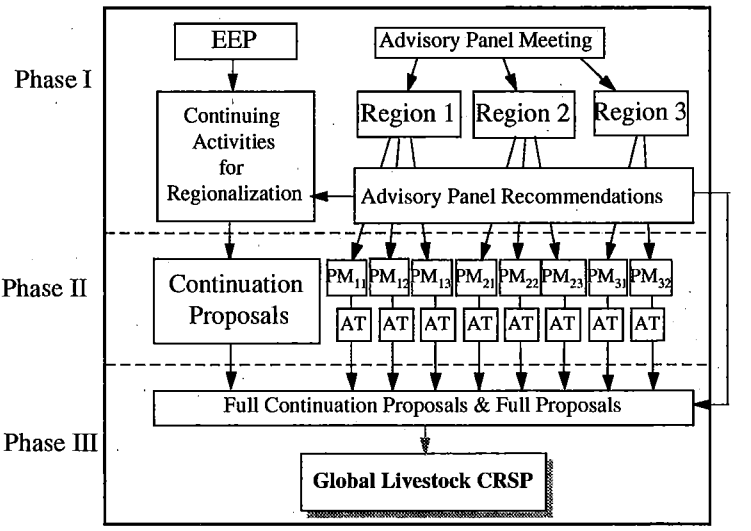
The first process has been described in detail above. The second avenue to funding was initiated with the report of the External Evaluation Panel on continuing activities. The Kenya project was recommended for consideration. The project, focused around the CRSP/ KARI breed of goat (Kenya Dual Purpose Goat), has formed an AT and received funding for those activities. They will be submitting a full proposal for the regionalization of their activities, previously focused in Kenya, and in line with the criteria for full proposals. The continuation proposal and the other AT proposals will form the pool from which the projects for the renewed CRSP will be formed.

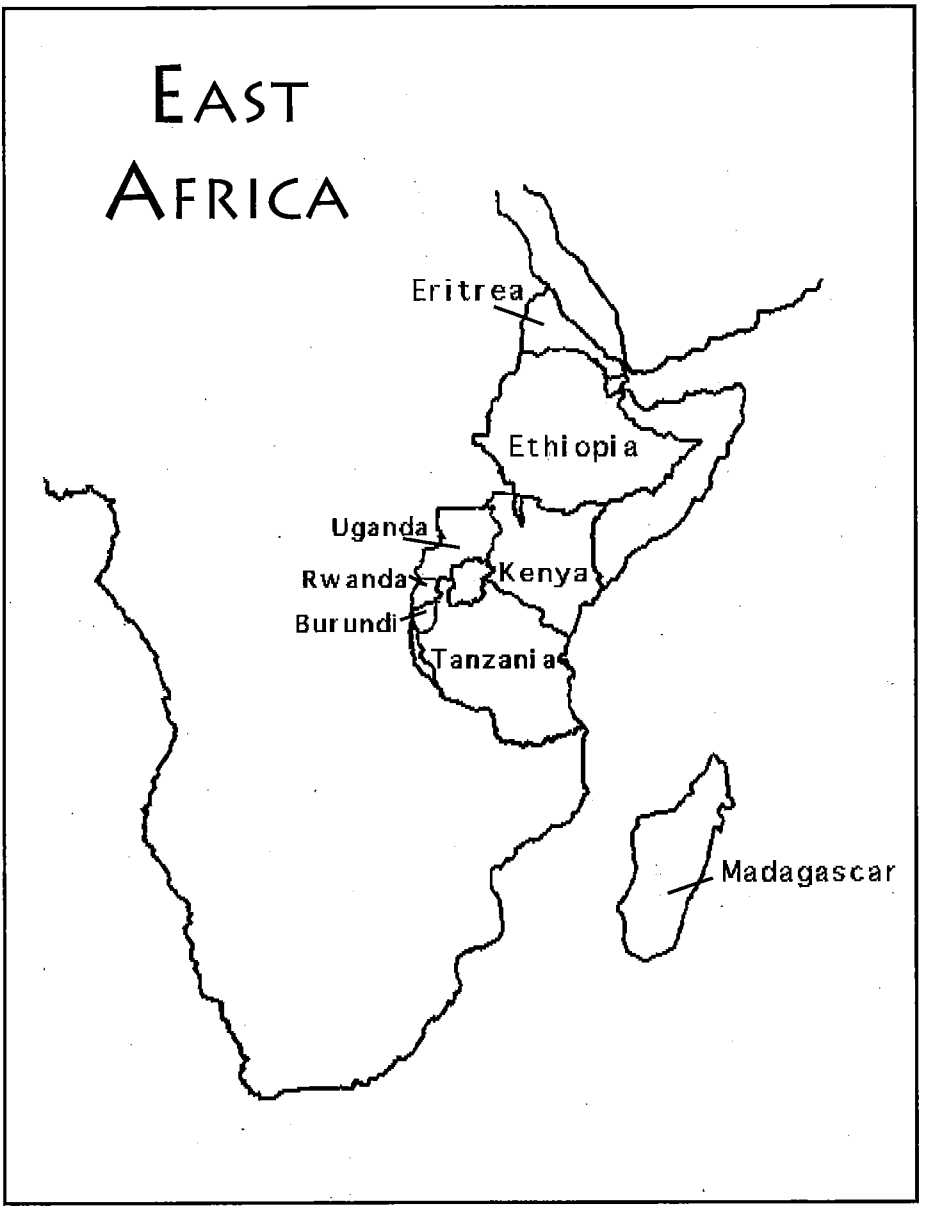
CONCLUSIONS

This year's reengineering efforts have been a stimulating and demanding experience for the CRSP team, but an essential one if the intent of Title XII is to be translated into action in the next century. We must recognize that the spirit of the Title XII legislation was a noble one; to use our best resources in agriculture to help those less fortunate in the world. Lofty goals and aspirations are often easy targets in a modern world of downsizing, "enlightened self-interest" and "trade not aid". What really gives value to what we do in the world of international development is a process that makes all people healthier, more creative, more productive and more self sufficient. Agriculture, as the food it produces and the land it uses, is the foundation of this process.

The reengineering of our CRSP has responded to a wide range of suggestions to make our work more effective and efficient; to make our impact greater and in the end address the fundamental problems of development. We hear recognition of the key problems of development residing in the root causes of chronic poverty, strife and famine but unfortunately often the lack of political will and leadership to attack those issues requiring long-term attention. One of Title XII's great contributions has been its commitment to fund programs that attack these long-term problems. It is unfortunate in the extreme that this congressional wisdom is often viewed as political pork barrel when in fact it remains one of USAID's most effective and cost efficient programs.

Figure 8: Grant Renewal Process




East Africa
Eritrea
Ethiopia
Uganda
Rwanda
Kenya
Burundi
Tanzania
Madagascar

OVERVIEW

Workshop Objective: *To identify, prioritize and describe the researchable problems of animal production in the region that will be used to develop the SR-CRSP program in the region for the next five years.*

In October of 1995, the Advisory Panel set forth a process for the grant extension of the Small Ruminant Collaborative Research Support Program (SR-CRSP). The renewal process, which emphasizes bottom-up inputs, places considerable importance on customer input, team building and planning. The process endorsed by the Advisory Panel closely follows reengineering principles and the new vision of AID.

In addition, the Advisory Panel identified three major themes on which the SR-CRSP program should focus in the next five years: nutrition and its implications for child development, livestock impact on the environment, and the role of policy environment to enable the economic development of the livestock sector.

The first step towards the SR-CRSP grant renewal, was the organization of regional workshops designed to identify and prioritize perceived problems and potential areas for research and development. As a forum for client input, the workshops were conceived to allow maximum opportunity for nationals of the region to present their perceptions of the issues and constraints. The problem models developed by the workshop participants will establish the potential scope of the CRSP's regional activities and form the topical basis for the renewal proposal. Using the specific problems identified at the workshops, the Management Entity of the Small Ruminant CRSP issued Requests for Proposals (RFPs) for assessment teams in June 1996. The Assessment Teams will have nine months to undertake comprehensive studies to identify the major constraints and issues associated with a specific problem. Within a year, each assessment team will prepare and submit a comprehensive proposal for review and possible funding for implementation.

The Advisory Panel recommended the SR-CRSP program concentrate in three regions of the world: East Africa, Central Asia and Latin America. In early 1996, the Management Entity of the SR-CRSP organized and

sponsored three workshops in each of those regions. The workshops were held in collaboration with a regional organization active in each region. The SR-CRSP teamed with ASARECA in East Africa, ICARDA and the Uzbek Academy of Sciences in Central Asia and IICA in Latin America. Workshop participants included representatives of the countries in the region, NGOs, NARs, IARCs, USAID, local universities and the private sector.

The workshops will play a significant rôle in the design and structure of the SR-CRSP extension. The workshop participants looked at problems of livestock in the region, identified major institutions involved in relevant research and established general guidelines for the Assessment Teams. The workshops were structured to provide each member country the opportunity to fully participate in the identification and prioritization of the problems that will serve as a basis for the future agenda of the SR-CRSP.

CRSP MODEL: STRUCTURE AND FUNCTION

At each workshop Dr. Montague Demment, SR-CRSP Director presented the history of the CRSPs, the advantages to the CRSP model and the SR-CRSP program goals and objectives. Details of his presentation are included in the foreword of this publication.

Advantages of the CRSP Model

Cost Effective. The CRSP model is designed to take advantage of the comparative advantage of the partners to ensure that USAID funds are leveraged to a maximal extent. The backbone of this cost efficiency is the spirit of partnership inherent in the formation of the CRSP. This partnership results in matching funds from both host country and US universities. In the SR-CRSP this funding has amounted to $50M over the life of the CRSP and exceeded the USAID contribution over that period. This level of matching and leveraged funds is the highest among the CRSP programs and certainly represents a major efficiency for the Agency. The other benefit of the partnership relationship has been the Principal Investigator (PI) and Resident Scientist relationship. This partnership, structured to provide strong linkages between the PI in the US and the Resident Scientist in the host country, makes obsolete the need for expatriate scientists in country and hence removes major costs of housing, transport, schooling that accompany expatriate positions in host countries.

Collaboration with US Universities. The success of American agriculture is due in large part to the productive partnership created between the Land Grant Universities and the farmer. This system has connected the power of basic science with the food production systems of the nation to produce a secure, cheap and profitable food supply. The US land grant universities also represent a major resource for expertise in the sciences related to agricultural production. For example there are more soil scientists in a single major land grant university than there are in the entire CGIAR system. The opportunity to link with such a rich system of scientific expertise provides NARS with a diversity of potential contacts that they can not achieve within their own countries. These linkages can be particularly productive as the ability to communicate quickly and cheaply become increasingly available.

Internationalization of US Scientists and Host Country Training. The power of the US culture and economy can be a force that isolates and limits the international perspective of its scientists. Because of the ease with which scientists can focus on domestic problems, it is essential to create mechanisms to expose developing US scientists to the international scene. This is especially true in the age of globalization. We need to develop a strong cohort of internationally focused scientists to make the international linkages that are the basis of intellectual and technologies exchange in the emerging markets. The training provided to US students through the CRSP does just this. The CRSP has also been a highly effective training mechanism for host country students.

Long Term Collaborations. The long-term nature of the CRSP programs has built strong ties between the cooperating institutions and their scientists. The relationships built during the program are a major link that provides stability to institutions and individual scientists that fosters creativity and accomplishment.

COUNTRY PRESENTATIONS

At each regional workshop, country representatives were asked to present a paper on the constraints of livestock production in their respective countries as well as identify potential collaborators. The presentations began with a look at the livestock production systems of the respective countries and the policies governing the use of land in the country. Representatives described the structure and interaction between the institutional components playing a role in the development of policy,

information and extension in the livestock sector. Linkages and reporting responsibilities of the national and regional institutions were also indicated. Data on the number of scientists in relevant fields to livestock was provided for each of the research institutions. Discussion time was allotted following each presentation.

RESOURCE PRESENTATIONS

In addition to the country representatives, resource people were invited to represent the thematic subjects. Presentation topics included Policy, Human Nutrition, Wildlife/Livestock interactions, Livestock/ Environment, Livestock Production Systems, Impact of Decollectivisation and NGOs.

PRIORITIES

Thematic working groups were charged with the task of producing a set of prioritized constraints related to livestock production that are the assessment and description of the underlying processes responsible or connected to the identified problem model in their theme. Themes included: Human Nutrition, Economic Growth, Policy, and Livestock/ Environment. The groups were further given the responsibility to identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model. At the conclusion of the workshop, participants ranked the priority topics with the SR-CRSP goals and objectives in mind.

INTRODUCTION

In collaboration with the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the Small Ruminant CRSP sponsored the East African Livestock Assessment Workshop January 29 - February 1, 1996, in Entebbe, Uganda. Seven of the ten ASARECA member countries were represented at the workshop along with participants from NGOs, NARs, IARCs, USAID, local universities and the private sector. Representation was primarily African with a few specialists of non-African nationality.

ASSOCIATION FOR STRENGTHENING AGRICULTURAL RESEARCH IN EASTERN AND CENTRAL AFRICA (ASARECA)

The workshop commenced with opening remarks by Dr. Mrema, Executive Secretary of ASARECA. Dr. Mrema presented the goals and aspirations of ASARECA. He began with a brief history of the formation of the association. ASARECA is one of the four sub-regional organizations for agricultural research in Sub-Saharan Africa. The others are: SACCAR (South Africa), CORAF (West Africa) and INSAH (Sahelian Zone). ASARECA is governed by a Committee of Directors, comprised of one director of agricultural research from each member country. The Executive Secretary is responsible for executing decisions of the Committee of Directors and assumes administrative oversight of the association.

The Association has the following objectives:

- To update the strategic national Agricultural Research Plans while ensuring that research responds to demands (clients/markets).
- To identify common constraints to agricultural productivity in the region.
- To implement joint regional research programmes.
- To create consolidated funding mechanisms for agricultural research.
- To contribute to meeting the human, physical and financial resource requirements of the regional programmes decided jointly.
- To establish a regional plan for the development and management of human resources.
- To harmonize and improve the management information systems of the member institutions.

- To establish harmonized systems of scientific and technical information and documentation.
- To publish the results of joint research
- To promote the exchange of genetic material.
- To stimulate the researchers to assume real responsibility for the research programmes in which they participate, and for the results.
- To develop more effective and cheaper mechanisms for linking research, extension, producers and markets.
- To disseminate new technologies and knowledge to end-users.

Dr. Mrema concluded with a brief look at the issues requiring consideration when prioritizing and identifying constraints in livestock research. He identified ten issues for consideration:

- Budgetary constraints
- Problem of pastoralists
- Supply of livestock products to urban and other non-livestock keepers
- Reduce transaction costs for trade in livestock products
- Urban farming
- Local production vs. imports
- Policies
- Intensive vs. Extensive systems
- Institutions
- Natural Resources/Conservation Issues

THEMATIC GROUPS

Workgroups in East Africa were formed around the following themes: Livestock/Environment, Human Nutrition and Economic Growth. The stated goals for the thematic workgroups were:

- To produce a set of prioritized constraints (problem models) related to livestock production that are the assessment and description of the underlying processes responsible or connected to the identified problem model in each theme.
- Identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model.
- Provide information for ASARECA to set their livestock research priorities.

The following problem models were the results of the group discussions.

Problem Models

PRIORITY TOPICS FOR RESEARCH IN HUMAN NUTRITION

Introduction: A high prevalence (40%) of childhood malnutrition exists in East Africa. Two types of malnutrition have been identified: (1) protein-energy malnutrition (PEM) resulting from inadequate quantities of food; (2) micronutrient malnutrition due to poor quality food (e.g., low intakes of iron, vitamin A, vitamin B12, zinc, and calcium). Children with PEM will usually have micronutrient deficiencies as well, although micronutrient deficiencies may exist without PEM.

Objective: To identify and evaluate practical methods to increase animal products in children's diets to alleviate malnutrition.

Hypothesis: Increasing animal products in children's diets will enhance child health and development.

Activities:
Review of literature and other available knowledge to clearly identify constraints and gaps in information regarding:
- Nutritional status and dietary data
- Policy, economic status, agricultural practices, etc.

Conduct surveys (PRAs, RRAs, etc.) for validation of existing information (if any) and establish the magnitude of the researchable nutrition problems
Characterize the nutritional content of typical diets
Develop the most appropriate intervention protocols:
- Educational
- Household animal production
- Community access to animal products

Implement randomized controlled trials
Measure impact of the selected interventions (e.g., improvements in birth weight, growth, child survival, and cognitive development).

Outputs:
Comprehensive description of the nutritional status of the community.
A summary of the nutritional adequacy of typical diets in the community.
An evaluation of the impact of adding animal products to children's diets.
A handbook describing these methods and their possible application in other communities.

Relevance: The problems are universal in East and Central Africa.

Actors:

- Land grant universities in the US.
- Agricultural universities in East and Central Africa.
- NARS and Ministries of Health and Agriculture.
- NGOs such as International Center for Research on Women (ICRW), FARM Africa, Save the Children's Fund, Freedom from Hunger, Heifer Project International, CARE, OXFAM, Action Aid, Plan International.
- IARCs (ILRI, IFPRI)
- UNICEF
- Private sector (e.g., US Livestock and Meat Board, Land O' Lakes, meat packers).

Active Projects:
ICRW/FARM Africa dairy goat project in Ethiopia (contact: Charlotte Johnson-Welch at ICRW, Washington, DC).

Note: Consideration should be given to incorporation of human nutrition components into existing livestock research and development projects.

PRIORITY TOPICS FOR RESEARCH IN LIVESTOCK PRODUCTION, WILDLIFE INTERACTIONS AND ENVIRONMENTAL CONSERVATION

Introduction: Under this general research area two main areas of interest were examined:

Crop/livestock production systems
Livestock/wildlife production systems

Bearing in mind the interests of the Small Ruminant CRSP and the considerable research already carried out on crop/livestock production systems the group concentrated discussions on livestock/wildlife production systems and examined areas of research that would promote increased production whilst enhancing environmental conservation in rangeland. It is felt that though some of the ideas may have relevance to forest areas, their greater significance is for arid and semi-arid rangeland habitats.

Livestock/Wildlife Production Systems

The major topics identified were:

1. Establishing policies that would support a sustainable balance between food production and conservation of the environment.
2. Community based management strategies for protected areas.
3. Management strategies to integrate livestock and wildlife populations to maximize the production of rangeland ecosystems.
4. Problems in pastoralist production systems in response to periodic droughts.

(1) Policies and their importance for incorporating wildlife into the development of sustainable balances between food production and conservation of the environment.

Objective: To establish an appropriate and sustainable balance between food production and environmental conservation.

Research has shown that mixed species systems can result in higher production in both biomass terms and economic terms than single species systems. Current policies in the east African region do not, however, promote such systems and traditional and cultural dispositions and the conservatism common amongst farmers tend to result in concentration on single species production systems, or at best the use of two or three domestic animal varieties. The expectation that the control of livestock diseases (notably by the effective control of tsetse fly) will make large areas of rangeland currently unavailable to livestock and often important wildlife areas available for livestock production also presents the opportunity for the development of mixed livestock/wildlife production systems.

Hypothesis: Creation of a well researched policy environment will permit optimal balances between food production and environmental conservation on land made available by the control of livestock diseases.

Activities: The following areas of research were identified as necessary for validating the above hypothesis:

- Social sciences:
  Society and resource use
  Conflict resolution
  Resource sharing

Traditional structures
Forms of social organizations
Needs and demands of rangeland communities

- Economics of production:
  Pricing and marketing
  Cost of production
- Range ecology:
  Conflicting uses
  Ecological monitoring
  Range and wildlife management (protection and use)
  Stocking rates in mixed species systems
- Ownership:
  Communal management vs. private management of land in terms of food production and conservation.
  Ownership of wildlife (private Vs state)
  Conflicting interests
- Development of wildlife industry:
  Relationship to tourism
  Processing of by-products
  Marketing
- Facilitation:
  Extension
  Producer associations
  Tax environment
  Conflict resolving current and future conflict between wildlife and other agricultural production systems.

Outputs: Lands likely to be opened up by eradication of diseases will be managed under optimum regimes balancing both environmental conservation and food production.

Relevance: The products of this research will apply to a great proportion of the rangelands in Africa.

Actors: Expertise is available to carry out these activities from; Land grant Universities, ILRI, Government agencies concerned with management of wildlife, and various NGOs. The following agencies are active in this type of research:

- UNEP
- WLTI
- NEMA (Uganda)

(2) Community based management strategies for protected areas.

Objective: To examine empirically the apparent advantages of a community based approach to protected area management in the pursuit of sustainable conservation areas.

The general acceptance of community based conservation as the correct approach to protected area management, largely replacing protectionist approaches, has come about largely in the absence of empirical evidence to demonstrate its facility. Despite the lack of real evidence, most western based conservation organizations, if not all African conservation authorities, now require that projects funded by them include activities to enable communities to participate in and benefit from protected area management. The complex nature of community based approaches to protected area management and the apparent failure of many of the pilot projects implemented around the continent, suggest the importance of a body of data to support the theoretical rationale for involving local communities in protected area management.

Hypothesis: Community based approaches to protected area management are more effective than traditional protectionist approaches.

Activities: The following areas of research were identified as necessary for validating the above hypothesis:

- Environmental monitoring
  - comparing environmental parameters both inside and outside PAs under different management regimes.
- Economic analysis
  - Respective costs of different management regimes, current expenditure and projections.
  - External pressure on protected areas and vice-versa - comparing the pressures exerted on the PAs to allow analysis of the degree of impact of management on the problem (land pressure, poaching pressure, natural resources, population pressure, etc.), and the degree of negative impact caused by the PA on local communities (e.g., crop damage, loss of livestock, loss of traditional resources, etc.)
- Sociological aspects
  - Attitudes of communities to the PA, roles of community structures in management, impact of management initiatives on social structures.

- Economic impact on the community, comparison between the economic cost of the PA on the community with the value of benefits created under a community based approach.

Outputs: This research will provide data which can be used to better evaluate the benefits of adopting a community based approach to protected area management. The techniques involved will be viewed realistically, and applied in a practical and appropriate way, rather than as an act of faith or as an act of political correctness.

Relevance: The products of this research will apply to most countries within the region developing various forms of community based conservation initiatives.

Actors: Available expertise to undertake these activities are: International research organizations like ILRI, Land grant Universities, NGOs, and some governmental organizations. Agencies with active research projects related to this topic are:

- AWF
- WWF
- WCI
- IUCN
- FOC
- IFF
- CARE
- KWS
- ANGAP (MADAGASCAR)

(3) Management Of Mixed Livestock/Wildlife Populations To Maximize Efficiency Of Use Of Rangeland Resources.

Objective: To maximize efficiency in the use of ecosystems by stocking both livestock and wildlife in the rangelands.

Rangeland management theory and wild and domestic animal ecology research suggest that productivity in terms of biomass production will be increased by employing a multi-species production system rather than a single species system. It is suggested that this will result from the ecological adaptations and niche separation demonstrated by the wide variety of large mammals and reflected to some extent in the different domestic animals. At a simplistic level it is clear that in

woodland savannas, a mixture of grazers and browsers will make fuller use of the available natural forage resource than either grazers or browsers alone. Thus, keeping a mixture of browsers and grazers would allow higher stocking rates to be maintained, leading to higher production from a given area. Management of a mixed species production system, however, is more complex, and where this included wildlife, the required technical skills may not exist.

Hypothesis: Animal production can be improved by incorporating wildlife into the production system.

Activities: The following areas of research were identified as necessary for validating the above hypothesis:

- Ecology of domestic and wild herbivores
  water
  forage
  habitat
- Management in drought prone environments
- Economics (natural resources/production).
- Production technologies
  harvesting animals
  processing
  fencing
  disease management
  most appropriate management techniques
- Training
  extension workers, producers
- Biodiversity - livestock, wildlife and plants
- Habitat modification in relation to production systems
  production levels
  cultural perspectives
  ecological mechanisms
- Use of animals (domestic and wild) as environmental management tools.

Outputs: The output of this research will be the formulation of stocking densities that are optimal for the rangeland ecosystems when stocked with a mixture of wildlife and livestock. This will prevent environmental degradation and allow for the most economic and ecologically efficient use of the land.

Relevance: The products of this research will apply to most parts of African rangelands.

Actors: Expertise available to carry out these activities are NGOs like WCI, WWF, Government agencies and Land grant Universities. It was difficult to identify agencies active in these activities in this region.

(4) Production inefficiencies in pastoralist systems resulting from droughts.

Objective: To research mechanisms that will assist pastoralists to overcome limitations on their livestock production system resulting from inability to de-stock rapidly in response to droughts and re-stock following droughts.

Traditional pastoralist strategies of reducing risk in rangeland in highly variable rainfall areas depended on mobility, exploitation of habitat variability, distribution of animals over a social network, and large herd sizes. These strategies were highly adaptive and enable higher levels of production from the land than western based ranching models of production. Reduction in mobility and the available land has compromised these strategies in many circumstances. Retention of large herds in particular tends to result in dramatic collapses in livestock populations in response to drought, often with accompanying damage to the environment. Enabling pastoralists to reduce herd size in advance of droughts to avoid die-offs and thus loss of capital, and restock rapidly to exploit available forage resources following droughts should increase the productivity of the rangeland and provide significant social and environmental benefits.

Hypothesis: Mechanisms for connecting pastoralist to financial institutions to increase liquidity of livestock would be effective in enhancing production and environmental protection in arid and semi-arid rangeland system.

Activities: This topic relates closely to the topic presented by the animal production for economic development group to examine the problems of pastoralists' responses to droughts. The rationale presented here could be combined with their rationale.

Crop/Livestock Production Systems

The following topics were examined:

1. Reducing herd sizes through intensification will ameliorate environmental degradation.
2. Testing available technology packages that are efficient, environmentally efficient and economically viable.
3. Development of methodologies for transfer and adoption of technologies
4. Use of marginal lands within high intensity production systems.

(5) Appropriate mechanisms can be developed to connect pastoralist systems to the central national economies in ways that allow livestock capital to integrated into national and local capital markets providing flexibility to deal with drought and minimize environmental degradation.

(Topic is similar to one identified by the economic development group.)

(6) Marginal lands within high intensity production systems.

Objective: To examine mechanisms for the sustainable use of marginal, ecologically fragile lands existing with high intensity production systems, currently subject to inappropriate and generally environmentally damaging production systems.

Many areas characterized by high population densities and high intensity crop/livestock production systems contain within them areas of marginal production potential, but which often play an important role in the provision of ecological services and are high in biodiversity. Examples would be steep forested or grassland slopes and seasonally inundated valleys or wetlands. Land pressure often forces farmers to exploit these marginal lands in inappropriate ways that are not sustainable and which may damage the production potential of the entire system, and certainly of the marginal lands. Land-uses for these marginal areas need to be developed which would contribute to the productivity of the farming system but which will be sustainable and support the retention of biodiversity.

Hypothesis: Sustainable management of marginal area resources can increase farming system production in the short term whilst retaining biodiversity.

Activities: The following areas of research were identified as necessary for validating the above hypothesis:

- Characterization of marginal lands within a high intensity production area selected for study.
- Examination of uses of marginal lands and economic analysis of their contribution to the production system.
- Impact of land use on habitat and biodiversity.
- Participatory development of alternative land uses for marginal areas that would increase production and reduce environmental damage.
- Economic and environmental impact analyses of identified alternative land uses.
- Specific examination of potential roles for wildlife within alternative land use systems (e.g. small antelopes for meat production, butterfly pupae production, honey production).

Outputs: Methodologies for examination of potential for marginal lands to contribute towards crop/livestock production systems.
Relevance: Highly relevant to highland areas in the region, especially Ethiopia, and to Uganda's extensive wetlands.

Actors: Potential collaborators would be IUCN (Wetland Program, Uganda), FARM Africa, NARs.

PRIORITY TOPICS FOR RESEARCH IN ANIMAL AGRICULTURE FOR ECONOMIC DEVELOPMENT

Introduction: Though no intellectual restriction was applied, selection of the major topics was done within the ASARECA identified priorities and with an eye to the exploiting the comparative advantages of the CRSP approach to collaborative research. There will be other priority topics, appropriate to other approaches to regional collaboration in agricultural research, that have not been identified in this exercise. This prioritization also assumes a commitment by regional national agricultural research institutions to collaboration with US Land Grant Universities and other institutions which will have to be validated by further consultation. The role of the CRSP in building capacity for achieving the research objectives will be assessed as a component of each selected project.

The major topics that were identified for research in animal agriculture

for economic development (not in order of priority) were:

1. Ensuring the food security and development needs of resource poor households.
2. Improving the ability of pastoral people to cope with and recover from drought.
3. Establishing a enabling policy environment.
4. Matching livestock genotypes to ecological and economic environments.
5. Improving input and output markets.
6. Conserving forage and browse plant and livestock biodiversity.
7. Optimizing land use and natural resource conservation by integrating domestic and wild animal species.

(1) Ensuring the food security and development needs of resource poor households

Objective: To use livestock, especially small ruminants to enable resource poor households to cope with stress and enter the monetary economy. The priority target group will most likely be women in households that currently do not have livestock and little opportunity to acquire them as a hedge against poor harvests.

Hypothesis: Livestock are important in maintaining household security in times of stress, especially in resource poor households.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- identifying appropriate target groups that are typical of a broad cross section of people in East Africa. This will be preceded by establishing criteria for identifying such groups;
- establishing human nutrition profiles partly as criteria for identification and as baselines for assessing progress in achieving food security;
- identifying appropriate interventions;
- developing appropriate means for resource people to access credit e.g., through women peer groups; and
- extension techniques in human nutrition.

Outputs: The output of this research will be viable approaches for improving the welfare and food security of the poorest communities in rural areas and enabling them to enter the market economy.

Relevance: The products of this research will apply to significant numbers of people in all East African countries.

Actors: The following agencies are active in this type of research and development:

- FARM-Africa
- Save the Children Fund
- CARE International
- International Center for Research on Women (with FARM-Africa)
- Ethiopian Health and Nutrition Research Institute
- UNICEF

(2) Improving the ability of pastoral people to cope with and recover from drought

Objective: To improve the chances of livestock people being able to withstand catastrophes and sustain their production systems and welfare under changing ecological, social and economic circumstances.

Hypothesis: By better matching of traditional coping mechanisms with appropriate policy and technical options, pastoral systems will be more sustainable and better able to accommodate change.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- identification of central and local government, and traditional authorities which affect the behavior of pastoral systems and elucidation of their roles;
- identification, description and evaluation of pastoral coping mechanisms;
- assessing extent, and consequences, of changing terms of trade between pastoral societies and providers of food grains and other essential goods and services. And studying food sources, quality of market information and state of infrastructure of trade in livestock and foodstuffs;
- identification of available technologies for amelioration of the effect of drought, especially water and feed options;
- analyses of options open for pastoral mobility and likely trends;
- design and implementation of a pastoral famine early warning system for East African countries that will complement the FEWS

in place for grain crops. This will involve the identification of locationally-strategic partners in research, extension and NGO communities and provision of means for them to be trained in famine early warning and enabling them to conduct trials on coping mechanisms suggested by the pastoral communities amongst whom they work; and

- depending on resources, this may be linked to the design and validation of appropriate herd health procedures to control diseases that exacerbate the deleterious effects of droughts.

Outputs: An early warning system that will constitute a vital component of effective relief to development assistance and which will ameliorate the effect of future drought and disease catastrophes.

Relevance: The products of this research will apply to significant numbers of people in all East African countries, especially those with large pastoral communities.

Actors: The following agencies are active in this type of research and development:

- FARM-Africa's northern Kenya camel production improvement project
- Save the Children Fund
- CARE
- OXFAM
- IGADD
- CARE International
- ILRI associated Livestock research networks; CARNET, SRNET and AFRNET
- World Bank
- USAID
- IDRC
- FAO

(3) Establishing an enabling policy environment

Objective: To provide government with the necessary information and analysis of options with which to formulate policies that will stimulate change and progress in animal agriculture for the benefit of smallholders, pastoralists and consumers of livestock products; milk, meat, fiber, hides, manure and draught power.

Hypothesis: The creation of an optimal policy environment will facilitate change and encourage economic growth.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- identifying of the agencies and communities involved in developing animal agriculture including state and NGO extension agencies, NARS and farmers' organizations;
- analyzing land tenure and resource use arrangements;
- identifying and logging meta data, i.e., what data exists on the particular topic, where it is, how much there is, its quality, its format and accessibility;
- analyzing the likely effect of different pricing policies for inputs and outputs; and
- studying the marketing arrangements and the role of government through regulation and the actions of parastatal marketing agencies and the degree of competition in the market place.

Outputs: Enabling policy options for consideration by government advisors and decision makers.

Relevance: The products of this research will apply to significant numbers of people in all East African countries.

Actors: The following agencies are active in this type of research and development:

- World Bank
- European Union
- Bilateral donors
- ILRI and IFPRI

(4) Matching livestock genotypes to ecological and economic environments

Objective: To provide the extension services concerned with animal agriculture with appropriate information on which to base advice to farmers on the use of indigenous resources rather than depending on exotic germplasm and foreign technologies that may not be well adapted to their less than ideal marketing and ecological circumstances.

Hypothesis: Matching animal genotypes to prevailing ecological and economic circumstances will maximize human welfare, farm profitability and the sustainability of smallholder farming systems.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- analysis of feeding and other production factors affected by the ecology and prevailing farming systems. This will inter alia included identification of appropriate crop residue, forage, browse and agro-industrial bi-products available for feeding to livestock. This will include determining the potential for utilization of novel feeds;
- analysis of the strength of demand for livestock products, the marketing systems including the provision of market information, the state of the infrastructure and central and local government policies and regulations that restrict freedom of trade;
- identification and epidemiology of the important endemic livestock diseases, diagnostic tools and capabilities and efficacy and delivery systems for of disease control measures;
- identification, characterization and assessment of the production potential and productivity traits such as disease and stress tolerance capability of available local and exotic livestock genotypes and their crosses; and
- modeling of key systems to take account of the above factors.

Outputs: Systems of smallholder production that despite less than maximum output are both more profitable and more sustainable than high input systems dependent on exotic germplasm.

Relevance: The products of this research will apply to significant numbers of people in all East African countries.

Actors: The following agencies are active in this type of research and development:

- ITAG
- Heifer Project International
- FARM-Africa
- VETAID
- ILRI, ICIPE, ICRAF

(5) Improving input and output markets

Objective: To provide decision makers with information they need to remove market imperfections that will reduce the prices of inputs and costs of sales and make animal products available to a wider cross section of urban consumers, especially the more disadvantaged families.

Hypothesis: that, present marketing arrangements constrain adoption of innovations and response to consumer demand; and

that, improvements can be made to processing and delivery systems to make foods of animal origin accessible to the poorer urban consumers.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- analysis of the demand for animal products;
- assess the need for credit and devise appropriate way of providing credit that will make inputs available in the rural areas. This should included inventory finance for wholesalers and rural retailers as well as for producers;
- the supply and maintenance of animal-drawn implements in rural areas including the capacity of commercial suppliers and local artisans
- assess the seasonal availability of animal feedstuffs;
- analysis of the supply of veterinary drugs and services and the role of government and the private sector in this;
- analysis of alternative processing and delivery systems that will reach the less well off communities with appropriate healthful products; and
- analysis of the effect of alternative pricing and import and export policies on the supply of inputs for animal agriculture and the demand for locally produced animal products.

Outputs: This research will provide suggestions for improved input and output marketing arrangements that will reduce the risks and increase the returns to investment in animal agriculture.

Relevance: The products of this research will apply to significant numbers of people in all East African countries.

Actors: The following agencies are active in this type of research and development:

- FARM-Africa
- ITAG
- Private sector

(6) Conserving forage and browse plant and livestock biodiversity

Objective: To ensure that the invaluable diversity of domestic livestock breeds and forage varieties are conserved for sustaining and improving future production systems

Hypothesis: that, varieties of forage and fodder plants and breeds of domestic livestock with valuable properties are threatened and that in situ conservation technologies and policies can be devised and implemented

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- characterize and phenotype indigenous forage and browse plants, and plants with medicinal veterinary uses that may be threatened due to expanding cultivation, overgrazing or other causes;
- characterize and phenotype indigenous livestock breeds that may be threatened by neglect, crossbreeding or other causes;
- determine population abundance and assess the extent and urgency of the threats to vulnerable population;
- identify important production and stress tolerance traits in threatened germplasm;
- determine appropriate conservation programs for selected plants in genebanks and in situ conservation schemes that can elicit community interest and participation; and
- devise and implement appropriate in-situ conservation schemes for threatened livestock breeds that can be profitable managed by communities that have traditional kept the breeds selected for conservation

Outputs: Invaluable plant varieties and livestock breeds preserved for the benefit of future communities world-wide.

Relevance: The products of this research will apply to significant numbers of people in all East African Countries and around the world.

Actors: The following agencies are active in this type of research and development:

- FAO
- ILRI
- ICRAF
- Signatories to the Agenda 21 convention on biodiversity including the USA
- UNEP

(7) Optimizing land use and natural resource conservation by integrating domestic and wild animal species

Objective: To ensure that the opportunity is not lost to conserve biodiversity and improve sustainable use of natural resources through ignorance of the benefits and technology for integrating wildlife into commercial land use systems.

Hypothesis: In certain circumstance wildlife can contribute to the sustainability and profitability of farming systems.

Activities: The following activities have been identified as necessary for validating the above hypothesis:

- conduct a desk study of the grazing and watering behavior of wildlife species with potential for commercial exploitation in mixed land-use systems;
- determine if there are ways of incorporating grazing and watering requirements into the prevailing land tenure and resource use systems where they might have commercial potential;
- determine the technology and husbandry required for rearing wildlife for efficient reproduction and profitably achieving appropriate size and ages for the desired end uses such as slaughter for meat, sport hunting and green hunting;
- determining the institutional constraints such as ownership law and market regulations that may constrain exploitation of wildlife and their products; and
- determine disease factors that may affect livestock species on the farms and ranches on; which the animals are kept and neighboring properties.

Outputs: Technical and policy recommendations for increasing the opportunities for rural producers to benefit from the humane exploitation of wildlife.

Relevance: The products of this research will apply to significant numbers of people in all East African countries.

Actors: The following agencies are active in this type of research and development:

- Private enterprise
- African Wildlife Foundation
- FARM-Africa

RANKING BY WORKSHOP PARTICIPANTS

1. *Ensuring the food security and development needs of resource poor households.*
2. *Identify and evaluate practical methods to increase animal products in children's diets.*
3. *Improving the ability of pastoral people to cope with and recover from drought.*
4. *Establishing an enabling policy environment.*
5. *Matching livestock genotypes to ecological and economic environments.*
6. *Improving input and output markets.*
7. *Optimising land use and natural resource conservation by integrating domestic and wild animal species.*
8. *Livestock/Wildlife Production systems.*
9. *Conserving forage and browse plant and livestock biodiversity.*
10. *Crop/Livestock Production systems.*

COUNTRY PRESENTATIONS

Livestock Development Policy Issues and Concepts

By Cyprian Ebong[1] and M. Mbuza[2]
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BACKGROUND

Livestock policy that guides research on and production of animals has been formulated on the basis of:

- The need to conserve genetic diversity threatened by selection for material output
- The need to meet the increasing demand for food estimated at a rate of 3-4% per annum
- The need to correct imbalances in regional, national and household access to wholesome food including livestock products
- The need to match production to the demand as well as the resource base of the production environment.

These considerations demand a careful evaluation of the biological and economic viability of various production systems in order to ensure that the basic objectives of national policy are met. The objectives of national policy are independence, economic efficiency, resource conservation, stability and equity.

The overall goal of livestock development is to improve livestock species and breeds, in relation to Uganda conditions and local biophysical and socioeconomic environments, in order to ensure food security and socioeconomic development. This goal includes production for self-sufficiency, surplus for export, economic efficiency and equity.

The relevance of such policy objectives can be viewed from a socioeconomic profile of the national population which consists of survival (13.5%), subsistence (75%), progressive (8%) and wealthy (3.5%) households. The per capita consumption of animal products by

the populace is below the world average, more so in rural areas. However the price elasticities of these commodities indicate that consumption is likely to increase if production increases and prices fall or if the income of farmers increases effectively increasing demand. Therefore it is envisaged that any meaningful livestock development must contribute to improved nutrition of the household and alleviation of household poverty.

MACRO-ECONOMIC POLICIES INFLUENCING THE LIVESTOCK SECTOR

Livestock production operates within 3 key policy environments that govern the distribution of resources and their utilization in food production and distribution. The major policies influencing livestock production are land tenure, decentralization, and privatization.

Land tenure

Land use policy in Uganda has a history of transformation. Before formal legislation, customary land tenure authorized inhabitants to acquire and use free land. Formal legislation on land was effected under the Africa Orders in Council (1889) by the Commissioner and Council General for the Protectorate of Uganda as Land Regulations No.4 (1897). It vested all powers over land in the Commission. In 1908 the Possession of Land Law was enacted. This law established the mailo land system which authorized ownership of land surveyed by the government up to 7770 ha. In 1912, the Land Succession Law specified terms and conditions for the succession of mailo land. In 1928 the Busulu (rent) and Envujjo (tribute) Law allowed tenants to pay rent and tribute to owners of mailo land. In 1945 a law empowered the Kabaka of Buganda to sequestrate land for purposes beneficial to the nation. In 1962 the Public Land Ordinance repealed the Crown (Government) Land Ordinance and established the Land Commission and District Land Boards. In 1975 the Land Reform Decree was promulgated. This decree vested ownership of all government land in the Uganda Land Commission. Freehold and mailo lands were converted to leaseholds; rents and tribute were abolished. Customary land was permitted by sufferance, i.e. lease of customary land. Finally, in 1995 the new constitution vested ownership of land in the people under freehold, enabling anybody to acquire and use land for purposes including agricultural development. The implication of present land tenure laws can be viewed in connection with the government s

privatization policy. The law enables investors to acquire land to use in profitable activities which include agriculture.

Decentralization

The new constitution has adopted a unitary system of government with certain powers devolved to districts. This is contrary to previous policy where development was initiated and monitored by the central government with the limited involvement of district authorities. The decentralization policy authorizes district authorities to develop, prioritize and manage development projects appropriate to the needs of the people. The central government plays an advisory role. This policy divests MAAIF of a number of the institutional functions of the veterinary department, namely: the control of diseases; regulation and supply of inputs related to diseases and parasite control; enforcement of public health regulations; veterinary certification of the wholesomeness of markets; diagnosis and epidemiology of diseases; supervision of professional ethics in the veterinary service; and the establishment and maintenance of disease-free zones.

Related to the decentralization process is the NARO Statute of 1989 which created the National Agricultural Research Organization (NARO), a semi-autonomous institution with a mandate to develop appropriate technologies for the crop, livestock, fisheries and forestry industries. Hitherto, research in various commodities was fragmented between the sister Ministries of Agriculture, Animal Industries and Fisheries, and Forestry/Environment. This arrangement resulted in the duplication of effort and lacked the holistic perspective of the farming system. The creation of NARO was designed to increase efficiency and the relevance of technological packages produced. Hence NARO operates in a multidisciplinary environment where interaction between scientists, within and between programs and disciplines, is maximized. The participation of the client in research planning, testing and evaluation is part of the process.

Trade liberalization/privatization policy

The trade liberalization/privatization policy has created a free market economy and has eliminated price barriers. Nationally-produced goods and services compete in the marketplace. This policy eliminates the monopoly by deprived parastatal organizations of the processing and

marketing sectors. The policy also enables capable individuals and organizations to invest in all sectors of the economy and compete with both internal and foreign market forces. The result has been the development of a number of agro-based industries.

AGRICULTURAL POLICIES SPECIFIC TO LIVESTOCK PRODUCTION

The government realizes that a lack of appropriate policy has been a major drawback for livestock production. Steps to correct the situation include:

- The Dairy Master Plan Study was completed in 1991.
- A National Genetic Resource Programme to promote the sustainable use of indigenous genetic resources was launched in March 1995.
- A National Breeding Policy with breeding and management guidelines for different agro-ecological zones has been formulated and awaits government approval.
- A Herd Recording Scheme has been initiated in 4 pilot districts.

Also envisaged for the future are:

- A Meat Production Master Plan Study, to be supported by ADB.
- A Small Ruminant Production Strategy Study, to be supported by BADEA.
- A Fisheries Master Plan Study, to be supported by ADB.

INSTITUTIONAL FRAMEWORK FOR LIVESTOCK PRODUCTION

Key actors in livestock production include government organizations, private organizations and farmers groups. Government organizations include: the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF); the National Agricultural Research Organization (NARO); the Faculty of Agriculture and Forestry, Makerere University Kampala

(FAF/MUK); the Faculty of Veterinary Medicine, Makerere University (FVM/MUK); district (local) administrations; and parastatal organizations.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)

MAAIF has 3 major departments with complementary functions in animal production. These include: Department of Animal Production and Marketing, Department of Veterinary Services, Department of Training and Information, and Department of Animal Production and Marketing.

Department of Animal Production and Marketing. The major functions of the Department of Animal Production and Marketing are:

- policy formulation for livestock production
- strategic planning for national livestock development
- monitoring of policy implementation
- training of technical support staff for research and extension in one of 6 agricultural, animal and fisheries training institutes
- regulation of the import and export of animals and animal materials
- promotion and conservation of animal genetic diversity: This function encompasses: establishment and maintenance of an Animal Genetic Resource Centre in one of the NARO institutions; establishment and maintenance of a National Livestock Registry; and establishment and execution of an appropriate system of performance evaluation.
- breeding and multiplication of improved livestock breeds
- improvement of the rangelands.

The department has been gradually divested of certain functions which have been transferred to:

- districts, through the implementation of the decentralization policy
- commercial and private sectors, through the privatization policy;
- NARO, through the NARO Statute which divested the ministry of strategic and adaptive research functions.

The ministry has been left with a minimal staff of well-trained scientists in disciplines related to animal production. These disciplines include breeding, modern breeding techniques and management of breeding

policy; general nutrition, including basic biotechnological skills in feed resource development and range ecology; animal production and management (dairy, beef, goats, poultry, and pigs); livestock statistics, including computer database development and systems analysis; marketing and business management.

Another vital asset of the Department of Animal Production and Marketing is the Animal Breeding Centre. The centre, an affiliate research outpost for NARO, is involved in the procurement of semen, ova, and/or embryos and associated equipment. It is also the National Genetic Data Bank and regulates transactions in genetic materials

Department of Veterinary Services. Following divestiture, the function of the Department of Veterinary Service is essentially to provide technical back-stopping to the districts in: control of disease; regulation and supply of inputs related to diseases and parasite control; enforcement of public health regulations; veterinary certification of the wholesomeness of markets; diagnosis and epidemiology of diseases; supervision of professional ethics in the veterinary services; and the establishment and maintenance of disease-free zones. Effective implementation of these activities has been largely divested to the districts or to the private sector, while the department retains the mandate for vaccine production/ importation and distribution and, as a member of the Uganda Drug Authority, the regulation of the importation of veterinary drugs.

Department of Training and Information. The responsibilities of the Department of Training and Information include:

- training of technical support staff most of whom will be deployed for extension and research
- collaboration with other departments in the production of audio-visual aids and literature
- compilation and dissemination of marketing information.

Department of Entomology. In addition to these three departments, the Department of Entomology oversees the control of the tsetse fly and other insects of economic importance.

National Agricultural Research Organization (NARO)

The primary function of NARO is research in crops, livestock, forestry and fisheries. Presently, emphasis is on adaptive and some applied

research. The organization has six research institutes, three of which have mandates to undertake research on animal production and disease management. These institutes have the capacity to undertake research in pasture agronomy, animal nutrition, breeding, entomology, epidemiology and reproductive physiology. NARO has adopted, as policy, client orientation and farmer participation in technology development. To achieve these, NARO has put in place a Research Extension Liaison Unit to close the gap between research and extension. The organization involves scientists, field extension staffs, and farmers in various stages of technology development and has a system of monitoring and evaluating to ensure various research programs attain desired objectives. NARO also has land and infrastructure that could be useful in animal management and the maintenance of parent stock for breeding purposes.

Makerere University

The primary function of the Makerere University is training and research. Key players at the university include the Faculty of Agriculture and Forestry and the Faculty of Veterinary Medicine. The Faculty of Agriculture and Forestry has the mandate to undertake both basic and applied research in pasture agronomy, nutrition, breeding, reproductive physiology, management, processing, economics and extension. All these fields are accommodated by various postgraduate training programs conducted by the Faculty. The Faculty of Veterinary Medicine has capability in all aspects of the veterinary sciences, including reproductive physiology. The Faculty has recently developed skills in AI and ET in small ruminants. Makerere University is closely linked to NARO; the deans of the two above mentioned Faculties are members of the Board of Directors of NARO. University scientists in various disciplines are members of program review committees at the institute level. They also participate in the implementation of projects where NARO has manpower gaps. Similarly, NARO scientists are obliged to teach at the Makerere University whenever requested to do so.

Parastatal organizations

Parastatal organizations include the Uganda Livestock Industries (ULI) Uganda Dairy Corporation (UDC) and Prison Farms. These organizations have purposes which are largely commercial in nature. These include:

- breeding and multiplication of quality stock

- establishment of nucleus breeding herds and flocks
- demonstration of improved farming practices
- processing and marketing of livestock products.

However, with privatization, these activities are no longer the monopoly of parastatal organizations.

Local administrations

The implementation of the decentralization policy has divested the central government of a number of activities which were formally undertaken by MAAIF. These include:

- facilitation of the extension services
- education and mobilization of the farmers for improved livestock production
- enforcement of by-laws
- establishment and maintenance of production, multiplication, conservation and demonstration units
- promotion of the formation of livestock farmers associations. These activities are now undertaken by respective district administrations.

Private organizations

Private organizations involved in livestock production can be divided into two categories. The first group includes non-profit organizations that are involved in input supply and distribution, group organization and mobilization, training, linkages and marketing. They include a number of non-governmental organizations (HPI, Send-a-Cow, Church Of Uganda and the Catholic Secretariat), aid and relief agencies (Oxfam), trade unions, and farmers groups (UNFA, etc.).

The second category includes commercially-oriented organizations. These include local and multinational companies involved in input supply, and feed manufacturing; production of farm machinery; importation of genetic materials; the running of AI services; and livestock research. Prominent examples of such organizations include: NOVITA and UGACHICK.

Constraints to animal production have been broadly outlined elsewhere. Technical issues of production are the mandate of NARO. To tackle these issues in 1994 NARO undertook prioritization exercises

Table 1: Number of Scientists with Respective Qualifications by Institute.

Institution	Ph.D.	Msc	Bsc	Total
MAAIF	3	15	2	20
NARO Secretariat	6	3	1	10
NAARI	1	7	0	8
SAARI	0	1	2[1]	3
LIRI	2	12	11	25
FAF/MUK	6	-	-	7
FVM/MUK	8	23	-	21
TOTAL	*26*	*61*	*16*	*94*

[1]All are at advanced stages of Msc programmes

in the areas of research and development. These priorities were reviewed in 1995 and it was recommended that future research adopt a commodity-specific production and marketing systems (CPMS) approach. The commodities identified were: dairy cattle, beef cattle, goats and sheep, pigs and poultry. The review categorized factors of production according to phases such as pre-production, production, marketing/processing, and handling.

INSTITUTIONAL CAPACITY

Current manpower with research and training capacity is depicted in Tables 1 and 2.

Table 2: National Scientific Capacity by Discipline

	MMAIF	NARO	FAF/MUK	FVM/MUK	Total
Nutrition	3	4	3	2	12
Physiology	3	2	1	3	9
Breeding	2	1	1	0	4
Pasture	2	5	1	0	8
Socio-economics	1	6	1	0	8
Animal Production		1	1	0	2
Parasitology		4	0	2	6
Entomology	2	5	0	0	7
Microbiology		7	0	2	9
Biochemistry		1	1	1	3

Livestock Status for Research and Development in Uganda

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GENERAL BACKGROUND

Physiognomy

Uganda lies astride the equator, between latitudes 4°12' north and 1°29' south and between longitudes 29°34' west and 35°0' east. Temperatures average about 21° centigrade, ranging from 15 to 30 degrees. More than two-thirds of the country is 1,000 to 2,500 meters above sea level. Precipitation is fairly reliable, and varies from 750 mm per year in the Karimojong pastoral areas in the northeast to 1,500 mm per annum in the high rainfall areas on the shores of Lake Victoria, around the highlands of Mt. Elgon in the east, the Rwenzori mountain range in the southwest, Masindi in the west, and Gulu in the north. A large proportion of the country's 241,319 sq. km. could be cultivated. Excluding lakes, swamps and forest reserves, more than 75% of the country (over 18 m hectares) is available for cultivation, pasture, or both. Pastures and grazing land are estimated to comprise only 5 million hectares.

A climate of well distributed rainfall and temperatures makes Uganda well suited for livestock production. In addition, the grasses that occur naturally are largely species planted to improve pastures in less well favoured areas. It has been estimated that the north could safely release 1,778 kg/ha/annum of dry matter. Comparative figures are 3,671 and 1,353 for the central and southern regions, respectively. With a daily dry matter quota of at least 2-3% of live-weight and sufficient grazing land available, there is great potential for supporting the cattle population.

Livestock population and products

Uganda's human population of about 18 million relies on a low performing livestock and poultry population of 5.1 million cattle, 5.7 million goats, 1.0 million sheep, 1.4 million pigs, and 21.4 million poultry, in addition to an unspecified number of domesticated micro-livestock, such as the rabbit.

Livestock production constitutes an important sub-sector of agricultural production in Uganda contributing about 9 percent to the total GDP.

Livestock, is an integral part of the agricultural systems of many parts of the country and contributes around 30 percent to the total AGDP. It is estimated that mixed farming small holders and pastoralists own over 90% of the cattle herd and almost all of the small ruminants. Pigs and poultry produce the bulk of domestic milk and slaughter animals.

From an economic point of view, cattle are the most important livestock, although goats and to a lesser extent sheep, pigs and poultry make significant contributions to the local economy and to human diets. As of 1994, the per capita availability of cattle products stood at about 15.2 litres of milk and 3.6 kg of beef, respectively. These figures yield a self sufficiency ratio (SSR) of 0.66 for milk and 0.56 for beef. At current production levels and population growth rates, the SSR for milk is expected to improve to 0.71 while that for beef is expected to increase by 2% to 0.58 by the year 2000. These ratios are very low when compared to FAO standards and the consumption levels in developed countries of 200 kg of milk and 50 kg of meat consumed per capita annually.

Human nutrition

Nutrition studies in Uganda indicate that a large proportion of the staple diet is of starchy carbohydrate sources such as plantain, sweet potatoes, maize, finger millet, rice and cassava. Protein rich food sources such as milk, meat, eggs, etc. are in short supply and for certain population groups severe protein food deficiencies occur. Uganda is therefore concerned about protein-energy-malnutrition which, on the average, is effecting almost 45 percent of the children below 3 years of age and 25% of expectant/nursing mothers in the form of reproductive waste and anemia.

Livestock production systems

Production systems as applied to cattle and small ruminants (goats and sheep) in Uganda have traditionally been defined as: a) communal grazing, b) pastoral herding, c) tethering, d) enclosed ranching, e) fenced dairy farms and, more recently, f) zero grazing.

Several variants of the above exist, the classification of which is mainly based on input usage, proximity to market outlets and potential for commercialization. A more appropriate classification based on recent reports and field observations yields six broad systems as described below:

Pastoralism. Under this system, livestock owners graze their herds of sheep, goats and cattle on natural grasslands mainly in the dry areas of the Karamoja, Mbarara, Ntungamo, Masaka, Rakai and Luwero districts of Uganda. The main source of food for the pastoralist is milk. Because of low human population density, milk availability per capita also tends to be high. However milk production per unit area is low and the producers have little or no control over feed resources and consequently there is limited opportunity for improvement.

In the pastoral system, collection of surplus milk for processing is difficult due to the mobility of producers and the small quantity of surplus milk available. Surplus milk or ghee is bartered or sold to agriculturalists nearby or on the migratory route, but surpluses are only available during the flush season. Within the pastoralist system very few inputs are used and the investment in production is very low.

Agro-pastoral systems. Agro-pastoral farming communities are based on sedentary farmers, who cultivate food crops for subsistence and sale and who keep livestock. Their herds and flocks feed on communal grazing land, fallow land and on crop land after harvest. Livestock is used for draught, savings, beef and milk production. Shifting cultivation is a common practice. Agro-pastoralists have little control over feed resources, common grazing land and crop residues. Milk production fluctuates with the seasonal availability of feed and collecting sufficient milk is almost as difficult as in the pastoralist system. With increased population and hence increased pressure on the land, this system often evolves into a mixed farming system. It is currently prevalent in the northern and eastern districts of Uganda where most of the land is still owned communally.

Mixed farming. Under this system, livestock and crop farming are maintained as complementary enterprises. Food or cash crop cultivation is the main agricultural activity. Farm size is normally small, 1-5 ha, with a moderate to high cropping intensity. Maintenance of soil fertility is one of the main problems. Livestock is kept for draught, valorization of crop residues, improvement of soil fertility and provision of additional

income from the sale of milk or meat. Dairy production is attractive since it offers the opportunity to diversify by establishing a supporting infrastructure and a milk collection-processing system. A reliable livestock marketing system, offering a fair price to the farmer, could also result in increased production. The mixed farming/milk production system is the most common smallholder dairy production system in the milk-shed areas of southwest, central and southeastern Uganda.

Intensive and semi-intensive dairy farming. Farmers use part or all of their land to cultivate fodder crops in the form of planted or improved natural pastures for their dairy cattle. In addition, they may purchase concentrates. Farmers may also use land for food crops or cash crops. Although dairy animals do not provide draught, their manure is used for improving soil fertility. However milk is the major source of farm income. Intensive farming is mainly small farmer activity using family labor, but large and medium-scale farms using hired labor can also be found in this system.

Zero grazing is becoming increasingly more popular especially in areas where there is a shortage of land. This system comprises only a small proportion (less than 5%) of the livestock production in the country.

Peri-urban milk production. Around major towns, in areas with a high demand for milk, dairy farming has developed. The main source of feed is fodder, crop residues, as well as domestic waste and agro-industrial by-products available in the towns (e.g. brewery waste, oilseed cakes, etc.). Dairy production may compete with vegetable production for land but can also support it by providing manure. Milk is often traded directly to consumers in the town. Milk is a major source of supplemental income for farmers, many of whom are either salaried employees or small business entrepreneurs. Peri-urban dairy farmers rely mainly on purchased feed. They are commercially oriented and will respond to an improved infrastructure for input supply. Examples of peri-urban milk production systems are to be found in the Kampala area where there has been an upsurge of zero-grazing units.

Extensive beef/dairy ranching. Progressively more sedentary and semi-sedentary livestock farming systems may be found in the districts of Mbarara, Bushenyi, Rukungiri and in Rakai, Masaka and parts of Mubende. Here farmers fence off land to establish ranches or demarcate communal areas for rotational grazing of livestock. They also cultivate

Table 1: Production systems and breed/species guidelines for the different eco-zones

Zone	Guidelines
AGRO-ECOLOGICAL ZONES	
Eastern (Teso system)	Draft power and extensive small ruminants, dairy, beef and multipurpose production.
Southern and Western (tall grasslands system)	Intensive, semi-intensive dairy and extensive small ruminants, beef and multipurpose production.
Northern (short grasslands system)	Draft power and extensive small ruminants and multipurpose production.
Montane (High altitude system)	Intensive dairying and rabbitries.
Semi-arid (pastoral system)	Multipurpose extensive beef and small ruminant production.
SOCIO-ECONOMIC ZONES	
Peri-urban	Intensive dairying, beef, goat, dairy, feedlots and rabbitries.
Rural	Breeding dairy replacement stock, extensive multipurpose cattle and small ruminant ranches.
Highly population areas	Intensive dairying, feedlots and rabbitries.
Low populated areas	Extensive multipurpose, breeding replacement stock, ranching and breeding store cattle.
Accessible areas	Intensive/extensive/ specialized or multipurpose production.
GEOGRAPHICAL ZONES	
(a) Rainfall	
Above 1500 mm	Intensive all stock production.
1000 - 1500 mm	Semi-intensive dairy, beef, SR production and breeding replacement stock.
750 - 1000 mm	Ranching, breeding store cattle, dairy ranching, small ruminants and multipurpose breeds.
250 - 750 mm	Extensive beef small ruminant and breeding store cattle and goats.
(b) Altitude (above sea level)	
Above 1500 m	Intensive dairying small ruminants dairy meat and rabbit production.
1000 - 1500 m	Semi-intensive beef rabbitries and breeding replacements and intensive multipurpose.
750 - 1000 m	Extensive multipurpose and SR extensive beef and dairy ranching.
DISEASE ZONES	
	The disease zones are tsetse infested, tsetse free, high tick challenge, low tick challenge areas and disease free zones. More efforts are needed to reduce or even eradicate livestock pests. Need to establish disease - free areas for production of beef and small ruminants for export.

annual and perennial banana crops as a source of food and extra income. Beef and dairy ranching are most suited for low rainfall, short/tall grasslands, and low to medium human population densities. Indigenous Ankole longhorn cattle provide the beef and milk products which characterize the economies of these systems.

Specific zoning criteria and production guidelines based on livestock breed/species choice are summarized in Table 1.

ANALYSIS OF SYSTEMS

Detailed analysis summary

For the purpose of analyzing the major production systems, their characteristics, location and commodity outputs, examples are drawn from dairy/beef production and are summarized in Tables 2 and 3. The macro-policy and technology development/transfer constraints are included under major inputs for the systems analyzed. Constraints that require solutions which are researchable include: feed resources and nutrition; genetic resources and breed evaluation; animal health and reproduction; as well as farming systems and marketing. Other constraints fall under the categories of training and extension services.

Table 2: Common indicators of livestock (cattle) production systems in Uganda.

	SMALL FARMER DAIRY		COMMERCIAL SEMI-INTENSIVE	
CHARACTERISTIC	1. PERI/INTRA URBAN	2. RURAL MIXED	1. PERI/INTRA URBAN	2. RURAL
Milking herd	2 milking cows (Exotic/Grade)	2.5 milking cows (Grade/Local)	5-10 milking cows (Exotic Grade)	9-15 milking cows (Exotic Grade/local)
Priority of farmer	Sale of milk	Milk/meal production Soil fertility Draught	Sale of milk	Sale of milk beef
Farmer's attitude	Cash income	Spreading of risk integration	Cash income	Cash income
Feed resources	Cultivated or purchased fodder Concentrate mixtures	Enclosed grazing Improved pastures Crop residues	Enclosed grazing Improved pastures Cultivated fodder Concentrate mixtures	Enclosed grazing improved pastures Milking by-products & concentrates occasionally
Land available/animal	0.05 hectares	05-20 hectares	0.05 hectares	0.5-20 hectares
Major inputs used	Concentrates Fodder Credit Extension Services Training Veterinary curative & preventative services Hired labour Breeding (AI) services	Credit Extension services Training Veterinary curative & preventative services Family labour	Concentrates Credit Extension services Training Veterinary curatives & preventive services Hired labour Breeding (AI) services	Extension services Training Veterinary curative & preventive services Hired labour
Dairy milk surplus	10-20 continuous	2 - 10 mainly seasonal	100 plus continuous	20-50 continuous

SOURCE: National Cattle Breeding Policy Draft Report 1995

Table 3: Other indicators of livestock (cattle) production systems in Uganda.

CHARACTERISTICS	DAIRY/BEEF RANCH	LARGE COMMERCIAL	RURAL SUBSISTENCE	
			1. COMMUNAL/ AGROPASTORAL	2. PASTORAL
Milking herd	9-15 milking cows (Exotic/Grade)	20-25 milking cows (Exotic Grade)	1-2 milking cows (local)	5-10 milking cows (local)
Priority of farmer	Milk/meat production	Sale of milk Sale of breeding stock	Subsistence Milk/meat production Draught	Subsistence Milk/meat production Livestock numbers
Farmer's attitude	Cash income spreading of risk	Cash income	Aversion of risk	Aversion of risk
Feed resources	Enclosed grazing	Enclosed grazing Improved pastures Cultivated fodder Concentrate mixtures	Communal grazing Crop residues	Communal grazing
Land available /animal	50-100 hectares	05-20 hectares	Variable	Variable
Major inputs used	Extension service Training Veterinary curative & preventative services Hired labour Credit	Concentrates Credit Extension services Training Veterinary curative & preventative services Hired labour Breeding (AI) services	Veterinary services (mainly vaccinations) Family labour	Veterinary service (mainly vaccinations) Family/ communal labor
Daily milk surplus	50 - 100 continuous	200 plus continuous	1.5 Seasonal	1-10 Seasonal

Researchable constraints: Large ruminant milk and meat production

Goal: To improve sustainable output and yield of cattle milk and meat produced under mixed crop-livestock smallholder and commercial farming systems.

Constraints:

- Low yield of milk and meat potential of indigenous cattle comprising 98.5% of the national cattle herd
- Lack of selective on-farm breeding technologies and information on the merits and limitations of indigenous genotypes under smallholder conditions
- Seasonal fluctuations in quantity and quality of natural pastures and absence of leguminous fodder in pasture development to improve the nutritive value of forages for high performing exotic cattle

- Sub-standard calving rates of less than 60%, long calving intervals, poor heat expression and calf losses of 20 to 30% are common due to poor nutrition, diseases and improper cattle husbandry practices

- Lack of appreciation for the importance of milk and meat production relative to other roles played by livestock (e.g. provision of draught power and manure, for energy and fertilizer, as well as both credit and security)

- Emphasis on satisfying urban demand for milk and meat rather than developing markets for rural milk supply and dairy products (i.e. butter, ghee, cheese) suited to remote areas where cattle ranches and small-holder farms prevail.

Research objectives:

- Improve productivity of natural pastures through selection and introduction of forage legumes

- Screen population to identify elite cattle for incorporation into nucleus breeding schemes for rapid genetic improvement

- Investigate factors limiting cattle improvement and production in different agro-ecological zones

- Establish the level of disease and parasitic tolerance in indigenous and tropicalized cattle breeds and determine genetic and physiological basis for their expression

- Determine appropriate mechanisms for improving rangeland productivity

- Develop appropriate methods of forage production, conservation, processing, supplementation and explore use of crop residues and by-products at strategic times of the year

- Investigate the qualitative aspects of meat provided by indigenous cattle for export markets

- Carry out an inventory of quantity and quality of feed resources

with a view to assessing the optimum carrying capacity of different zones and hence breed specifications

- Investigate social, economic and institutional policy factors which promote successful small holder milk and meat production and marketing.

On-station and on-farm research:

- Compare adaptation, feed utilization efficiency and conduct cost-benefit analyses of indigenous and exotic dairy and beef breeds and their F1 crosses under the following conditions: natural pasture and rangeland grazing, improved pasture grazing and fodder conservation, zero grazing on planted intensive fodder gardens, zero grazing on crop residues and domestic waste.

- Explore the genetic limits of milk yield for elite indigenous Ankole cattle under improved pasture grazing with rumen bypass supplementation.

- Investigate low cost silage making technologies and fodder bank development techniques for small holder dairy production systems.

- Develop qualitative characterization of beef products from indigenous Ankole-longhorn and Zebu cattle.

- Introduce and evaluate more promising tropical breeds of cattle (Sahiwal and Kenana) through direct embryo transfers and cross-breeding with the Ankole and Nganda breeds through AI.

Researchable constraints: Small ruminant meat/milk production

Goal: To develop technologies to increase goat meat/milk productivity in the mixed crop livestock and range farming systems in Uganda.

Constraints:

- Inadequate goat supply relative to demand for local consumption and live goats for export markets.

- Insufficient information on intensive and extensive goat/sheep

management approaches to enhance small ruminant meat/milk production under Uganda's conditions.

- Low genetic potential among local goat/sheep breeds for growth and development of small ruminants with relatively heavier body size.

- Lack of socio-economic data on land tenure and settlement, as well as institutional and policy constraints influencing supply and demand of small ruminant production and competitive prices.

Research objectives:

Research problems to address fall under the following broad disciplines: a) feed resources and nutrition, b) genetic resources and breed evaluation, c) animal health and reproduction, and d) farming systems and marketing.

Feed resources and nutrition:

- Establish analyzed feed resource inventories for goat feeding in Uganda.

- Establish growth, fattening and carcass characteristics of goats under low cost feeding regimes, including rumen bypass, kid milk replacers and leaf protein feeding technologies.

- Study energy partitioning for fat deposition and protein accretion in goats vs. sheep, including physiological interventions as management tools for accelerated growth performance in goats.

Genetic resources and breed evaluation:

- Characterization and genome analyses of indigenous breed/types of goats in Uganda to establish special adaptive qualities for conservation by management.

- Evaluation of population screening procedures for establishment of superior (elite) nucleus of indigenous goat herds for wider use in Uganda.

- Quantification and establishment of meat productivity indices for breed/types of goats under low and high planes of nutrition for GxE interaction studies.

Animal health and reproduction:

- Conduct epidemiological surveys to establish agro-ecological zones and status of endemic small ruminant diseases in Uganda with special reference to goats.

- Establish the state and significance of external and internal parasitic infections among young goats in the major ecological zones in Uganda.

- Develop appropriate methodologies for multiple ovulation and embryo transfer among indigenous goats for faster elite goat flock multiplication.

- Develop cost effective preventative and therapeutic measures for promoting small ruminant health and production.

Farming systems and marketing:

- Survey and documentation of indigenous goat farming technologies for developing economically viable socio-culturally acceptable and environmentally sustainable intensive and extensive goat production systems in Uganda.

- Investigate, by policy analysis, the market forces relating to availability, pricing and demand/supply of goat meat and skins to stimulate production at subsistence and commercial levels. Analyze socio-economic factors affecting technology uptake and evaluate impact of improved production systems on farm income and producer's welfare.

On-station and on-farm research:

- Establish feed, water and mineral requirements of breeding does and weaner meat goats for reproduction and growth.

- Compare goat meat productivity efficiencies among indigenous

Mubende, Kigezi, and Karamoja goat strains.

- Develop feeding packages for breeder and weaner goats under the following conditions: early weaner rations for kids and lambs, restricted-zero grazing, pastoral-agroforestry/alley farming system, crop residue utilization systems, range supplementation practices.

- Develop elite prolific strains through screening of indigenous goat and introductions from outside germplasms (Boer and Galla goats).

- Introduce and evaluate tropically adapted breeds of sheep (Dorper, Sudanese and Horro sheep) and goats for drier areas of Uganda.

LONG-TERM DEVELOPMENT OBJECTIVES

Long-term livestock development objectives for research and technology transfer will be:

- To promote methodologies and develop feeding technologies for sustainable livestock production in Uganda.

- To explore the genetic potential of indigenous stock for milk, meat and multipurpose production, and improved human nutrition

- To develop integrated crop and animal agriculture for sustainable natural resource management and alleviation of malnutrition and poverty in Uganda.

- To train and develop indigenous manpower resources and institutional capacity in order to create a critical mass for scientific/ technological development and knowledge extension to African grassroots people.

- To evolve focused national and international network approaches to livestock research and development in East Africa.

Ethiopia's Livestock Production Potential: Major Constraints and Priority Areas for Collaborative Research

By Alemu Gebrewold
IAR, Holetta Research Center

Ethiopia is a developing country whose economy greatly depends on agricultural development. Crop/livestock production is the mainstay for 85-90% of the population. In 1990, the human population of Ethiopia was estimated at 51 million, with an annual growth rate of 3.0%, while food production grows at a much lower rate (CSA, 1984). By the year 2020 it is estimated that the population will reach 138.9 million and that urban dwellers will double in the same span of time (Table 1). Urbanization will force commercialization of agriculture, which in turn will lead to intensification of crop and livestock production. To meet the demand for milk and meat, production will need to increase more than 3.0% per annum.

Ethiopia's ruminant population is the largest in Africa and tenth in the world. The country's livestock resource base includes 31 million head of cattle, including around 3.9 milking cows, 6 million draft oxen, 23.4 million sheep, 17.5 million goats, 7 million equines, 1 million camels, and 52 million poultry (Table 2).

LIVESTOCK PRODUCTION SYSTEMS

Ethiopia can be divided into two broad regions based on altitude -the highlands and the lowlands. Livestock play an important role in both regions.

Livestock production systems in the highlands

The highlands consist of areas above 1500 m. The annual rainfall ranges from 500 mm to over 2000 mm (FAO, 1992), with a temperate climate. The highlands occupy 44% of the total land area of the country and contain about 88% of the human population, 72% of the cattle, 74% of the sheep, and 34% of the goats.

The majority of ruminants are of local origin and so far only a few types have been identified and characterized.

Table 1: Ethiopian human population projection to the year 2020

	1984	1990	2000	2020
Total population (million)	42.8	51.7	71.4	138.9
Urban dwellers (million)	4.9	7.3	12.9	39.2
Percent increase	11.4	14.1	18.1	28.2

Source: Central Statistics Authority, the 1984 Population and Housing Census of Ethiopia, Addis Ababa. 1991.

According to the Ethiopian Highlands Reclamation Study (EHRS, 1987), the highland regions may be subdivided into three distinct agro-ecological zones.

High-Potential Cereal/Livestock Zone. The High-Potential Cereal/ Livestock Zone (HPC/LC) covers 133,000 km2. This zone has reliable rainfall, fertile soil, and favorable climatic conditions. A mixed crop/ livestock farming system predominates in this zone. Around some towns, where high demand for milk and meat prevails, periurban dairying and cattle fattening schemes are emerging. The livestock population of the zone is estimated at 8.5 million head of cattle, 6.9 million sheep, 1.8 million goats, and 1.4 million equines (EHRS, 1987) (Table 3).

Low-Potential Cereal/Livestock Zone. The Low-Potential Cereal/ Livestock Zone (LPC/LZ) is located in the northern part of Ethiopia. It covers 150,000 km2. This zone is characterized by low and erratic rainfall and severe soil degradation. An estimated 60% of the total land area has been eroded. The livestock population of this zone is estimated at 5.4 million head of cattle, 367 thousand sheep, 1.1 million goats, and 1.9 million equines (Table 3).

High-Potential Perennial Crop/Livestock Zone (HPP/LZ). The High-Potential Perennial Crop/Livestock Zone (HPP/LZ) consists of the

Table 2: Livestock population in eastern sub-Saharan African countries, 1988

Country	All cattle		Milking Cows		Sheep		Goats		Camels	
Ethiopia	31,000	(36.2)	3,875	(26.8)	23,400	(33.8)	17,500	(25.3)	1,060	(9.4)
Kenya	9,800	(11.3)	2,255)	(15.6	7,300	(10.6)	8,500	(12.3)	790	(6.9)
Somalia	5,000	(5.8)	1,000	(6.9)	13,500	(19.5)	20,000	(29.0)	6,680	(58.7)
Sudan	22,500	(26.3)	3,450	(23.8)	18,500	(26.7)	13,500	(19.6)	2,850	(25.0)
Tanzania	13,500	(15.8)	2,800	(19.4)	4,700	(6.8)	6,600	(9.6)	---	---
Uganda	3,910	(4.6)	1,080	(75.0)	1,740	(2.6)	2,800	(4.2)	---	---

Figures in Brackets are percentage of the total

Table 3: Livestock distribution in different agro-ecological zones (highlands)

Zone	Type of livestock	Population (1) (000')	Livestock conversion (2) to TLU	Total TLU (000')
HPC/L	Cattle	8520	0.7	5964
	Sheep	6887	0.1	689
	Goat	1796	0.1	180
	Equine*	1480	0.625	925
	Total			7758
LPC/L	Cattle	5391	0.7	3774
	Sheep	367	0.1	437
	Goat	1139	0.1	114
	Equine*	1860	0.625	1163
HPP/L	Cattle	6843	0.7	4790
	Sheep	5543	0.1	554
	Goat	1440	0.1	145
	Equine*	1950	0.625	1219
	Total			6708

Source: 1 - Janke, 1982: Ethiopian Highland Reclamation Study, 1984; ILCA, 1991.
2 - Ethiopian Highland Reclamation Study, 1984.
* - Included to calculate the feed availability for nimnant livestock (Table 3) in the different agro-ecological zones
TLU - Tropical Livestock Unit.

southwestern and western parts of the country. The estimated land area of this zone is 144,000 km2. The zone is characterized by high annual rainfall, an extended wet season, and a moderate-to-warm climate. The important food and cash crops grown in the zone include coffee, enset, barley, horse bean, peas and root crops. The livestock inventory includes 6.8 million head of cattle, 5.5 million sheep, and 1.4 million goats.

Livestock production systems in the lowlands

The lowlands (pastoral) areas of Ethiopia broadly include all land areas below 1500 m elevation. The lowlands are located around the borders of the country. The physical properties of the lowland environments are characterized by extremely variable and unreliable rainfall and scarce and seasonal vegetation. Recent estimates put the area covered by the rangelands at 78.1 million ha, or about 70% of Ethiopia's land area (FAO, 1992). Because of insufficient rainfall to sustain crop production, the area is being used for nomadic grazing and wildlife habitation.

The rangelands are support 12% (5 million) of the human population and 26% (21 million head) of the livestock population. It is estimated

that 28% of the cattle, 66% of the goats, 26% of the sheep, and 100% of the camels in the country are found in the lowlands. The rangelands can be broadly classified into three.

Arid Zone. The arid zone covers 49.8 million ha located below 1000 m. This zone is characterized by erratic and unreliable rainfall at 450 mm. Livestock production is nomadic herding with very little agro-pastoralism.

Semi-arid Zone. The semi-arid zone covers 16.7 million ha and is located between 1000 m and 1500 m. This region receives about 700 mm of rainfall. Livestock production is pastoral and agro-pastoral with nomadic herding and sedentary households. In recent years there has been an increase in agro-pastoral production systems.

Sub-humid Zone. The sub-humid zone covers 11.6 million ha. The area lies between 1000 m and 2000 m in the west. Although arable production is possible in this zone, tsetse limit livestock production and draft capabilities.

LIVESTOCK PRODUCTIVITY

The productivity of Ethiopian livestock is the lowest among East African countries. Meat off-take is estimated at 7% for beef and 33-36% for sheep and goats, with corresponding carcass weights of 100-110 kg and 8-10 kg, respectively. Cows do not reach maturity until 3.5-4 years of age and they calve every other year. They produce 250-300 liters of milk per lactation (Table 4). Estimated per capita consumption of all meat and milk is 7.8 kg and 14.4 liters, respectively, per annum (ILCA, 1991), and consumption is declining.

Table 4: Average yield per productive animal (1986)

	Yield (kg)		
Commodity	Ethiopia	East Africa	Sub-Saharan Africa
Beef	110	127	130
Mutton	10	12	12
Cow milk	219	343	329

* Per animal slaughtered or per cow milked.

CONTRIBUTION OF LIVESTOCK TO THE ETHIOPIAN ECONOMY

Background

Livestock production involves more than direct food production. For many farmers, livestock are a living bank investment and play a crucial role in crop production systems through provision of draft power and manure for fertilizer and fuel. The sale of livestock and their by-products provide farmers with cash income. Moreover, livestock are closely linked to the social and cultural lives of the resource-poor farmers, for whom animal ownership is security and the key to survival. The overall contribution of livestock, especially in light of their multipurpose contribution to food and agricultural production, is often underestimated.

Human nutrition: Dairy products and meat

The quality and quantity of food is a primary indicator of the quality of life, human welfare, and social development of a country. Animals are an important source of food, particularly of high-quality protein, minerals, vitamins and micronutrients. The value of animal protein is in excess of

Table 5: Indication of dairy development potential of eastern sub-Saharan African countries

Country (%)	Land Area sq. ('000)	Area tsetse infested	Livestock units per sq. km	Kg milk per sq. km/day	Self suff. in milk %
		(1)	(2)	(3)	(4)
Ethiopia	1101	9	24	2.9	84
Kenya	569	17	16	6.1	98
Somalia	627	5	21	8.5	98
Sudan	2376	17	9	4.1	96
Tanzania	886	72	13	1.6	90
Uganda	200	57	21	3.0	95

Foot Notes

1. % of land area infested by tsetse fly
2. Livestock units per sq. km
3. kg of milk per sq. km per day
4. % of self-sufficiency in milk, local production as % of local prod. + imports.
5. Feed exports as % of milk imports - feed value of exports converted into milk as % of milk imports.
6. Disease situation
   + seasonal constraints
   - less problems
7. Land tenure system
   + communal as well as individual
   ++ communal ownership
8. Training Extension Demonstration
   1. Training, small scale processing pastoral area

its proportion in diets, because it contains essential amino acids that are deficient in cereals. Eating even a small quantity of animal products corrects amino acid deficiencies in cereal-based human diets, because animal proteins are more digestible and are metabolized more efficiently (Winrock International, 1992).

Ethiopia owns 36.2% of the cattle, 26.8% of the milking cows, 33.8% of the sheep, 25.3% of the goats and 9.3% of the camels that inhabit eastern African countries. The corresponding figures for Kenya are: 11.4%, 15.6%, 10.5%, 12.3% and 6.9%, while those for Somalia and Sudan are: 5.8%, 6.9%, 19.5%, 29%, 58.7% and 26.3%, 23.8%, 26.7%, 19.6% and 25%, respectively (Table 5).

In terms of total milk production in the region, the contributions of Ethiopia, Kenya, Somalia and the Sudan are 12.2%, 13.2%, 23% and 35.4%, respectively (Table 6). All East African countries are more self-sufficient in milk production than Ethiopia (Table 1).

Dairy production lags behind demand, and the contribution of dairying to the food security of the country has eroded substantially. From 1977

Feed export as % of milk imports	Production Constraints			Dairy Development Possibilities	
	Disease	Land Tenure	Training ext. Dem. Systems		Potential Product:
(5)	(6)	(7)	(8)	(9)	(10)
23	-	+	1,2	3	1,2,3
124	+	+	2	3	1,2,3
0	-	++	1	2	1
85	+	+	2	3	1, 2,4
37	+	+	2	3	1,2,3
5	+	+	2	3	1,2,3

2. Development - demonstration, training and extension of new dairy
9. Potential
   1. Potential in selected areas and for selected markets
   2. Good potential
10. Production system
   1. Milk collection for processing in pastoral area
   2. Development of milk production in mixed farming system
   3. Development of intensive rural milk production system
   4. Development of peri-urban production system

Source: Winrock 1992

Table 6: Milk production in eastern sub-Saharan African countries.

Country	Cow Milk		Sheep Milk		Goat Milk		Camel Milk	
Ethiopia	814	(16.40)	66	(6.3)	95	(6.7)	212	(9.3)
Kenya	1,015	(20.5)	29	(2.8)	82	(5.7)	158	(6.9)
Somalia	550	(11.1)	378	(35.9)	640	(45.5)	1,336	(68.8)
Sudan	1,750	(35.3)	580	(55.0)	530	(37.6)	570	(25.0)
Tanzania	448	(9.1)	—	—	63	(4.5)	—	—
Uganda	378	(7.6)	—	—			—	—

to 1988, the estimated annual growth rate of milk consumption was 2.5%, while production growth during the same period averaged only 1.4%. In per capita terms, milk production has actually fallen from a level of 27 kg per person in 1977 to 17 kg per person in 1995. Dependence on inputs for dairy products has grown during the same period, from 4.1% to 12.8%. These inputs have grown at a rate of 15% annually, with commercial inputs increasing most rapidly (24%) per year. This has raised the level of commercial inputs as a share of dairy consumption from 0.3% to 2.3%.

Economics

Cattle, owing to their large numbers, contribute more to the economy than any other category of livestock. Small ruminants (sheep and goats) are second to cattle in their contribution to the national economy. Cattle hides and small ruminant skins supply all the raw materials for local leather industries; they are second only to coffee in foreign exchange earning.

In monetary terms, the livestock subsector accounts for 16% of the total GDP and 40% of the agricultural GDP of the country (Winrock International, 1992).

Livestock production and land use

In recent years in Ethiopia livestock have been seen as a major cause of soil erosion in the highlands and of increased desertification in the arid and semi-arid zones. However, there is no evidence to support this view. An extensive review of the literature on the impact of livestock on the rangelands has concluded that the effects of grazing and drought have been confused and that there is no solid evidence of an irreversible effect of livestock on vegetation, other than at water points and near permanent settlements (Dodd, 1991).

In the mixed crop/livestock farming system of the highlands, livestock have a crucial place in developing sustainable and environmentally sound

agricultural production systems. As a means to increase production, intensification is an alternative to expanded cultivation of marginally productive lands that are vulnerable to degradation. Livestock directly contribute to the sustainability of farming systems by providing manure, which is the principal soil amendment and fertilizer available to many farmers. In addition, as agriculture becomes highly intensified, legumes grown to feed livestock also provide nitrogen for crop production.

In Ethiopia land belongs to the state; however, in highland production systems, arable land is individually owned, i.e., individuals have user rights. Grazing lands are used and owned communally. In the rangelands, land is communally used; tribes and clans control its distribution and use.

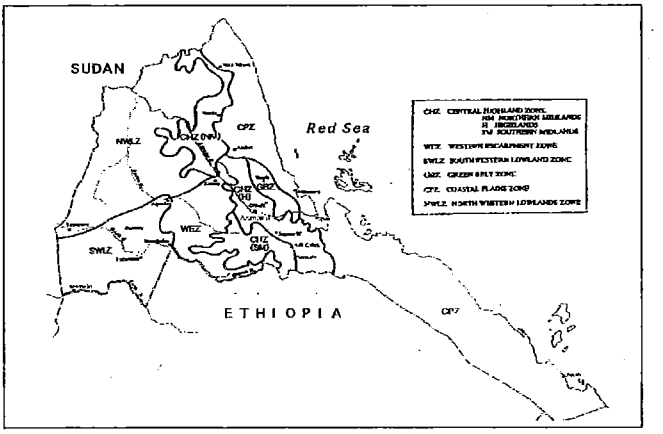
LIVESTOCK RESEARCH AND DEVELOPMENT

Agricultural research structure

According to the new Ethiopian agricultural research policy, the National Agricultural Research Council (NARC) is the apex institution for all agricultural research undertakings in the country. The country follows a federal system of government and a free market economy. The structure of agricultural research in Ethiopia has three levels. The research and management processes they incorporate are given in Figs. 1a, 1b, 1c.

- National Agricultural Research Council (NARC)
- National agricultural research institutes and centers
- Regional agricultural research institutes and centers

Figure 1a: The National Agricultural Research Process



Livestock research and development institutions. Livestock research is conducted by national and regional agriculture research institutes and centers, by the Institute of Biodiversity, and by institutions of higher education. Development projects are the province of national and regional ministries of agriculture.

Livestock research in IAR. Livestock research efforts of the Institute of Agricultural Research (IAR) have concentrated on the following:

- Genetic improvement: breed evaluation, selection, and crossbreeding in a few cattle and sheep types for improved milk and meat production.
- Animal husbandry: feeding and management of cattle and sheep breeds.
- Animal feeds and nutrition: forage improvement and laboratory analysis of Ethiopian foodstuffs.

Figure 1b: The National Agricultural Research Process

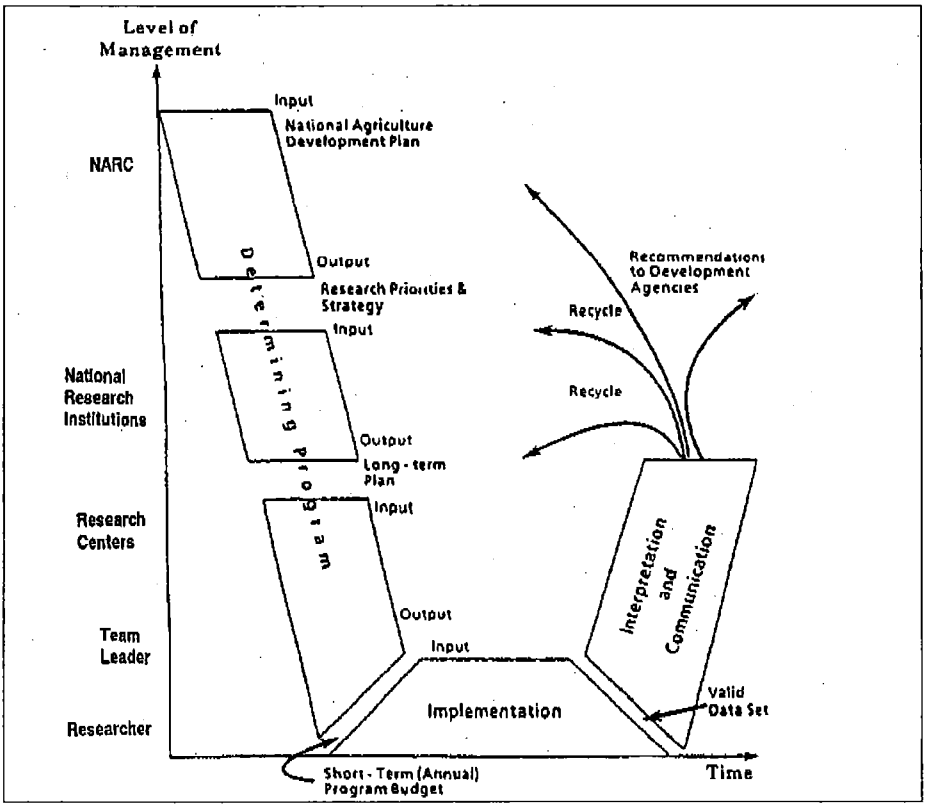
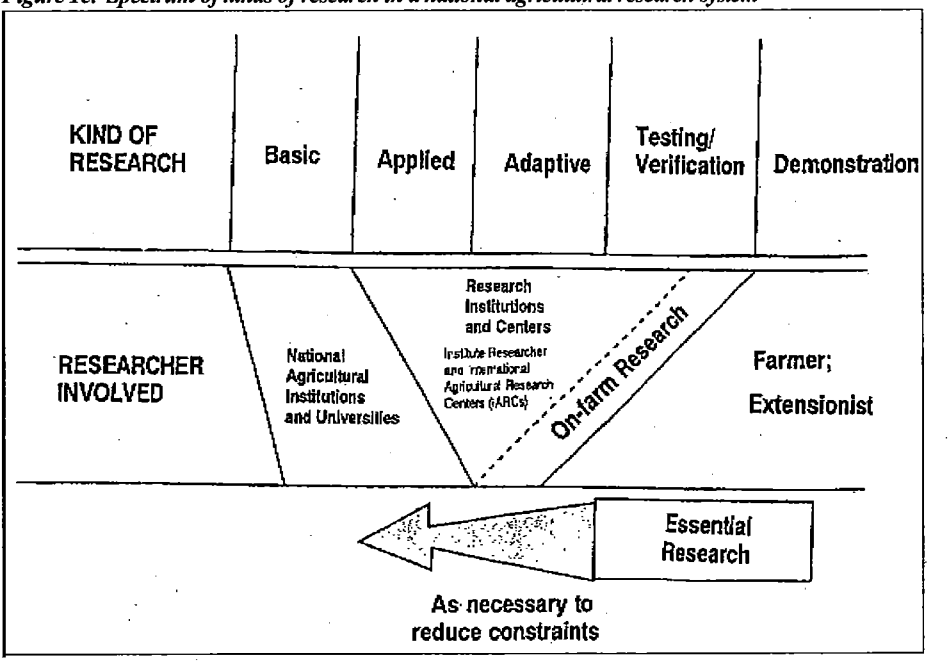


Figure 1c: Spectrum of kinds of research in a national agricultural research system



- Range management: primary evaluation of plant species that are adaptive to the rangelands.

Livestock research in institutes of higher education. The major educational institutes involved in livestock research are: Alemaya University of Agriculture (AUA); Faculty of Veterinary Medicine (AAU); Awasa College of Agriculture; and Ambo and Jima Junior Colleges of Agriculture. At the institutions of education, teaching staff are obliged to allocate 25% of their working time to research. At AUA, livestock research programs include breeding and selection of cattle, goats, sheep and poultry, and studies on animal feeds and nutrition.

Livestock research in the Institute of Biodiversity. The former Plant Genetic Resources Centre/Ethiopia (PGRC/E), a sister organization of IAR, has been charged with the responsibility of undertaking livestock biodiversity and conservation studies.

Livestock research in development institutions. The Ministry of Agriculture (MOA) conducts adaptive studies and extension activities in collaboration with national and regional research centers.

Resources

Funds. Agricultural research is largely publicly financed. So far, the involvement of the private sector in livestock research is virtually nonexistent.

Facilities. At national and regional livestock centers, additional facilities and equipment are needed to undertake research.

Trained personnel. There is a pressing need for the IAR to promote staff development graduate study at the Msc and PhD levels. The livestock research program is currently suffering from shortages of trained personnel (Table 7).

Table 7: Ethiopian graduate livestock research personnel in IAR and in teaching institutes

	Year	Ph.D.	M.Sc	DVM	B.Sc.	Dipl.	Total
IAR	92/93	1	8	5	31	44	90
Teaching Institutes	91/92	16	34	28	19	8	105
Total		18	42	33	50	52	194

COLLABORATIVE RESEARCH AND LINKAGES

National collaboration

IAR is a member of the NARC. With respect to livestock research, IAR has a good working relationship with AUA, the Faculty of Veterinary Medicine (AAU), Awasa and Jima Agricultural Colleges, and Ambo Junior College.

At the regional level, there exist Research Extension Liaison Committees (RELCs) through which most research technologies will reach end-users.

International collaboration

Livestock researchers at IAR work closely with International Agricultural Research Centers (IARCs) based within the country. At present, some projects are assisted by the European Community, the World Food Programme, the International Atomic Energy Agency, and the

International Foundation for Science (IFS). IAR and the International Livestock Research Institute (ILRI), formerly ILCA, are collaborating in a Crossbred Cow Traction Project on-station and on-farm.

FUTURE EFFORTS IN LIVESTOCK RESEARCH

Agro-ecological focus

The highlands above 1500 m constitute the high-potential and mixed crop/livestock farming systems zone, where technology transfer has a high probability of success and should, therefore, be the focus of livestock research.

Client focus

Smallholder mixed crop/livestock farms are considered the best option for increased livestock production, through mixed farming to take advantage of crop/livestock interaction.

Commodity focus

In addition to the overriding objective of food self-sufficiency, import substitution, export earnings, employment opportunities, and the considered use of resources are priority items that have been identified as targets for livestock research. IAR has prioritized livestock research as follows:

- High-priority : dairy cattle, beef cattle, and sheep
- Medium-priority : poultry, bees, draft cattle and goats
- Low-priority : fish, equines, camels, and swines.

MAJOR CONSTRAINTS ON LIVESTOCK PRODUCTIVITY UNDER DIFFERENT PRODUCTION SYSTEMS

The highlands

1) The low genetic makeup of ruminant livestock for milk, meat, and draft power:

- lack of appropriate breeding systems and policy
- lack of trained personnel and facilities
- subsistence nature of farming systems.

2) Inadequacy of feed in both quantity and quality:
- overstocking of livestock in the highland areas
- lack of appropriate feeding packages
- shortage of trained personnel and facilities.

3) Poor livestock management practices:
- socioeconomic factors
- undeveloped market structure and the low price of
- animals and animal products
- low purchasing capacity of farmers
- underdeveloped delivery systems.

4) Prevalence of diseases and parasites:
- unproductive animals
- shortage of health services and lack of drugs
- shortage of capital.

5) Weak research-extension linkages:
- limited number of technology packages
- shortage of trained personnel for animal extension services
- scarce inputs
- lack of clearly defined policy.

The lowlands

1) Degradation of the rangelands:
- low off-take rate
- socio-cultural factors
- poor management systems.

2) Prevalence of diseases and parasites:
- inadequate veterinary services
- shortage of drugs
- lack of capital.

3) Recurrent drought:
- shortage of feed and water
- high rate of animal losses
- poor livestock rearing knowledge.

4) Poor marketing system:
- border price differential
- underdeveloped marketing facilities.

5) Poor research extension services:
- shortage of trained personnel
- lack of appropriate policy.

AREAS OF COLLABORATIVE ACTIVITIES IN LIVESTOCK RESEARCH

There is an urgent need for collaborative activities in livestock research, because research needs resources (trained personnel and facilities) to generate information for policy making and development undertakings. Areas of collaboration indicated in this section focus on the high-priority commodities of dairy and meat.

The highlands

Objectives:
- To increase food production from ruminant livestock
- To develop new technologies for smallholder producers

Dairy Cattle

To generate new technologies to develop the dairy subsector of the country the following areas are of high priority:

1) Production and improved economic performance of crossbred cows under small holder systems.

2) Production and evaluation of potential for improved economic performance of local cattlebreeds.

3) Comparative advantages of indigenous versus grade animals in utilizing local feed resources.

4) Breeding and genetic improvement (both cattle and sheep):
   - Crossbreeding methods.
   - Selection methods.

5) Animal traction.
•Multipurpose uses of crossbred cows for milk, draft, and meat.

6) Small-scale milk processing

Small Ruminants:

-Dairy Goat:

1) Crossbreeding methods
2) Selection methods.

-Sheep

1) Crossbreeding for meat and wool
2) Selection for meat and wool
3) Selection for resistance to internal parasites.

Forage seed production studies under different agro-ecological conditions

Human nutrition. Assessment of the impact of increased milk production from crossbred cows on:

- the diet of smallholders
- income generation (crop vs. livestock).

Environmental issues

- effects of dairy intensification herd size on land use and soil conservation.

Biodiversity and conservation

- characterization, evaluation and conservation of the various indigenous ruminant livestock species.

The lowlands

Range management

- Assessment of yield and quality of rangeland forage production

- Determination of optimal stocking rates for sustainable livestock production

- Development of appropriate livestock management systems.

Breeding

- Identification of selection methods for indigenous livestock species

SUMMARY

Ethiopia is characterized by a variety of climatic regimes that have resulted in a great diversity of biological conditions. Livestock production systems range from low- intensive in the rangelands to high-intensive in the highlands. The genetic diversity of Ethiopian livestock is wide and their potential is relatively untapped. In all production systems, livestock have multiple uses.

Even so, agricultural productivity is not keeping pace with increasing population growth. As urbanization rapidly increases, there is a growing demand for livestock products in major urban centers.

Improvements in livestock production have been impeded by the subsistence nature of production systems, by inappropriate agricultural policies, and by a lack of improved and appropriate agricultural technologies.

In recent years, national research institutions have been steadily strengthened. The country has developed a national agricultural research policy. However, as the Institute of Agricultural Research is a semi-autonomous organization that is largely publicly financed, livestock research has been possible on only a few livestock species.

IAR has a good working relationship with national and international institutions. Collaborative programs have permitted joint research undertakings which have generated technology packages for sustainable production systems.

Intensification of agriculture is inevitable and livestock will be crucial in developing suitable and environmentally sound production systems. This situation calls for more extensive regional collaboration with international agencies to step up livestock research in high-potential zones.

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Burundi Breeding Sector

By E. Manirambona
ISABU

INTRODUCTION

Burundi is situated between 2° 20' and 4° 27' south latitude and between 28°50' and 30° 53' longitude. It is close to the equator and is situated astride the 30th meridian. The total area of the country is 27,834 km. This figure includes the surface of the territorial waters of Lake Tanganyika, which cover slightly more than 2,000 km.

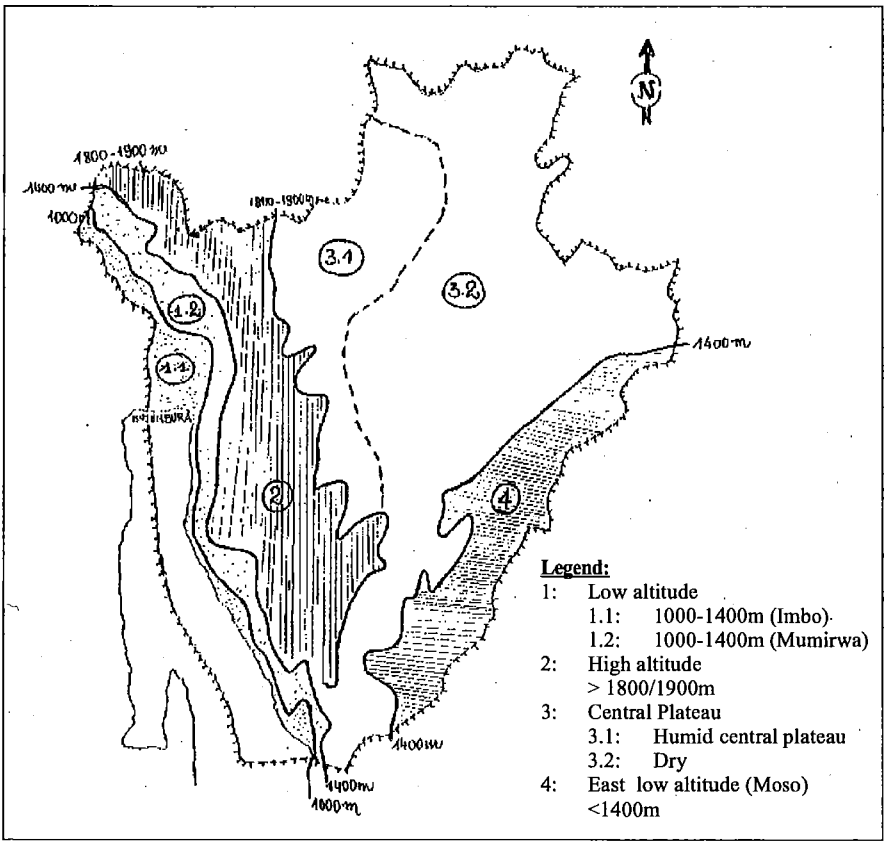
On the west, Burundi is separated from Zaire by Lake Tanganyika and the Rusizi River. To the north, the Kanyaru River and Lakes Cohoha and Rweru divide Birimdo from Rwanda, while on the east and southeast the Malagarazi and, to a lesser degree, the Ruvubu separate the country from Tanzania.

Table 1: Characteristics of population and area by natural region

Regions	Area (ha)	Human population (hab)	Human density
1. Bugesera	195,973	427,817	218
2. Buragane	116,996	133,443	114
3. Bututsi	140,096	194,896	139
4. Buyenzi	210,463	770,418	366
5. Buyogoma	427,824	454,251	106
6. Bweru	238,217	522,671	219
7. Imbo	175,504	330,750	188
8. Kirimiro	275,785	874,291	317
9. Moso	286,547	241,879	84
10. Mugamba	246,576	437,776	178
11. Mumirwa	272,317	668,891	246
12. Bujumbura city	8,652	235,440	2,721
Total	2,594,950	5,292,793	4896

Source: ISABU, Socioeconomic program, Annual report 1991/1992

Map 1: Agro-ecological zones of Burundi



The eleven regions that compose the country have widely varying agroecological characteristics. However, based on the altitude lines of 1000 meters, 1400 meters and 1800/1900 metres, one can regroup these regions into four agroecological zones (Map 1). This regrouping will provide a framework for the planning of sectorial interventions. Tables 2, 3, 4 and 5 summarize the characteristics of the four different zones.

Agriculture in Burundi is characterized by intensive earth exploitation, strong demographic pressures, and growing demand for agricultural products. The main constraint on animal livestock production is the availability of feed, while problems of health (helmenth, ticks and tick-born diseases) affect supply and sometimes cost.

Under these conditions, available resources consist primarily of low quality pastures (which are in progressive reduction) and dry season crop residues. The utilization of the latter is further limited to consumption in the field after harvest.

Table 2. Characteristics of Zone 1: Imbo and Mumirwa

Characteristics	Imbo	Mumirwa
Altitude (m)	780-100	100-1800
Rainfall (mm)	< 900	100-1250
Dry Season	4-5 months	4 months
Mean Temperature	24° C	< 18° C
Human Population	330,750	668,891 ha
Human Density	188 hab/km^2	246 hab/ km^2
Total Area	183,520 ha	225,495 ha
Cultivated Area	48,750 ha	64,550 ha
Grazing Area (ha)	47,000 ha	38,400 ha
Farmer Own Area	0.79 ha	0.73 ha
Livestock Population (head)		
Bovine	35,500	12,600
Goat	98,100	202,700
Sheep	18,000	64,600
Pig	11,400	19,800
Livestock production system	pastoral	mixed crop
Soils	Regogley, basic and black clay	Hygroferrisoil without B horizon
Mains crops	Banana Cassava Bean Sweet Potato Sorghum Peanut Rice Maize	Banana Sweet potato Cassava Bean Sorgo Peanut Maize
Proportion of land fertilized by livestock manure	30%	51%
Cash Crops	Cotton	Coffee

Table 3: Characteristics of Zone 2: High altitude land

	Mugamba		Bututsi
	North	South	
Altitude(m)	1800- 2600	2000 - 2600	1800- 2200
Rainfall	1400 - 1200	1400-1600	2000- 1600
Dry season	3 months	3-4 months	4 months
Mean year T_	13 - 15_C	15 - 17_C	15-17
Human population	286.116	151.600	194.896
Popul.density	200 - 300	150-275	100 - 200
Total area	246.576ha		140.096ha
Land cultivated	155.727ha		69.854ha
Grazing area	20 - 25%	40-50%	45 -55%
Livestock population(head)			
Bovines	9.000	61.000	90.000
Goat	65.000	45.000	40.000
Sheep	22.000	18.00	25.000
Pig	25.000	-------	2.000
Livestock production system	Mixed crop/ livestock Ferrisol (Al toxic.)	Mixed crops/ livestock Ferralsol (Al toxic.)	Mixed crops / livestock Ferralsols (Al toxic.)
Soil Main crops	Small pea Bean Maize Banana Wheat Sweet potato	Maize Small pea Wheat	Maize Bean Banana Sorghum Sweet potato Potato Small pea
Proportion of land fertilized	77%	95%	
Cash crop	Coffee Tea	Tea	-------

Table 4: Characteristics of Zone 3: Central Tray (Plateau)

Characteristics	S/Z West	S/Z East	S/Z Southeast
Natural regions	Buyenzi Kirimiro	Bugesera Bweru	Buyogoma Buragane
Altitude (m)	1800-1400	16000-1300	1800-1400
Rainfall (mm)	1400-1200	1200-700	1400-1100
Dry Season	3 months	3-4 months	4 months
Mean year temperature area	16 - 18° C	18 - 21° C	12 - 21° C
Human density	1,580,682	900,920	701,559
Cultivated area	444,773 ha	398,441 ha	622,084
Grazing area	355	226	113
Farmers area (acres)	669,836	252,474	182,452
0 - 40	31.2%	28.4%	2.8%
40-50	42.0%	44.5%	40.4%
80-150	20.8%	21.4%	39.4%
> 150	6.0%	5.7%	17.4%
Soil	Hygroferrisols Ferralsols Regosoils	Ferralsols Regosoils	Lithosoil Hygroxeroferralsoils
Main crop	Sweet potato Colocase Cassava Banana Small pea Peanut	Sorghum Bean Banana Sweet potato Cassava Maize Colocase	Sorghum Banana Bean Cassava Sweet potato Maize Small pea Colocase
Livestock population			
Bovine	45,844	42,025	106,969
Goat	292,219	313,865	367,979
Sheep	117,587	75,592	12,598
Pig	2,775	6,000	460
Livestock production system	Mixed crop/livestock	Mixed crop/livestock	Mixed crop/livestock
	45%	40%	54%
Cash crop	Coffee	Coffee (margin)	Coffee (margin)

Table 5: Characteristics of Zone 4: Moso

Characteristics	
Altitude(m)	1125 - 1500
Rainfall (mm)	1252 (mm)
Dry season(months)	4 months
Mean year temperature	21.7°C
Human population	291,879hab.
Total area(ha)	286,547
Density (Hab/km)	84
Grazing area(ha)	71,627
Livestock population(head)	
Bovine	19,800
Goats	89,300
Sheep	22,600
Pigs	8,500
Soils	Hygroxeroferralsoils Hygroferrisoils
Cash crops	Cotton(margin)

Table 6: Number of animals

Species	1987(*)	1991(**)
1. Cattle	479,000	436,000
2. Goats	723,000	944,498
3. Sheep	329,000	367,127
4. Pigs	77,000	80,983
5. Poultry	3,700,000	739,633

ANIMAL PRODUCTION

Animal population

Among the main animal species raised ruminants include cattle, goats and sheep, while non-ruminants include pork, rabbit and poultry (mainly chicken). Table 6 gives the number of animals raised in 1987 and 1991.

There has been a decline in cattle, while the number of small ruminants has increased. For poultry, the reliability of data is in doubt, given the methods used to estimate numbers.

Despite demographic pressures resulting in severe diminution of grazing surfaces in some regions of the country (particularly in Zone 3), the breeding of all species is represented throughout the country. Data in Table 7 reveals the different trends observed.

Note the introduction of mini-breeding (*cobay*) as a response to space shortage and as a solution to the need for a source of animal protein for consumption by the population. This trend stems from a spontaneous reaction of the peasants and there is no frame of reference for comparison.

Table 7: Animal population in a region of high human density: Kayanza natural region

Year	Cattle	Goat	Sheep	Pigs	Poultry	Rabbit	Cobay
1980	52.200	105800	77600	16800	114900	20000	---
1991	34.018	145648	84669	21657	97837	41331	30214
D(%)	- 34%	+ 37%	+9,1%	+ 29%	14,9%	107%	---

Production data

In 1988, animal production was distributed as follows:

Meat

- Cattle 10,000 tons/year
- Small ruminants 4,750 tons/year
- Pork 2,400 tons/year
- Poultry 2,500 tons/year

Total 19,650 tons/year

Milk 33,000 tons/year

Eggs 750 to 1,000 tons/year (10 to 20 millions).

At the same time, the annual need for maintenance of self - sufficiency was estimated at:

- Meat 42,000 tons
- Milk 210,000 tons
- Eggs 420 million

Under these conditions of severe food shortage, the development of breeding is imperative. The estimated intake of protein per capita is 47 grams, of which 12.5% is of animal origin, that is, only 6 grams of animal protein per capita per day.

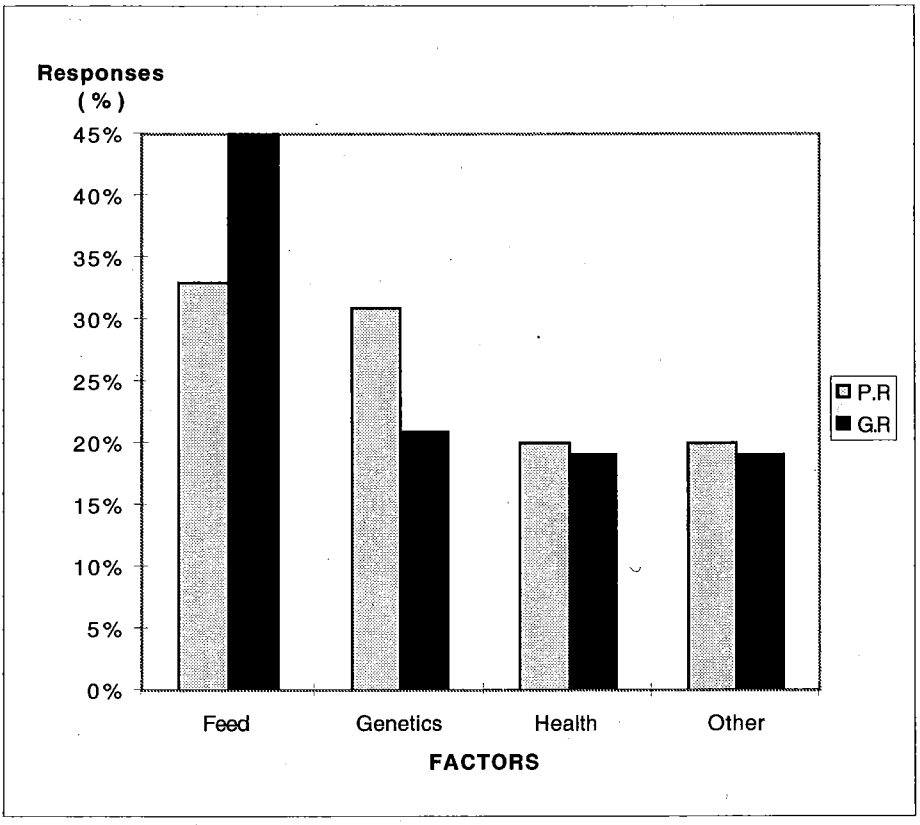
Small ruminant productivity

Types of small ruminant raised in Burundi are the East African Goat and the East African Sheep. Reproduction and production performances were obtained from the University of Burundi's agricultural station situated at Imbo. The data for the two species is found in Table 8.

Table 8: Reproduction and production performances of the East African Goat and East African Sheep

	Goat	Sheep
Index of fertility	96.50%	97.97%
Prolificity	2.02	1.28
Interval between births(days)	270	220
Index of fecundity	2.45	2.08
Female weight at first birth	27.96 kg	26.98 kg
Birth weight	.40 kg	2.08 kg
Mortality before severance	35.70%	23.50%
Weight at severance	7.64 Kg	12.92 Kg
Average age to severance (days)	126	124.5

Figure 1: Constraints of breeding



Resources, forages and feeding systems

Feeding is recognized as the main constraint on animal production in the rural middle region (Figure 1). The high densities associated with the current growth of Burundi population are accompanied by a parallel reduction of the available land and living space. This pressure has resulted in progressive land degradation due to the disappearance of natural vegetation.

Modes of most represented conduct are at stake especially in the rainy season (problems with both space and hand-work) and the grazing land, especially where sheep are kept with bovine in regions of weak density (Bututsi, Mugamba).

The problem of feeding is amplified during the dry season, when the availability of food is limited further by the insufficiency of forage and the increased cost of supplements.

Forages. Although the cultivation of forage is not widely practiced, *Trypsacum laxum, Setaria* and *Pennisetum* are frequently cultivated in the rural mid-region. Cultivated legumes, less known because of their recent introduction, include *Leucaena leucocephala, Calliandra calothyrsus* and *Leucaena diversifolia.*

The most frequently used mode of forage conservation is the reserve on foot; silage and haymaking are not practiced in the rural mid-region.

Crop residues. Bananas, beans, sweet potatoes and corn are the greatest suppliers of residues used for the feeding of animals and for other purposes, such as mulching for coffee trees, roof cover, heating, etc. The portion consumed by animals is eaten directly from the fields.

By - products, agro-manufactures and mineral supplements. By-products, agro-manufactures and mineral supplements are used mostly in the feeding of small ruminants. Known constraints to their utilization are linked to cost and availability.

INSTITUTIONS

University of Burundi

The Department of Animal Breeding has a research station for small ruminants with approximately 200 goats and sheep. Three assistants are currently in Belgium studying for their Ph.D. and no scientists are in place.

The Agronomical Science Institute of Burundi (ISABU)

ISABU, whose animal division is in collaboration with the University of Burundi, has four research scientists on staff, all of whom are involved in breeding projects. Among these are three veterinarians and one agricultural scientist. Before the crisis of October 1993, ISABU oversaw research activities on small ruminants in the central plateau region. With the advent of civil turmoil, all animals and material were looted or destroyed.

Development projects

Development projects have included small ruminant programs.

Particularly of note is the Ngozi project in the Buyenzi region. This project has secured financing from Germany (GTZ) for the crossing of local species with the alpine and the boar to improve growth.

CONCLUSION

Burundi agriculture is characterized by intensive earth exploitation, strong demographic pressures, and growing demand for agricultural products. With respect to livestock production, availability of feed is recognized as the main factor constraining animal performance in rural areas. There is a need to address these constraints by developing well focused research and research support activities, so that sustainable productivity can be achieved. Research, however, is suffering from a lack of training in certain areas and insufficient information.

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Livestock Production Constraints and Research Priorities in Madagascar

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INTRODUCTION

Zebu cattle play a large socioeconomic role in the lives of the Malagasy people in that they produce many useful commodities (capital, milk, meat, traction, hides, fertilizer, etc.). The cattle are also a sign of wealth. At present, Madagascar is self-sufficient in all livestock products, except dairy products. This general situation, however, is not equally shared. Despite technological achievements in the fields of agricultural and livestock production, one part of the population goes to bed hungry each night.

This paper presents the current situation of livestock production and research in Madagascar.

GENERAL BACKGROUND

Malagasy Island covers an area of about 587,000 km^2. The country can be divided into five main agroclimatic zones (Oldeman, 1988) defined by the length of the rainy season and the number of wet days. Three zones are important for livestock production:

- highlands with an altitude of more than 1000 m a.s.l and around 1200 mm rainfall/year
- humid lowlands with an annual rainfall of more than 600 mm
- dry lowlands with a rainfall of less than 600 mm.

For the entire country, rainfall is unimodal. The driest months begin in May and end in September. Grasslands cover more than 318,000 km^2, that is, 53% of the total area of the island. Throughout the country, erosion is extensive.

DEMOGRAPHIC CHARACTERISTICS

The latest census (BDE, 1993) estimates the Malagasy population to be 12 million, with an annual growth rate of 3.3% (Unicef, 1996). The

urban population represents 21% of the total population and its growth rate is 5.9% (Unicef, 1996). Nutrition problems are more frequent and more acute in towns than in the rural zone. In towns, non-educated people represent 43% of the population, but in the urban and peri-urban zones they are 24%. In terms of age, 47% of the total population are less than 15 years old. Mother's level of education and professional activities helps determine children's nutritional intake (Rabenja, 1994). The prevailing situation is that of undernutrition. The GNP per capita is estimated at US $ 220 (Republique de Madagascar, Unicef, 1994), representing a decline of 2.6% per year between 1980 and 1993.

LIVESTOCK POPULATION AND PRODUCTION

Agriculture is the backbone of the Malagasy economy. Rice is the stable food and coffee remains the principal export product. The role played by livestock is substantial. Livestock contribute to the production of food and industrial raw materials, to cash income and to hard currency earnings.

The populations of different livestock species are shown in Table 1. The cattle population is comprised of zebu (9.5 million head) and exotic breeds and their crosses (400,000 head). Their growth rate is low and some recent studies conclude that the cattle population is decreasing. Nevertheless, cattle can be found everywhere on the island, but more in the western part than in the eastern, which is covered by rain forest.

Table 1: Livestock production

Species	Number of Heads
Cattle	9,970,250
Pigs	749,700
Small ruminants	1,663,780
Poultry	22,500,000

Pigs and poultry are mainly located in peri-urban zones. The pig industry is one of the most important in sub-Saharan Africa. However, pig production seems to have declined since 1985. One of the many reasons for this decline is the cost of feed and the fact that the price of pork is rather high in comparison to that of beef.

The small ruminant population is primarily goats (1 million head) and these are concentrated in the dry southern part of the country.

LIVESTOCK PRODUCTS

Statistics indicate that cattle production is most important in the evolution of meat production from 1960 to 1995. Ruminant productivity in relation to grazing area is estimated to be 5 kg/ha/year, which is equivalent to 16.4 kg of meat per ruminant per year; and the production per capita is 13.7 kg/hab. While the majority of meat produced is locally consumed, exported meat may reach 18,000 t/year (1970). The current quota for ECC is 5000 t/year.

The national consumption of livestock products is presented in Table 2. For all commodities and in reference to 1960 data, there is a decreasing trend. That is also the case for milk, which was 48 litre/hab. in 1960 and only 29 litres/hab. in 1988 (PSE, 1989). Total meat consumption in the same period decreased from 33.5 kg/hab/year to 23.9 kg/hab/year (Rapport PAEC, 1992).

Table 2: Evolution of livestock product consumption from 1960 to 1993 (per habitant, per year)

Year	Beef (kg)	Pig (kg)	Poultry (kg)
1960	23.8	4.2	1.4
1985	15.7	4.6	1.4
1993	12.6	3.5	1.5

The values of different livestock products on the foreign exchange are presented in Figure 1. The figure reveals that export values are constantly increasing and that from 1991 on they have become more important in comparison to import values. In 1993, the difference between these two figures reached US $ 10 million. Exported products are mainly deboned meat, duck fat liver and skins.

Figure 1: Evolution of values of livestock import and export products

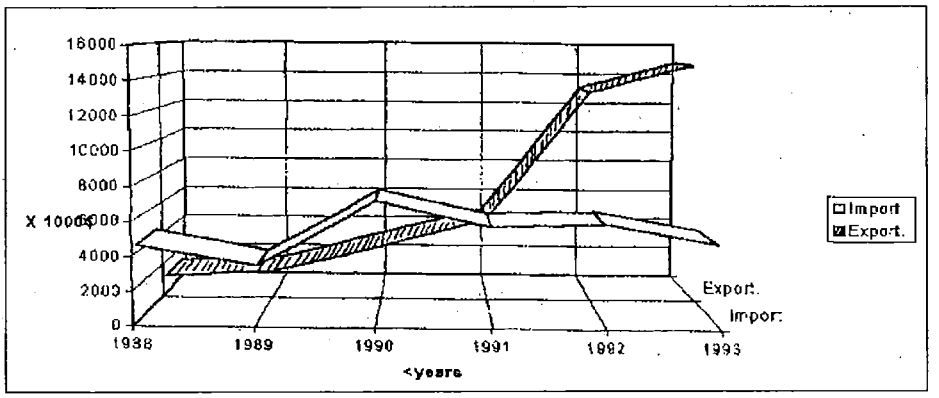

Table 3: Characterization of farming systems

Traditional subsistence system	Market-oriented system
- Extensive	- Intensive-mixed farming
- Rural	- Peri-urban
- Zebu	- Cross-Breed (Zebu x Taureau)
- Poultry-Pig	- Poultry-pig
- Low Production/Animal	- Higher Performances/Animal

CHARACTERIZATION OF FARMING SYSTEMS

Two farming systems can be described, as in Table 3. The first system is prevalent in rural zones (inhabited by 80% of the total population). This system is represented by traditional subsistence farming, characterized by extensive management of herds. Animals are mainly of local breeds (zebu, local poultry and pigs). They feed on natural vegetation, where it can be found, and their growth rates are low. Livestock raised in this manner are principally for subsistence and security. Commercialization is not first priority; the sale of animals depends on the monetary needs of the owner.

The second system is semi-intensive mixed farming, where crops and livestock are integrated in farm management. In this case, farms are generally localized in peri-urban zones and animals are mainly improved—Local X Exotics—for dairy, pig and poultry production. Individual performances of these animals are higher than those of pure local breeds. Most of their products are marketed.

MAJOR CONSTRAINTS

The major constraints on Malagasy livestock production are of three types: technical, socioeconomic and policy.

Technical constraints

Inadequate nutrition due to fluctuating nutrient supply is one of the most important limiting factors to livestock production. For small scale farmers in peri-urban zones, grazing areas are declining due to expanding arable cropping and population pressures. The six-month dry season

results in a forage shortage, which does not yet have a socioeconomic solution. For pigs and poultry, the periodic non- availability and high cost of raw materials are known to constrain adequate feeding. In addition, concentrates are purchased from distant places which hinder their frequent use. Poor nutrition results in low rates of production and reproduction, as well as increased susceptibility to animal diseases and a high mortality rate.

Livestock diseases seriously limit production. Drugs and chemicals are so expensive that in some instances farmers use them in reduced doses, so that the efficiency of the drug is lowered. Low reproductive rates are caused by missed heat detection, and by poor or non-existent artificial insemination delivery services.

Crossbreeding is the most common method of genetic improvement. Imports of live food animals (except for day old chicken) are forbidden by veterinary regulations. Artificial insemination services are expensive and not wide spread. Embryo transfer has not been explored.

Table 4: Most common livestock diseases

The Main Ruminant Diseases

Infectious diseases	Parasitic diseases
Antrhax	Liver fluke
Black legs	
Tuberculoses	
Streptotorichosis	
Tick borne diseases	

The Main Pig Diseases

Infections diseases	Parasitic diseases
Teschen disease	Gastro intestinal worms
European swine fever	Ecto-parasites

The Main Poultry Diseases

Infectious diseases	Parasitic diseases
Newcastle disease	Coccidiosis
Avian cholera	
Gumboro	
Mareck's disease	

Socioeconomic constraints

A recent survey (Rasambainarivo and Al, 1995) has revealed that 83% of dairy farmers in the highland zone have received an education higher than primary school. That means they can read and write, but they do not receive a written technical newsletter. The development of livestock production requires changes in management methods, because husbandry standards for local stock usually lead to failure if applied to improved stock. Any livestock development strategy must therefore involve improvements and dissemination of relevant information and training in management skills for smallholder producers. Technical and socioeconomic information does not reach farmers.

Land tenure is a constraint on ruminant production, as common ownership inhibits the adoption of improved techniques on grazing lands. The bulk of the population in rural regions engages in subsistence farming. Few farmers market their products. The price of livestock products relative to the cost of agricultural inputs is not favorable to farmers.

Economic analysis of pricing policies with respect to livestock development has been limited. Data on the contribution of different livestock products to net farm income are scarce.

Policy constraints

Credit practices are inappropriate for the small scale livestock sector, because interest rates are excessively high (more than 30% per year). Therefore, there is a lack of operating funds.

Roads in rural areas are in bad condition. In some regions, they are impassable during the rainy season, a period which coincides with peak milk production.

Support services are weak in most of the country. The main constraint to providing good advisory services in animal husbandry has been a limited number of advisory staff with appropriate training and experience in farm management to promote the adoption of better technologies.

Animal theft is common in some rural zones. Farmers associations are still in the formative stage.

RESEARCH PRIORITIES

In all foreseeable circumstances, the need for milk, meat, eggs and other animal source products will increase and changes will occur in both production systems and demand structure. The main driving force of change will be population growth. So the overall goals of production are

- to improve the living conditions of the population
- to enhance the food security
- to increase the export value of livestock products
- to preserve the natural environment and resources.

Based on these targets, livestock research priorities in Madagascar will be on

- dairy production systems
- ruminant meat production
- and monogastric meat and eggs production.

These priorities may be ranked in different ways according to each region's potential within the country. In peri-urban zones, dairy and monogastric programs would be first priority, whereas in rural zones first priority would be ruminant meat research. In any case, the different constraints cited above need to be addressed.

Research to benefit the smallholder is the immediate concern. The emphasis is on multi-disciplinary research and increased communication between researchers, extension workers and farmers. Research will be conducted simultaneously on the biological and the socioeconomic aspects of research problems.

LIVESTOCK RESEARCH INSTITUTES

More than 90% of applied agricultural research is undertaken by FOFIFA, which is the principal livestock research institute of the

Department de Recherche Zootechnique et Veterinaire (DRZV). This institute is under the Ministere de la Recherche Appliquee au Developpement (MRAD). In this same ministry, C.I.D.S.T. functions as the center for documentation, information and dissemination. FIFAMANOR (Ministry of Agriculture) and the Agronomic University of Antananarivo (Ministry of the University) also contribute to livestock research.

CONCLUSION

In 1984, Monyo (FAO) wrote that on the whole, the productivity of research in tropical Africa has been low, particularly during the last fifteen years. Inadequate funding, lack of functional linkages between research and extension, including political instability in some instances, are among the factors contributing to the poor performance of research and its lack of impact on food and agricultural production.

Livestock research and production cannot be viewed as separate but must be considered as one component in the overall pattern of rural and peri-urban development. The adoption of new technologies at farm level does not only depend on innovation itself, but also on the environment in which the farmers work.

We hope that at the end of this workshop, we can identify and prioritize researchable areas, but in addition, we would like to be able to recommend ways to improve communication between scientists, planners, decision-makers and producers.

THE TANZANIAN LIVESTOCK INDUSTRY

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Tanzania Ministry of Agriculture, Dept. of Research and Training

SUMMARY

Tanzania has about 13.6 million cattle, 8.6 million goats and 2.7 million sheep mainly concentrated north of the central line. Livestock is estimated to produce 244,000 tons of red meat and 620 million liters of milk annually. Egg production is estimated at about 394,000 eggs for the year 1995/96.

Consumption has been calculated at 7.67 kg per capita per year but recent data shows a declining trend. The traditional livestock sector contributes the bulk of red meat, while 80% of egg production takes place in the commercial sector.

The livestock industry is constrained by biological factors as well as non-biological factors.

The National Agricultural and Livestock Research Masterplan (NALRM) was developed to consolidate research in view of limited financial and research facilities. At the national level, two priority research areas were identified for livestock, namely ruminant meat and milk production and animal disease research programmes. At zonal level 5, commodity programmes were identified, namely, beef, dairy, small ruminants, pastures and forages, and animal disease research programmes. Prioritization of commodity research programmes at the zonal level has been extremely tentative. To carry out these programmes, a financing gap of USD 4.9 million exists. Donor assistance is being sought to bridge the gap.

INTRODUCTION

Tanzania is the largest country in East Africa. To the south of the country is Mozambique and Malawi; to the west is Zaire and Burundi; to the north is Uganda and Kenya; and to the east is the Indian Ocean.

Agriculture and livestock production are the major occupations of the people and these contribute about 50% of the Gross Domestic Product (GDP). Livestock alone contributes about 2.7%.

Table 1: Number of livestock in Tanzania

ZONE	REGIONS	CATTLE	SHEEP	GOATS	POULTRY	PIGS
CENTRAL	DODOMA*	1600275	274561	944611	1207072	22773
(3.0 m)	SINGIDA	1382333	377388	676518	1261137	2869
NORTH	ARUSHA*	1399189	469232	123842	937728	16634
	KILIMANJARO	485540	206904	597342	984016	14273
EAST	TANGA*	1087459	176827	606361	957660	6804
	MOROGORO	326632	94330	231437	1064450	40089
	COAST/DSM	51312	4472	34048	787518	--
LAKE	MWANZA*	1652153	144495	627272	215862	--
(4.7 m)	SHINGANGA*	1866027	404955	111250	1957442	
	KIGOMA	32097	20418	230513	411642	1288
	KAGERA	419730	60576	526938	870101	18010
	MARA	746966	140108	363485	1095109	--
WEST	TABORA	547286	109919	274477	1009639	942
SOUTH	LINDI	1245	16825	40429	762283	6604
	MTWARA	58080	25744	182051	676754	9968
S/HIGH	IRINGA	449749	54746	220947	1392514	44622
	MBEYA	911069	61237	293253	1629028	127244
	RUVUMA	52341	32945	285695	871343	108382
	RUKWA	548111	17034	144892	552885	9178
TOTAL		1361755	269276	864121	2068522	429682

OTHERS: TOTAL NO. — RABBITS 269455
— BUFFALOES 13916
— DONKEYS 277427

- Average number of cattle/household = 13 for households that kept cattle
- Cattle population was about half the human population
- In Singida and Dodoma regions cattle outnumbered humans
- Shinyanga, Arusha and Mwanza cattle numbers almost equaled humans

* Regions with most cattle: Shinyanga, Mwanza, Dodoma, Arusha, Singida, Tanga, and Mbeya

SOURCE: NATIONAL LIVESTOCK CENSUS 1993/94

According to the National Agriculture and Livestock Census, conducted in 1993/94, the national herd reached 13.6 million cattle, 2.7 million sheep and 8.6 million goats. With regard to poultry and pigs, there were 20.7 million and 0.5 million, respectively. Rabbits, buffalos and donkeys were 0.3, 0.01 and 0.3 million (Table 1).

In 1978 and 1984 complete counts were made while sample censuses were done in 1991 and 1993. From the sample census for the year 1993,

which covered rural areas only, it is estimated that cattle may total more than 13.6 million. Some improved dairy and dual-purpose cattle are kept under zero-grazing in urban areas.

A total of 3.7 million agricultural holdings were said to exist in the 1993/94 sample census. Of these, 64.9% supported the cultivation of crops, while 34.7% supported mixed agriculture and livestock. Only 0.42% of total holdings were dedicated to livestock alone. About 18% of agricultural holdings were headed by females while 82% were headed by males.

The distribution of mixed crop and livestock holdings (Figure 1) showed that 50% of the holdings were in 5 regions, namely, Shinyanga, Arusha, Kilimanjaro, Mwanza and Mbeya. Except for the Mbeya region, all other regions are north of the central line. Pure livestock holdings were found in the coffee-banana zones of the Arusha, Kilimanjaro and Kagera regions (72%) (Figure 2). Forage and fodder holdings were found in Kilimanjaro (4.55), Dodoma (31%) and Mtwara (25%) (Figure 3).

Figure 1: Distribution of crop and livestock holdings

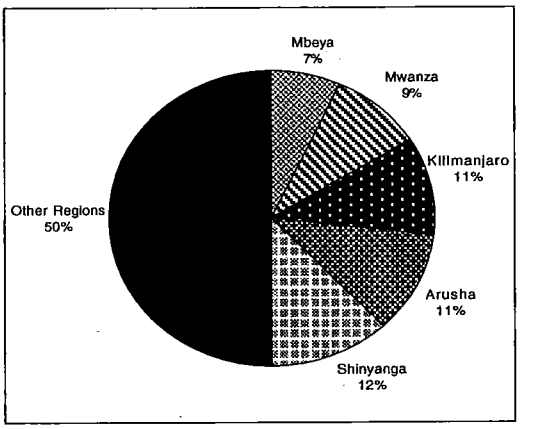


Figure 2: Purely livestock holdings

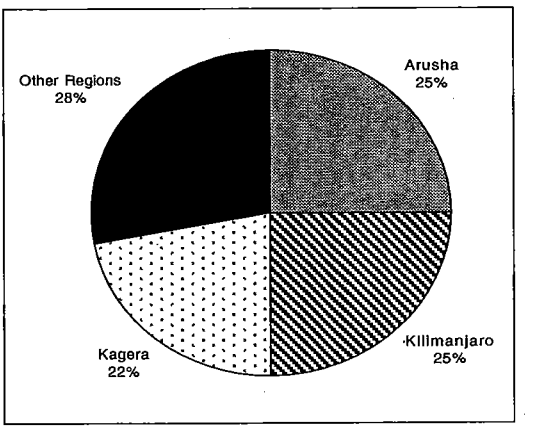


Figure 3: Forage and fodder holdings

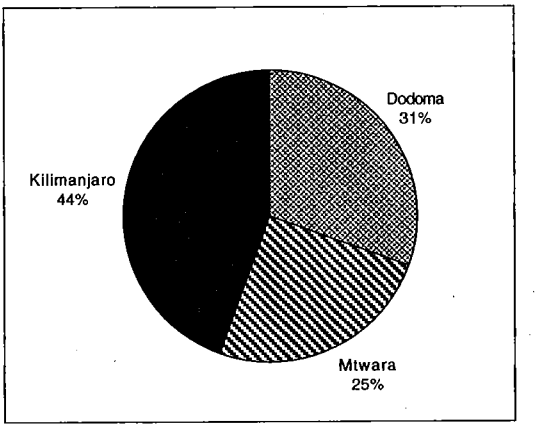


Figure 4: Regional distribution of goats

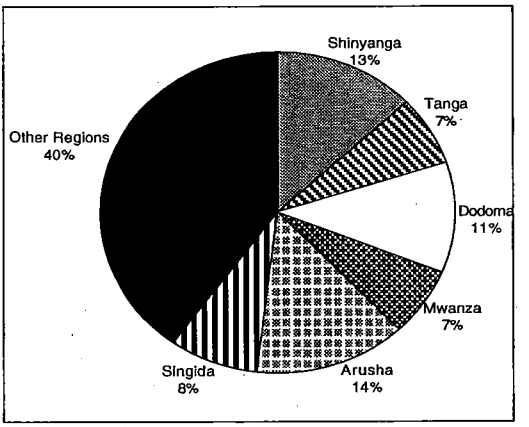


Figure 5: Regional distribution of sheep

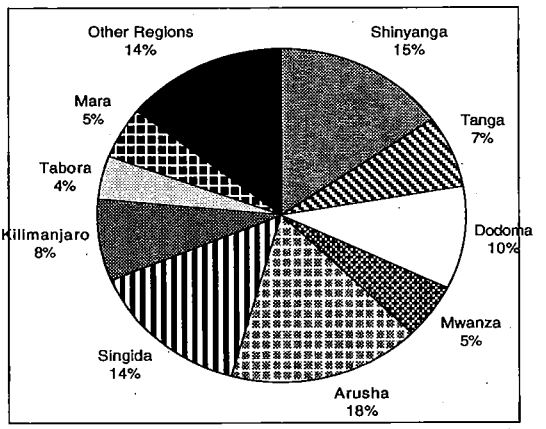
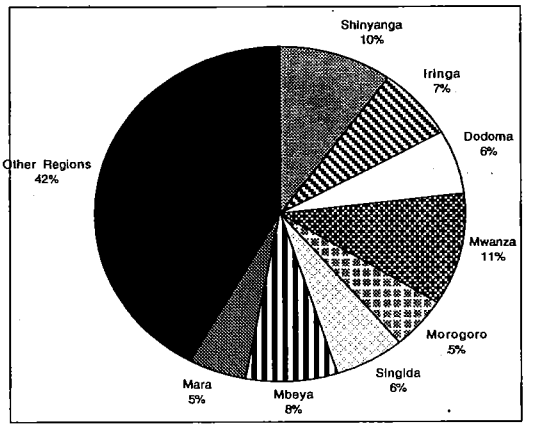


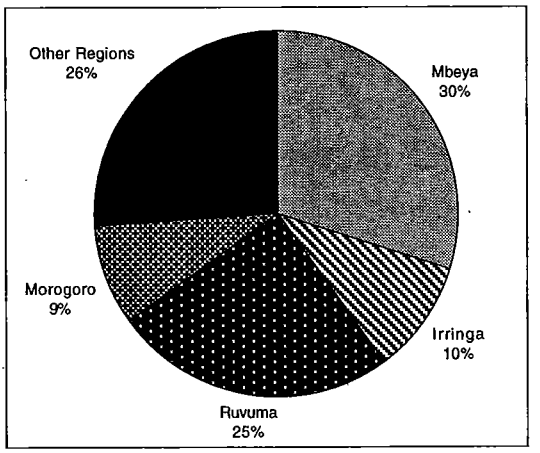
Figure 6: Regional distribution of chickens



Livestock numbers generally increased between 1971 and 1984. Cattle increased by about 70% and goats doubled from 1971-1993. On the other hand, sheep increased by 38% from 2.6 to 3.6 million between 1971-1978 but declined thereafter to 2.7 million in 1993. Most of the cattle population was concentrated in Dodoma (Central Zone), Arusha (Northern Zone), Mwanza and Shinyanga (Lake Zone). There was also a fair livestock concentration in Mbeya (Southern Highlands Zone) resulting in a large concentration of cattle north of the central line. The distribution of goats followed closely that of cattle (Figure 4) with 60% of the goat population found north of the central line. On the other hand, sheep, while showing similar distribution trends to those of goats, were distributed throughout many regions (Figure 5).

About 58% of the chicken population is concentrated in Mwanza (11%); 10% was in Shinyanga; only 5% was found in the Morogoro and Mara regions. The chicken population in urban areas was not taken into account (Figure 6).

Figure 7: Regional distribution of pigs



Pigs were found in Iringa, Ruvuma, Mbeya and Morogoro (74%). The pig population depicted in Figure 7 represents an indigenous breed raised only in extensive systems; the number of pigs in intensive systems was also not accounted for in the 1993 sample census (MOA, 1994).

PRODUCTION OF LIVESTOCK PRODUCTS

The enormous livestock population in Tanzania ranks the country the third in Africa for livestock production. It has been estimated that about 211,000-244,000 tons red meat are produced annually. Similarly, about 585-620 million litres of milk are obtained (Table 2). Indigenous herds are the main contributors of both beef (94%) and milk (64%). In addition, the production of hides (cattle) and skins (sheep and goats) (Table 3) has increased from about 17 million in 1992/93 to 4.0 million in 1995/96. (MOA, 1995a).

Table 2: Estimates of production of livestock products

PRODUCT (TONS)	1992/93	1993/94	1994/95	1995/1996
Red Meat (Tons)				
Beef (Tons)	132000	140000	137000	149000
Goat (Tons)	40000	40000	45000	50000
Pork (Tons)	9000	9000	10500	10000
Poultry (Tons)	30000	30000	34500	35000
Total (Tons)	211000	219000	227000	244000
Milk (Litres) "000"	385000	36600	390000	396000
Indigenous cattle				
Improved cattle	200000	189000	200000	224000
Total (Litres)	585000	555000	590000	620000
Eggs "000"	365000	320000	380000	394000

SOURCE: MINISTRY OF AGRICULTURE 1995

Table 3: Collection of hides and skins

YEAR	HIDES	GOATS	SHEEP	TOTAL
1992/93	987000	433000	247000	1667000
1993/94	1400000	1000000	450000	2850000
1994/95	1800000	1500000	561000	3841000
1995/96	1800000	1600000	600000	4000000

Source: MINISTRY OF AGRICULTURE 1995

ROLE OF THE LIVESTOCK SECTOR

General role

About 90% of the households in Tanzania keep livestock. Livestock is kept for many reasons, including:

- Subsistence
- Sale for income to meet urgent needs
- Source of regular income (especially small-scale dairy holders)
- Manure (for agro-pastoralists)
- Draught power
- Mobile bank.

Economic role

At the micro-economic level, livestock:

- Provides a major source of income
- Increases savings by meeting family food requirements
- Improves output of the crop sector in agro-pastoral production systems.

Social role

At the household level:

- The use of livestock in social functions, such as marriages, funerals, etc. is an important function in uniting families
- The social value of livestock might be measured by quantifying traditional activities.

Nutritional role

For a long time red meat has been the cheapest and most affordable type of meat consumed by all social classes in Tanzania. Consumption was projected to increase due to the growth in human population; however, owing to a decline in purchasing power, consumption rates have dropped. Consumption has declined from 11.5 kg/head/year in 1969 to 7.67 kg/head/year in 1989, and the main source of livestock products is still the traditional sector, contributing 99% of red meat, 93% of milk and 50% of poultry consumed. The commercial sector has been the main contributor of eggs (80%) (Table 2).

PRODUCTION SYSTEMS

The livestock production systems in Tanzania incorporate both traditional and commercial sectors. These production systems may be classified as:

Traditional livestock production systems

These systems embrace the activities of pure pastoralists, including both nomads and semi-nomads. Collectively, pure pastoralists contribute 20% of the livestock in the national herd. These pastoralists comprise the Masai people in Northern Tanzania.

Agro-pastoral systems

Mixed livestock and crop production systems may be sub-classified into extensive and intensive agro-pastoral systems.

Extensive agro-pastoral systems. These systems contribute about 35% of the livestock in the national herd. The systems are most prevalent in the Dodoma region.

Intensive agro-pastoral systems. These systems also contribute about 35% of the livestock in the national herd. The systems are prevalent in the Shinyanga and Mwanza regions, where there is permanent cultivation of cotton and maize. The farmers use draught power intensively.

The national herd is comprised of about 98% of all livestock resources in Tanzania. Briefly, this herd could be improved by:

- Improvement of health care (veterinary services)
- Improvement of nutrition (through systems approach)
- Draught power development
- Improvement of genetic material.

Small holder dairy/beef systems

These systems may be found in the Kilimanjaro, Arusha, Mbeya, Iringa, Kagera, Tanga regions and in urban areas. Livestock are kept under intensive or semi-intensive stall-feeding systems. The cattle are usually crosses of dairy or beef cattle.

Semi-extensive dairy/beef systems

These systems may be found in the Mbeya, Iringa, and Kagera regions, as well as on the coast. The systems are characterized by the raising of a small number of cattle, 1-10 dairy cattle, along with crop production. These regions have high potential for the development of the dairy industry.

Commercial sector

Large to medium-sized farms usually belong to individuals (non-Africans) and parastatal organizations, such as National Diaries Ltd. These farms are for profit. They are specialized in dairy, beef (National Ranching Company), broiler, and egg production (Inter chick Ltd.).

CONSTRAINTS ON LIVESTOCK PRODUCTION

General constraints:

Factors common to all sectors of the economy which constrain expansion of livestock production include:

- Shortage of funds of both local and foreign exchange
- Skilled man power.

Support services:

- Insufficient number of and poorly trained extension staff
- Poor supply of improved cattle (beef and dairy)

- Lack of artificial insemination services
- Deterioration of marketing infrastructure, where it exists.

Land tenure:

- Conflict between the livestock owner and pressure for the suitable utilization of land resources (communal grazing system)
- Conflict between crop farmers and livestock owners
- Emphasis on food and fiber crops resulting in crop cultivation on grazing land otherwise suitable for livestock production.

Animal health:

- Expense and irregular supply of veterinary drugs, resulting in delayed disease control/treatment of sick animals
- Near collapse of programmes due to unavailability of acaricides and water
- Inability to exploit export markets, particularly for beef (fresh, chilled or frozen), due to animal diseases.

Range utilization:

- Break down of traditional system of grazing livestock control; need for new methods to replace them
- Poor rangeland conditions, indicating lack of resource development and incentives for improvement
- Uncontrolled burning of rangelands, resulting in tons of forage materials lost to livestock annually.

Credit:

- Need for large investments to expand and improve output from livestock
- Lack of access to credit for those with little or no collateral.

Human resources:

- Acute shortage of adequately trained and motivated personnel
- Lack of skilled manpower in production, processing, distribution and extension.

Livestock nutrition:

- Lack of adequate feed and water throughout the year, affecting livestock performance
- Inability to fully exploit local feed resources, limiting livestock performance, particularly in dairy cattle.

Genetic resources:

- Inadequacy of meat and milk genetic traits in national herd, limiting productivity
- Need to import genetic traits for increased meat and milk production.

Socio-cultural environment:

- Lack of profit orientation, leading to inefficiencies in traditional herd management
- Maintenance of large herd size as insurance against risks and natural disasters.

Constraints caused by government policies:

- Low priority accorded small-scale producers for government assistance
- Low priority given to animal health and extension services
- Laxity in enforcement of public laws related to livestock
- Manpower policies that do not encourage initiative and dedicated service
- High tax levied on livestock inputs such as drugs and animal feed ingredients.

PROSPECTS AND STRATEGIES FOR THE LIVESTOCK INDUSTRY

Prospects

The livestock industry in Tanzania has a relatively high potential for development. The increased supply of livestock products (Table 2) coupled with an increase in human population (2.8%) will amplify demand.

Policy reforms which have resulted in the creation of a market economy, economic liberalization, and the realization of land value favor investment in the livestock sector.

Strategies

- Red Meat: Improve livestock control in the rangelands, marketing, and veterinary services.
- Milk: Improve animal nutrition and husbandry.
- Poultry: Increase availability of improved stock: encourage proper poultry management: and develop alternate and cheaper sources of protein.
- Pigs: Establish breeding units and educate farmers on pig husbandry practices.

NATIONAL AGRICULTURE AND LIVESTOCK RESEARCH MASTERPLAN (NALRM)

Owing to limited funding and lack of research facilities and manpower in Tanzania, a National Agriculture and Livestock Research Masterplan (NALRM) was launched in 1991 with assistance from the World Bank. Two livestock research priorities were identified using pre-determined criteria (export/source of foreign exchange) and modified to suit specific commodities. These livestock research priority areas were:

- Ruminant meat and milk research
- Animal disease research

Ruminant meat and milk research

- Research in livestock nutrition:
  Crop residues as dry season field supplements
  Agricultural by-products as dry season feed supplements
  Nutritive value assessment of local forage tree resources

- Development of low cost supplements

- Identification of species/breeds most suited to local conditions

- Development of management systems

- Development of low cost preventive veterinary packages.

Animal disease research

Research is being conducted in:

- Bacterial diseases
  Brucellosis: Surveys, screening and control.
  Mastitis: Epizootiology studies and control methods.
  Salmonellosis: Diagnostic techniques and immunological studies (chicken).
  Tuberculosis: Epidemiology and control studies.
  CBPP and CCPP: Prevalence.

- Virology:
  Rinderpest: Epizootiology and control studies.
  FMD: Epizootiology and control studies.
  Lumpy skin: Epizootiology and control studies.

- Pharmacology:
  Stability and efficacy of new drugs.
  Identification of medicinal plants.
  Identification and testing of poisonous foods, plants and chemicals.

- Parasitology:
  Tick and tick-born diseases: Epidemiology, ecology and population dynamics.
  Helminthiasis: Epidemiology and control of parasitic gastroenteritis.
  Trypanosomiasis: Epizootiology and control.

- Immunology:
  Development of vaccines and antigens.
  Studies of resistance and immunity development.

- Pathology:
  Study of incidence, pathology and etiology of important livestock diseases.

PRIORITY PROGRAMMES

After determining the national priority research areas in livestock,

Table 4: Zonal prioritization of livestock commodity programmes

Zones	Commodity Programme				
	Beef	Dairy	Small Ruminants	Pastures & Forages	Animal Diseases
Central	1	1	2	1	1
Lake	1	1	2	1	2
Eastern	1	1	2	2	1
Northern	2	1	3	2	3
S. Highlands	1	1	2	3	2
Western	1	1	2	2	1
Southern	2	2	1	2	2

Source: Ministry of Agriculture Zonal Research Priorities summary for all zones - 1995

the zonal priority areas became apparent. National livestock research priorities were examined in light of zonal requirement and five livestock commodity programmes were recommended, namely, beef, dairy, small ruminants, pastures and forages, and animal disease (MOA, 1995b).

From Table 4 it can be seen that the commodity programmes varied in importance in different zones. The beef commodity programme for instance was of high priority in the Central, Lake, East, S/Highlands and Western Zones. The programme was only second priority in the Southern and Northern Zones.

Researchable problems in livestock research were identified and matched with zones and commodity programmes (Table 5). It can be seen that different commodity programmes attached different importance to the various problems. For instance, decline in soil fertility ranked low priority (2) for beef, dairy and small ruminants in the Central Zone, whereas these were high priority in the Northern Zone (Table 5). The same can be said for other researchable problems listed in Table 5. The problems were rated by 1st, 2nd, and 3rd priority. (MOA, 1995b)

FINANCING GAP

The cost of implementing the five commodity programmes was determined relative to total funds allocated to the programmes for a period of five years (1996-2000). Total funds allocated to the programmes amounted to USD 567,100, while total funding required was USD 5,468,660. For the successful implementation of the programmes, there is a demonstrated financing gap of USD 4.9 million (Table 6). Profiles for the five commodity programmes have been drawn up and are available for reference purposes for any prospective donor (MOA, 1995c).

Table 5: Researchable Priority Problems

Problems	Zones						
	Central	North	Eastern	Lake	Western	South	S. Highlands
Decline in soil fertility	B2 D2 S2	B1 D1 S1	B2 D1 S2	B1 D2 S1	B1 D1 S1	B1 D1 S1	B1 D1 S1
Drought & Weather Uncertainty	B2 D2 S2	B1 D1 S2	B2 D1 S3	B1 D2 S1	B1 – S1	B1 – S1	B3 D2 S2
Environmental Degradation	B1 D1 S1	B2 D1 S1	B3 D1 S3	B1 D3 S1	B1 D3 S3	B1 D1 S1	B3 D2 S2
Animal Diseases	B1 D1 S1	B1 – –	B3 D1 S1	B1 D2 S2	B3 D1 S1	B1 D1 S1	B2 D1 S1
Marketing Problems	B3 D3 S3	– – –	B1 – –	B2 – –	B1 D1 S1	B1 D2 S2	B1 D1 S1
Lack of Crop/Livestock Integration	– – –	– – –	– – –	– – –	B3 – –	B2 D2 S2	B1 – –
Poisonous Plants	– – –	– – –	– – –	– – –	– – –	B2 – S3	– – –
Dry Season Feeding	B1 D1 S1	– D1 S1	– D1 S1	– D1 S1	– D1 S1	B3 D2 S2	– D1 S1
Low Productivity of Indigenous Animals	B1 D2 S1	B1 – –	B1 – –	B1 D1 S1	B1 – S2	B2 – –	B1 D1 –
Infertility	– – –	– – –	– – S2	B1 – –	B2 – –	– – –	– D3 S3
Processing/Utilization	– – –	– D2 S2	B2 – S2	– D3 –	– D3 –	– – –	B3 – –
Mineral/Vitamin Deficiency	– – –	B2 – –	B3 D3 S3	– – –	B1 – –	– – –	– D3 S3
Lack of Knowledge Genetic variability	B2 D2 S2	– D3 S3	B3 – –	– – –	– D1 S1	– – –	B1 D1 S1
Low Quality Animal Feed	B1 D1 S1	B2 – –	– – –	– – –	– D1 S1	– – –	B2 D1 S2
Low Range Productivity	– – –	– – –	– – –	– – –	– – –	– – –	– – S3

B=Beef, D=Dairy, S=Small Ruminants
Pastures and Forages Research Programme caters across the Beef, Dairy and Small Ruminants Programmes as Priority one

SOURCE: Beef, Dairy and Small Ruminants Research Programme Profiles 1995 MoA

(B1, D1, S1 meeans that Beef, Dair, and Small Ruminant Commodity Programs are in Priority One Etc.)

Table 6: Financing gap

Attributed	A1	B	C	D	E	Total
Total funding	731550	950000	758650	2062000	96460	5468660
Funds for 5 years	60000	102000	103000	45000	257000	56714
Financing Gap	671550	848000	655010	2017000	709460	4901020

1
A = Small Ruminant Research Programme
B = Dairy Cattle Reassert Programme
C = Beef Cattle Research Programme
D = Animal Health Management Research Programme
E = Pastures and Forages Research Programme

2
Investment Cost
- Equipment
- Civil works rehabilitation
- Farm Development

Incremental Decurrent Costs
- Tractors and implements
- Administrative costs

ACKNOWLEDGMENT

The authors sincerely thank the Small Ruminant Collaborative Research Support Program (SR-CRSP) for inviting Tanzania to participate in the workshop.

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Annex I: Dairy sub-sector.
Annex II: Beef sub-sector.
Annex III: Small Ruminant sub-sector.

MOA (1995b) *Zonal research priorities: Summary for all zones.*

MOA (1995c) *Beef, dairy, small ruminants, animal diseases research programme profiles.*

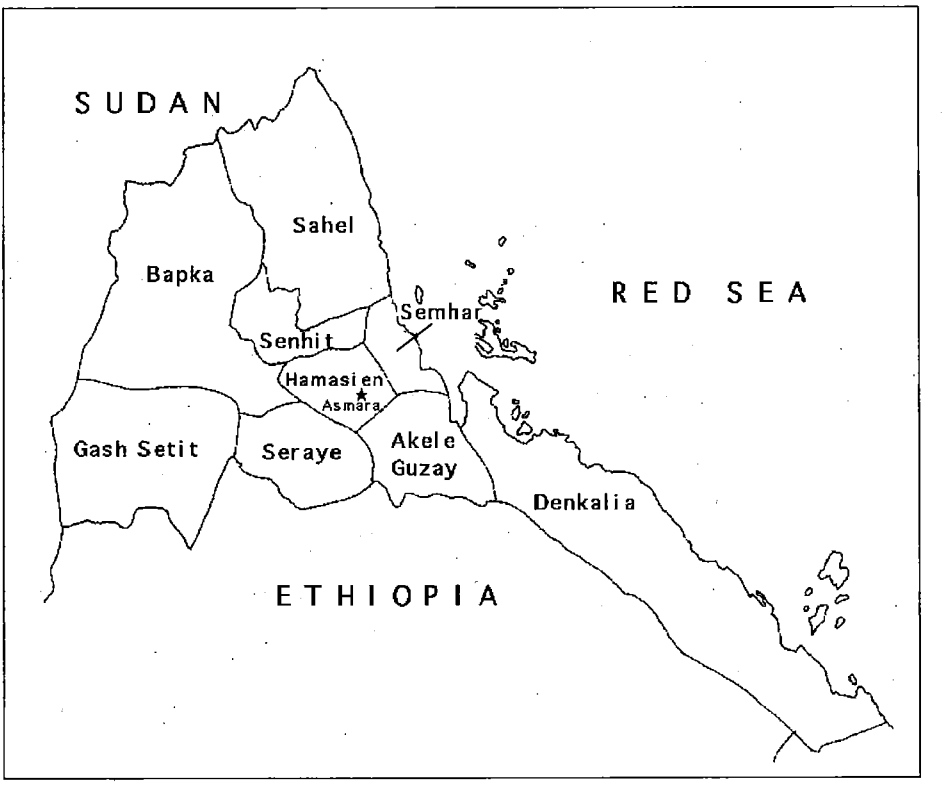
The Status, Constraints and Problems of the Livestock Sector in Eritrea

By Tesfai Tzeggai

Eritrea is a country in northeastern Africa bordered on the east by the Red Sea, on the south by Djibouti and Ethiopia, and on the north and west by Sudan (see Map 1 of Eritrea). It has a land area of 125,000 square kilometers and a population estimated at 2.2 - 3.5 million. The country has an estimated annual population growth rate of 3.3%. Eritrea gained independence in 1991 after thirty years of conflict and was formally recognized as a sovereign nation by the international community in 1993. It is currently in the process of establishing its public sector institutions and its strategies for socioeconomic development.

Eritrea's economy in general, and the agricultural sector in particular, have been seriously affected by the prolonged war. The military conflict displaced farmers, reduced the availability of agricultural inputs and

Map 1: Map of Eritrea



destroyed support services including extension. Crop production and livestock numbers fell by one-half and one-third, respectively, during the 1980s alone; there is a significant level of dependence on food aid, with annual requirements of aid ranging from 150,000 tons to 300,000 tons. Nearly 50% of the population still requires food aid to meet their consumption requirements for at least part of the year.

DESCRIPTION OF THE AGRICULTURAL SECTOR

The agricultural production systems characteristic of the country range from nomadic pastoral to intensive irrigated horticultural systems. The vast majority of producers use traditional animal breeds, crop varieties and management practices. A small number of farmers concentrate on commercial production using more modern technologies. Due to the predominance of traditional production practices, rapid return to farm production and higher productivity in traditional systems can be obtained through the generation and dissemination of improved technology. Production improvements can also be made through crop diversification.

Agro-ecological zones

The Ministry of Agriculture has defined 6 major agro-ecological zones (see Map 2):

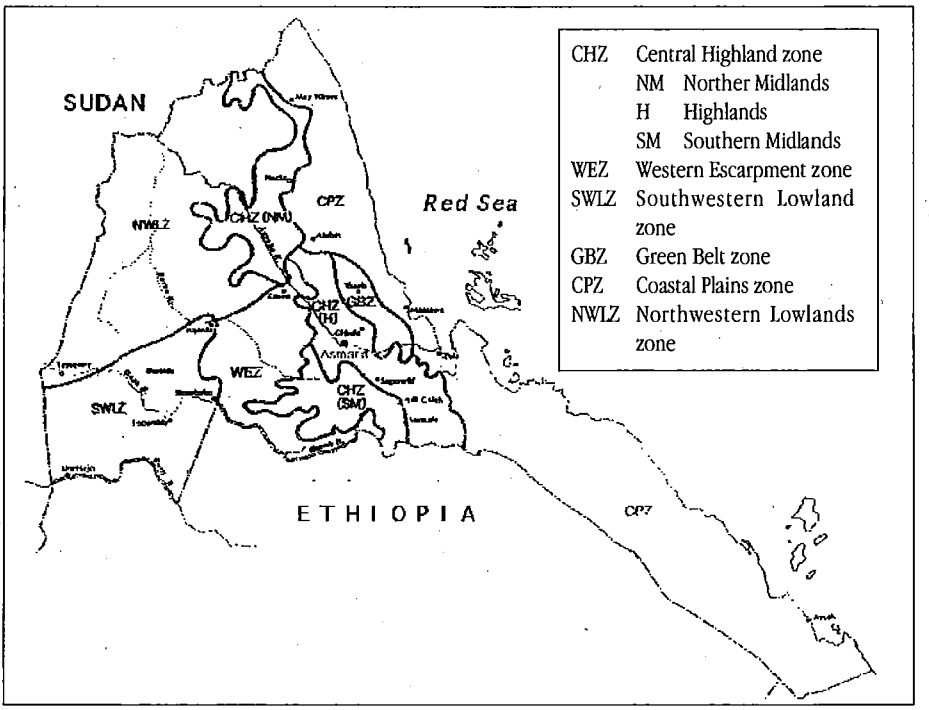
- The Central Highlands Zone (CHZ) has a cool, semi-arid climate above 1,500 m in altitude, approximately 400 - 700 mm of annual rainfall, and a potential evapotranspiration rate of 1,300 - 1800 mm.

- The Western Escarpment Zone (WEZ) has a warm to hot, semi-arid climate from 600 - 1,500 m above sea level and averages 600 - 700 mm of rainfall per year.

- The Southwestern Lowland Zone (SWLZ) is 600 - 700 m in altitude with hot, a semi-arid climate and flat topography; average rainfall is greater than 400 mm per annum.

- The Green Belt Zone is an eastern escarpment area of the Highlands between 750 - 2,000+ m in altitude, with an average of 700 - 1,000+ mm annual rainfall and a sub-humid to humid tropical climate.

Map 2: Major agro-ecological zones of Eritrea



- The Coastal Plains Zone (CPZ) ranges in altitude between 600 m to below sea level with a hot desert climate. It receives an average of less than 200 mm of rainfall per year; the potential evapotranspiration rate is over 2,000 mm.

- The Northwestern Lowlands Zone (NWLZ) ranges from 400 to 1,500 m altitude; it has a hot, arid climate with less than 300 mm of rainfall per year. The potential evapotranspiration rate is 1,500 - 2,000 mm.

Within these six agro-ecological zones crop production is concentrated in the central highlands, and throughout the western and eastern lowlands (an area which has spate irrigation).

Farmers and production systems

Eritrea is a country predominated by subsistence farmers and pastoralists, constituting approximately 80% of the population. Crop and livestock production techniques are traditional, with little use of modern inputs. There is a reliance on animal traction (primarily in the highlands) and manual labor.

Production systems:

I. CHZ
- Rainfed cereal/pulse system
- Irrigated horticulture system
- Semi-commercial, peri-urban livestock (dairy/poultry) systems.

II. WEZ
- Agro-pastoralist system.

III. SWLZ
- Nomadic pastoralist system
- Semi-sedentary agro-pastoralist system
- Crop/livestock mixed system
- Small scale irrigated horticultural system
- Commercial farming system.

IV. NWLZ
- Nomadic pastoralist system
- Irrigated commercial fruit and vegetable system.

V. CPZ
- Nomadic pastoralist systems
- Agropastoralist spate irrigation system.

VI. GBZ
- Mixed cereal/pulse system.

To service these agro-ecological zones, three research stations were selected: Halhale for CHZ, Shambako for SWLZ, and Shieb for CPZ.

LIVESTOCK PRODUCTION AND ITS CONSTRAINTS

Livestock production accounts for a large portion of rural household income, and oxen, camels and equines are significant means of traction and transportation. Small ruminants number approximately 5 million (goats 4.1 million and sheep 0.85 million), cattle (beef, dairy and draft) 1.5 million, camels and equines 0.23 million. With few exceptions, the breeding stock is comprised of mixed and mostly unidentified genotypes. Current herd sizes are roughly half previous levels, with some recovery in recent years.

Over twenty percent of cattle are kept for traction; the remainder are kept for household meat and milk supplies, and also for income generation. Livestock management practices vary according to agro-ecological zones and land use systems of producers. In the highlands, cereals and livestock comprise a closely integrated system, with cultivation by traction oxen. Most farmers of the area have one ox and a small flock of small ruminants that graze on the hillsides and in the fields after harvest. Manure is used more for fuel than for fertilizer.

About 60% of livestock produced are found in the lowlands, where herds and flocks are moved on a seasonal basis. There is a high proportion of females, reflecting the importance of milk for household consumption and the need for rapid recovery of population levels after adverse seasons. Young males are sold for income.

The livestock-based land use systems in low rainfall areas are of two basic types: agropastoralist and pastoralist. Agropastoralists supplement livestock production with cropping in lower riverine areas where seasonal crop failure is nevertheless common.

Pastoralists are semi-sedentary and migrate long distances for grazing. These traditional lowland livestock systems are centuries-old and well-adapted to the arid conditions of the marginal areas of the country. Increasingly, they are coming under pressure from changing land use patterns and population growth.

Livestock production constraints

The major constraints to animal production are lack of feed and poor nutrition, endemic diseases and parasites.

Inadequate nutrition is the major constraint to increased livestock production. Nutritional adequacy varies both between provinces and within and between seasons. The condition of the rangelands varies as a consequence of soil type, rainfall and past utilization. Many areas have lost their original vegetation and now carry heavy infestations of nutritionally inferior invaders. In most cases the grazing and browse available in the communally managed grazing lands is of very poor quality.

The degree of animal malnutrition vary from area to area and year to

Table 1: Animal health status

Cattle	Sheep and Goats
Infectious Diseases	
Rinderpest Blackleg/Blackquarter Anthrax Foot and Mouth Disease (FMD) Malignant Catarrh Fever (MCF) Haemorraghic Septicemia (HS) Contagious Bovine Pleuro Pneumonia (CBPP)	Sheep Pox Pasteurellosis Peste des Petit Ruminants Contagious caprine pleuropneumonia Brucellosis Contagious Ecthyma
Internal Parasitism	
Intestinal Nematodes and Cestodes Lung Worms Liver Flukes	Intestinal Nematodes/Trematodes Nasal Bots Liver Flukes
External Parasitism	
Ticks: *Amblyomma sp., Hyalomma sp., Ripicephalus sp., Boophilus sp.* Mites: Sarcoptes and Chorioptes Flies: *Stomoxys calcitrans* and *Hyppobosca rufipes* (no tsetse flies reported) Protazoal/Rickettsial Blood Parasites: Anaplasmosis: Anaplasma sp. Babesiosis: Babesia sp. Trypanosomiasis: Machanical only Diseases of Public Health Importance: Brucellosis Tuberculosis Rabies Cysticercosis/Hydatid disease Infertility and Abortion Brucellosis: confirmed Vibriosis: suspected Trichomoniasis: suspected	Ticks: as cattle ticks Mites: as cattle mites Flies: as cattle flies Fleas

year. In the worst (driest) years, many animals die; in most years many animals are short of feed at the end of the season. Overall growth rates are slow, although compensatory weight gains occur following the rains. But overall maturity is delayed and calving materials increased.

There are no facilities in Eritrea for analyzing the nutritive content of animal feed. At present, there are no experience among either farmers or scientists in Eritrea experienced in the growing of fodder crops or the proper use of crop residues and by-products.

Institutional constraints

The establishment and operation of a strong agricultural research service is a high priority in the government s reconstruction and economic recovery program. Particular focus is on effective and efficient utilization of all available resources. The strengthening of agricultural research will be a gradual and sequential process of building institutional capacity.

Animal science research has faced a number of institutional constraints. These include:

- Inadequate financial investment by the government
- Few and inadequately-trained staff
- Inexperienced management
- Lack of laboratory, office and housing infrastructure at station locations
- Lack of vehicles, equipment and supplies
- Inadequate operating funds.

Potential livestock research areas

Potential livestock research areas are:

- Adaptation trials of different forage trees, legumes and grasses
- Identification of native grasses
- Identification of crop residues and by-products
- Evolving cheap feeds using agro-industrial by-products
- Identification of the nutritive value of forages, crop residues and byproducts
- Range management research
- Feeding trial research
- Breed characterization of Eritrean goats, sheep and cattle
- Genetic improvement of the milk yield of Barka goats and cattle
- Improvement of the productivity of animals by cross breeding native animals with exotic breeds
- Epidemiology and control of different infectious diseases
- Seasonal variation and economic effects of internal and external parasites
- Relationship between human and animal tuberculosis.

AGRICULTURAL RESEARCH POLICY OBJECTIVES AND STRATEGIES

Under the macroeconomic policy framework of the government and the sectoral development strategy of the Ministry of Agriculture, policies that strengthen agricultural research services have been given a high priority. The current environment of change, particularly through commitments to increased research investment by the government and donors, offers advantages for improving productivity in the rural sector.

Policy objectives

Current policy objectives are:

- Achievement of food security (highest priority)
- Improvements in the living conditions and levels of income of the Eritrean people in general and the peasant farmers in particular
- Improvements in existing production systems/farming systems by developing and disseminating technology and genetic materials appropriate for small scale and commercial producers and users
- Increasing the supply of agricultural raw materials for agro-industry and promoting the expansion of agro-industry
- Encouraging high value livestock export production, through research on relevant agricultural technology
- Developing research outputs that promote soil and water conservation and prevent environmental degradation.

Strategies

Strategies to achieve these objectives:

- Train and develop human resources for the implementation and management of agricultural research
- Engage in adaptive and applied research on existing and imported technologies and knowledge that offers timely results for the removal of production constraints
- Establish linkages with appropriate regional and international research organizations in order to access available technology and knowledge
- Develop the institutional capacity to manage resources and research processes
- Improve the structure and organization of public institutions involved in livestock research
- Provide infrastructure and equipment adequate for livestock research coverage of the major agro-ecological zones and the needs of producers.

Table 2: Prioritization of production systems

High Priority (HP)	Moderate Priority (MP)	Low Priority (LP)
• Crop/Livestock Mixed system (SWLZ) • Small-scale Irrigated Horticulture systems (SWLZ) • Commercial Farming System (SWLZ) • Rainfed Cereal/Pulse System (CHZ) • Agro-pastoral Spate systems (CPZ) • Semi-commercial peri-urban Livestock System (CHZ)	• Agro-Pastoralist System (WEZ) • Irrigated Horticultural system (CHZ) • Irrigated Commercial Fruits and Vegetable System (NWLZ) • Semi-Sedentary Agro-pastoralist System (SWLZ)	• Mixed cereals/ Pulse/ Cash crop Systems (GBZ) • Nomadic Pastoralist System (SWLZ) • Nomadic Pastoralist system(NWLZ) • Nomadic Pastoralist System (CPZ)

LIVESTOCK RESEARCH PROGRAMS AND PRIORITIES

Livestock research programs and priorities have been established at two levels: the production system and commodity production levels.

Priority setting at the first level has identified the production systems within agro-ecological zones that offer the greatest potential for rapid improvements, which will lead to increased system productivity. Economic, social and environmental criteria were used to establish the relative importance of fourteen production systems.

Commodities were grouped under high, medium and low priority areas. The results are summarized in Table 3.

Table 3: Prioritization of commodities

Livestock		
High Priority	Moderate Priority	Low Priority
1. Sheep 2. Goats 3. Dairy cattle and goats 4. Cattle 5. Poultry 6. Camels 7. Fodder crops 8. Range management	1. Bees 2. Pigs	1. Donkeys 2. Mules 3. Horses

LIVESTOCK RESEARCH IN KENYA

By A. N. Abate
Kenya Agricultural Research Institute

INTRODUCTION

Kenya depends on the agricultural sector for economic development. It is estimated that agriculture represents nearly 30% of the country's Gross Domestic Product (GDP). Currently the human population is estimated at about 25 million with an annual growth rate of about 3.5%. Agriculture and related activities play a major role in the creation of approximately 70% of total employment. It is also estimated that over 60% of the total foreign exchange earnings come from agricultural products, mainly coffee, tea, and horticultural crops. The sector also contributes to national food security, generation of farm incomes and creation of employment. Over the last two decades, agriculture has generally grown by about 4% annually. Other sectors in the economy are dependent on agricultural growth.

The livestock sector contributes about 30% of total agricultural production. This contribution comes from cattle, sheep, goats, poultry, pigs, camels and other herbivores such as donkeys and rabbits. In the arid areas, livestock is the only means of transforming plant species into food and income for pastoralists. The communities in these areas sell livestock to buy other types of food during droughts when crops fail.

Livestock are distributed throughout various parts of the country. The most common species, cattle, sheep, goats, poultry and pig are normally kept as mixed species under various systems of production. The main products from these animals are meat, milk, eggs, hides and skins. At the national level, it is estimated that livestock contribute about 26% of the total recorded GDP (Table 1) and provide over 50% of the employment in the agricultural sector. It is also estimated that 48% of the land used for crop and livestock production is accounted for by dairying.

POPULATION AND DISTRIBUTION OF LIVESTOCK

The national livestock population is made up of about 13 million cattle, 9 million sheep, 11 million goats, 20 million chicken, 900,000 camels,

Table 1: Role of livestock in the national economy

Year	Agricultural production	Cattle and calves	Dairy products	Total livestock	% Agric. Production due to livestock
1980	363	34	15	56	15.4
1981	387	47	23	80	20.7
1982	449	52	29	92	20.5
1983	555	52	33	94	16.9
1984	789	59	26	998	12.4
1985	766	70	36	122	16.2
1986	938	84	57	160	17.0
1987	818	104	62	190	23.2
1988	946	139	61	239	25.3
1989	1,003	149	66	250	24.9
1990	1,104	164	84	291	26.4

Source: Economic Survey: 1982, 1988 and 1991 Editions. Central Bureau of Statistics, Nairobi

125,000 pigs and 250,000 rabbits. The livestock sector is estimated to produce 2.4 billion kg of milk, 370,000 tons of meat, 1 billion eggs and 857 tons of wool. In addition the animals produce hides and skins and manure. The latter plays an important part in improvement of soil fertility and ensuring sustainability of agricultural production. Animals also provide draught power which is extensively used for tillage in the dry areas.

The population of 13 million cattle is composed of 3 million pure dairy animals or crosses of the main dairy breeds with the local zebus. More than 70% of the dairy cattle are found in the medium to high rainfall areas of the country where they are kept under zero-grazing, semi-zero-grazing or extensive systems of production. The rest of the herd is made up of indigenous breeds including the Boran and the East African short horn zebu. These animals are found in semi-arid areas. There is, however, a sizable proportion of indigenous cattle found in some high potential areas such as the humid coastal strip and parts of western Kenya. Disease challenge, particularly Theleriosis and Trypanosomiasis, is one of the major reasons that the indigenous cattle are kept in these areas that would otherwise be used for dairy cattle production.

Approximately 80% of the total sheep flocks and goat herds in the country are found in semi-arid and arid areas. Wool sheep and dairy goats, which make up just about 10% of the total small ruminant population, are found mainly in medium to high potential areas. The population of cattle, sheep and goats in different agro-climatic zones are shown in Table 2.

Table 2: Livestock population and distribution in various agro-ecological zones

Species	Population (%)		Distribution (%)		
			Agro-Ecological zones		
			II-III	IV-V	VI-VII
Cattle	grade	3.0	47.8	35.4	16.7
	indigenous	9.7			
Goats		11.0	17.8	50.2	32.0
Sheep		9.0	25.3	44.2	30.5
Camels		0.9			
Pigs		0.1			
Poultry		20.0			
Rabbits		0.3			

Poultry, particularly indigenous birds, are found in all parts of the country although there is a tendency for western and coastal provinces to have more indigenous chicken than other provinces. Facilities for commercial chicken production are normally located around urban centres where there is a ready market.

LIVESTOCK PRODUCTION SYSTEMS AND CONSTRAINTS TO PRODUCTION

Livestock production systems in Kenya can be classified into three broad categories, namely: intensive, semi-intensive and free range production systems. The three systems are to a large extent dictated by agro-climatic characteristics and the pressure of human population. Differences in these systems in terms of land size and ownership, socioeconomic activities and level of inputs into livestock farming warrant careful consideration in the development of a relevant research agenda. Some constraints to livestock production may be similar, but strategies to alleviate these constraints may differ from system to system.

Intensive livestock production system

This system is typically located in agro-ecological zones II and III and is characterized by:

- high rainfall (> 1,000 mm per annum)
- high human population
- smallholder farming
- land tenure system normally freehold
- exotic livestock breeds and crosses of these with indigenous breeds
- fodder grown for livestock for cut and carry system
- limited level of inputs (drugs, feeds) into livestock production

- livestock contribution to total farm production usually approximately 30%
- high level of integration of crop/livestock production.

Major constraints to livestock production include:

- Inadequate supply of feed resources and their utilization, particularly in the dry season.
- Animal health issues (cattle, small ruminant), particularly theileriosis, trypanosomiasis, helminthiasis, lumpy skin and foot and mouth diseases, diarrhea and pneumonia, and infertility.
- Socioeconomic factors, including marketing and pricing policies, delivery of health and other services, credit availability.
- Genetic resources (matching available feed resources to livestock type).

Semi-intensive production system

This system is located in agro-ecological zones I-V and is characterised by:

- medium rainfall (< 700 mm per annum)
- land units generally larger than in (i), over 10 hectares freehold tenure;
- pure livestock genotypes and crossbreeds
- natural pasture and limited grown forages
- integration of cropping and livestock production is increasing (nutrient recycling)
- livestock contribution about 50% (food, employment and income) level of inputs on-farm is low.

Constraints to livestock production in this system are generally similar to the constraints in the intensive production system. The process of prioritization for both production and health research programmes for intensive and semi-intensive systems has been carried out using established regional research-extension-farmer clusters.

Extensive livestock production system

This system is located in agro-ecological zones VI-VII and is characterized by:

- low erratic and poorly distributed rainfall (< 500 mm/per annum) droughts are common

- farms are normally large
- land tenure freehold or communal in pastoral systems
- livestock breeds mainly indigenous
- 70% indigenous cattle, 85% small ruminants, 100% camel, some poultry
- role of livestock (70%) critical as sole food and income generator, livestock provides employment
- inputs such as drugs limited to diseases that cause mortality rather than morbidity
- low human population
- hardly any crop/livestock integration as crops do not prosper well here.

Constraints to livestock production have been identified as:

- socioeconomic, marketing and pricing/offtake, particularly in pastoral systems
- overgrazing due to poor management of natural resources
- poor delivery of livestock services (vaccines, lack of extension facilities).

Institutional components involved in the livestock sector

In the past, various institutions involved in livestock research and development carried out their activities independently. Research planning was done through specialist committees with little involvement from extension personnel, farmer and other organizations that had an interest in the agricultural sector. There was little feed-back from extension to research to indicate relevance and promote adoption of research technologies developed in the last three decades. Farmers and consumers needs for research and extension were not considered in the process of technology generation and dissemination. Lack of collaboration with stakeholders has contributed to the current low levels of new technology adoption and to the setting of policy guidelines that have not benefited the whole continuum of livestock research and development.

In the current phase of the National Agricultural Research Project (NARP) there is a shift in emphasis in research calling for participation of clients (farmers) and other stakeholders in the development of the research agenda. The major stakeholders in the livestock sector include:

- research institutions: KARI, KETRI, KEFRI, ILRI, ICRAF
- universities

- extension agencies
- farmer cooperatives, such as KNFU
- processing and marketing companies

The participation of all stakeholders in the research and development process is currently underway. The development of the National Dairy Cattle Research Framework in 1994 also involved crucial stakeholders. As a result, the parties concerned fully identify with the objectives of research and are committed to fulfilling their obligations in relation to the activities of the National Dairy Cattle Research Programme.

Table 3 provides a partial picture of the research capacity of Kenyan NARS involved in livestock research. The actual numbers of scientists in IARC-involved areas of research relevant to livestock production were not provided. Also figures from the two national universities involved in livestock research may have recently changed. English is the medium of communication in all Kenyan schools; all scientists in the NARS have excellent speaking and writing skills in English.

Table 3: Institutions and number of scientists involved in livestock research in Kenya

Institution	No. of Scientists	Level of training			Other research facilities
		Ph.D.	M.Sc.	B.Sc.	
KARI					Ample land all spp.
- Animal production	66	20		2	of livestock & poultry
- Animal health	45	25	20	0	Laboratory and library facilities
- Range management	21	1	17	3	
KEVEVAPI					
Egerton University	≅ 35	Mainly Ph.Ds & M.Scs.			Land, animals, libraries, and laboratories
Nairobi University	≅ 30	Mainly Ph.Ds			land, animals, libraries, and laboratories
IARCs					
- ILRI					Laboratory and library facilities
- ICRAF					Laboratory and library facilities
- KWS					Laboratory and library facilities

CONCLUSION

In priority-setting exercises carried out in KARI in 1991, livestock research programmes were ranked very high (top 10). It is therefore critical that the livestock sector is accorded resources to enable it to fulfill its role in national development.

The Kenyan NARS is playing an increasing role in providing accurate analysed agricultural data to policy makers, which will assist them in formulating policies to enhance livestock development.

A change in policy as far as provision of services to the livestock sector, e.g. privatization of services, will require that research and extension workers collaborate closely with private companies and individual farmers. For instance in the multiplication of plant and animal germplasm, government farms previously used for multiplication of seeds have been privatized.

Judging from literature on constraints to livestock development in other countries of the region, there is enormous scope for collaboration. This collaboration will no doubt result in the efficient use of resources and much needed interaction between livestock scientists. The Kenyan NARS can collaborate efficiently with other NARSs in the region in all areas of ruminant livestock, especially in pastures and fodder research. Both of these research areas are well staffed with qualified scientists. The strengthening of collaboration in the region will allow livestock scientists to interact regularly.

ACKNOWLEDGEMENT

On behalf of the Kenya Agricultural Research Institute (KARI) and on my own behalf, I wish to express sincere appreciation to the Small Ruminant Collaborative Research Support Program (SR-CRSP) for inviting my institution to participate in this workshop. Through the SR-CRSP, KARI has had a beneficial 15-year collaborative association with U.S. institutions. I hope this workshop is yet another step to furthering this collaboration.

RESOURCE PRESENTATIONS

KENYA SR-CRSP EXPERIENCE

By P.P. Semenye
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INTRODUCTION

The origins of the Small Ruminant Collaborative Research Support Program (SR-CRSP) lie in the passage of the Famine Prevention and Freedom from Hunger Act (1975) by the U.S. Congress. The provisions of Title XII of the Act are three-fold: (1) to strengthen the capabilities of U.S. universities, (2) to conduct research overseas and provide aid to developing countries in the form of commodity transfers, and (3) to provide long-term support for agricultural research and development rather than for the small, short-term, stop-and-go projects which have characterized much of past technical assistance.

The SR-CRSP started operations in Kenya in 1980 with the Ministry of Livestock Development as its host institution. The U.S. institutions that contributed to the work of the SR-CRSP Kenya were: the University of California, Davis (Management Entity), the University of Missouri (Socio-economics), Texas A&M University (Breeding), Winrock International (Production Systems), and Washington State University (Animal Health).

ADMINISTRATION

The administrative structure of the SR-CRSP in Kenya is based on collaboration and consensus between host country and U. S. scientists. The Management Entity at the University of California, Davis coordinates and facilitates communication with the Board of Directors, the Technical Committee, and the principal funding agency (USAID).

Within the host country, a week is reserved annually to review research activities and prepare budgets and work plans. The proposal for future activities resulting from these meetings is then presented to the Technical Committee for approval and funding. The week also provides SR-CRSP scientists (both U.S. and host country) the opportunity to come together to develop a work program for the coming year. It should be noted that these exercises are carried out democratically.

After this week of planning, an open workshop is held where SR-CRSP scientists present scientific papers. The quality of each paper helps to evaluate the performance of both resident and collaborating scientists. Resident scientists have been dismissed and collaborating scientists discontinued for poor performance. In summary the SR-CRSP administrative structure can be characterized as one based on horizontal relationships. These relationships are committee driven and tailored to foster equality in partnership.

SR-CRSP POLITICS

SR-CRSP activities in Kenya have been vulnerable to political change. The first host institution was the Division of Research within the Ministry of Livestock Development. Following a cabinet reshuffling, the ministries of Livestock Development and Agriculture were amalgamated to form the Ministry of Agriculture and Livestock Development. A short time later the new ministry dissolved, the Ministry of Livestock Development was re-created, and subsequently, an Act of Parliament created a separate Kenya Agricultural Research Institute (KARI). The SR-CRSP then moved to KARI, whose mother ministry was and continues to be the Ministry of Research Technical Training and Technology.

The selection of host countries by U. S. partners is also political in nature. Kenya would not have been selected as the SR-CRSP host country if it had not been favored by the Department of State and the local USAID mission. Host country sites without obvious advantages might also be picked, as was the case with the western Kenya site.

The program has also been plagued by diminishing host country funding and inconsistent funding from the United States.

FINANCIAL MATTERS

Activities have been affected by currency fluctuations, positively or negatively depending on the appreciation or depreciation of the Kenya shilling against the U. S. dollar. When the shilling was depreciating the program absorbed budgetary cuts in dollars and the effects of local inflation without altering work plans. Recently, however, as the shilling has started to appreciate, the reverse was observed. The continuation of some activities has been jeopardized.

Funds from U. S. institutions are channelled directly to respective projects or resident scientists. Initially this procedure was unpopular with the host institution, but it has now gained acceptance due to its efficiency. In fact, the procedure has been adopted for some of KARI's own projects.

The ability of the SR-CRSP to tap into funds from three sources (USAID, collaborating and host institutions) is of great advantage for financial stability. Had this mechanism not been in place, financial instability caused by budget cuts, inflation and other events would not have been contained effectively. Furthermore without matching funds it would not have been possible to pay scientists differentially, relative to experience and country of residence, without draining research funds.

The cornerstone of collaboration between U. S. institutions and the host country has been the memorandum of understanding (MOU). The MOU for the SR-CRSP Kenya was signed in 1980 followed by an amendment in 1990, to accommodate changes in tenure, administration, procurement and research activities.

MANPOWER DEVELOPMENT

Over the years SR-CRSP Kenya has undertaken a rigorous training program. To date, the program has trained a total of 34 Kenyans (6 PhD, 24 MSc, 2 BSc) and two others are still in training. Build the capacity of Kenyan scientists, so they may continue research after the program ends, has been one of the program's greatest achievements. An equal number of American students have also been trained.

The successful training of host country students has rested on the combination of course work in the U. S. and research in Kenya. This arrangement has enabled students to take advantage of the academic superiority of U.S. land grant universities as well as to lay the foundation for research in Kenya upon completion of their studies. It has also facilitated friendship and long term collaborative ties between Kenyan students and their U. S. counterparts and professors.

The SR-CRSP in Kenya has hosted animal agriculture interns from U. S. and Kenyan institutions of higher learning. While at Maseno and now at Katumani and Mtwapa students on educational tours continue to be attracted by KDPGs and related activities.

The SR-CRSP in Kenya has also participated in major agricultural shows in Kenya and, in collaboration with the Ministry of Livestock Development, has hosted field days for farmers countrywide. The Kenya Dual-Purpose Goat and its accompanying technology packages have attracted so much interest from farmers, extension agents, non-governmental organizations (NGOs) and policy makers that we have been unable to meet the demand. Currently plans are underway to contract commercial multipliers for KDPGs.

RESEARCH ACHIEVEMENTS

During the tenure of the SR-CRSP in Kenya there have been major changes in international research. During the early years emphasis was on farming systems research (FSR). FSR was first developed for crop agriculture, and we in the animal agriculture had to adapt it to meet our needs. The SR-CRSP Kenya was one of the first programs to take the challenge of FSR with goats. Successful on-farm research based on FSR was conducted in western Kenya. The focus on FSR was replaced by interest in developing sustainable agriculture and in the most recent phase of SR-CRSP research, we are placing a greater importance on impact and development. Although the overall objective of the SR-CRSP in Kenya has included research with the KDPG for provision of improved nutrition, KDPGs have not been widely distributed. Changes necessitated by the outlook of international agriculture are underway.

ANIMAL HEALTH PROJECT

Several important successes in disease diagnosis, disease control and manpower development have been achieved by the Animal Health Project. In the area of disease diagnosis, development of highly sensitive reagents for detection of contagious caprine pleuropneumonia (CCPP), heartwater and anaplasmosis have been developed. These include:

- a rapid diagnostic kit for CCPP using purified antigens
- a monoclonal antibody highly specific for F38, the mycoplasma that causes CCPP
- a DNA probe for detecting Cowdria ruminantium in ticks and infected goats
- a DNA probe for detection of Anaplasma ovis in goats in Kenya.

A number of these products have the potential for use as reference typing reagents in other parts of the world. For example, the SR-CRSP is the reference laboratory for the F38 monoclonal antibody.

In collaboration with the Ministry of Livestock Development the Project has been able to establish the presence of caprine arthritis encephalitis (CAE) virus in goats imported to Kenya. This discovery saved Kenya the cost of combating and controlling the disease. As a result Kenya is free of CAE. Research in the field has lead to identification of management practices that will facilitate introduction of goats into areas infested with trypanosomiasis and define areas in Kenya that require selenium supplementation.

In the area of animal vaccines, the Animal Health Project has been in the forefront both in conventional as well as in contemporary strategies for vaccine development. An inactivated CCPP vaccine has been developed and shown to be efficacious in limited on-farm trials. The shelf-life of the vaccine has been extended by lyophilization. This vaccine when properly used at the recommended regimen is highly effective. Other strategies being used include the development of a multivalent virus-vectored vaccine for small ruminants using the goat poxvirus as the carrier. Such vaccines will be endowed with the thermostability of the poxvirus thus obviating the need for maintaining a highly expensive cold-chain. In this direction the Project has developed a recombinant capripoxvirus carrying the Rift Valley fever virus (RVFV) gene that encodes for antigens important in protection against infection with RVFV. The protective efficacy of this recombinant will be tested in animals under controlled environment. Similar work on the Nairobi sheep disease virus is in progress. A cDNA library has been constructed and the process of identifying the relevant vaccine genes for incorporation into capripox virus has been initiated.

PRODUCTION SYSTEMS PROJECT

Over the years, the Production Systems Project has evolved into two components. One is geared towards development and preservation of suitable feed resources and the other towards nutrition and management issues of small ruminant production in smallholder production systems.

Studies conducted relative to feed resources include:

- screening forage crops from various parts of Kenya and other tropical countries to determine their suitability for smallholders
- determination of production and utilization potential of Sesbania sesban as a forage for small-ruminants
- selection of sweet potato cultivars best suited for fodder and food production
- development of appropriate silage and hay baling techniques for resource poor farmers
- evaluation of fertilizer value of goat manure for food and feed crops under smallholder conditions.

With respect to nutrition and management, studies conducted include:

- palatability ranking and nutritive analysis of commonly used forages in Kenya
- quantification of feed resources available for livestock throughout the year
- evaluation of the effect of wilting grass on helminth larvae infestation and dry matter intake among dual purpose goats
- development of appropriate nursing regimes in dual purpose goats
- development of mineral bricks
- identification of suitable milk replacers and refinement of tethering management (type and length of rope, tethering stations and pattern of tethering).

Overall, the Production Systems Project has addressed basic questions concerning small ruminant production under smallholder management conditions. In view of the pervasiveness of smallholder production systems in Kenya and the importance of small ruminants in these systems, the implications of the technology package emanating from this research are far reaching. On-farm research activities conducted by the Production Systems Project on 150 smallholder farms in western Kenya acquainted farmers well with the dual purpose goat technology. In collaboration with the Breeding Project, nucleus dual-purpose goat (DPG,F1) herds have been established at Bukura Institute of Agriculture, the Lumigo Women's Group, the Government Prison Farm at Kibos and the Siaya Livestock Multiplication Center. In collaboration with the Ministry of Agriculture, Livestock Development and Marketing, the program has been conducting field tests and has been exhibiting KDPGs and their

supporting management packages at local agricultural shows since 1985. It is estimated that over 50,000 people have been exposed to program activities through these channels.

The Production Systems Project and sister projects have shifted their focus to eastern and coastal Kenya. While proxy DPGs (two-way crosses F1s) were used in western Kenya, true KDPGs (four-way crosses) will be used in the new areas and the first female offsprings will be passed to farmers in waiting. This is a sustainability strategy borrowed from Heifer Project International (HPI), whereby only a small number of farmers are allocated does under the condition that they pass on the first female offsprings at the approximate age of six months to fellow group members. The process should then continue until each group member has received a pass-on.

In the new study area we have been working in three districts (Machakos, Kwale and Kilifi) in which there is a total of 100 smallholders. Initial results have been encouraging because KDPGs are out-performing local goats in milk production and growth. This performance adequately compensates the need for more attention in husbandry and health care. The investment yields a return on average of 700 ml of milk per doe/day and the attainment of 25 kg body weight at one year. Typically local goats attain 25 kg only at the age of three years or more. Weaner males up to the age of six months and weighing approximately 15 kg have been sold at between 1100/= and 1700/= (1 US $ = 55 K.Shs). Some farmers have sold fresh KDPG milk at between 15/= and 30/= per bottle (700 ml). All farmers in the study have been given planting materials to establish fodder banks.

BREEDING PROJECT

Over the years, the Breeding Project has been developing a synthetic breed of dual- purpose goat to meet the requirements of small-scale farm families. This synthetic goat is composed of equal proportions of two adapted local goats (the East African and Galla) and two exotic goats (the Toggenburg and Anglo-Nubian). The objective is to synthesize a goat that has acceptable milk yield, fast growth rate, high fertility and high adaptability to various agro-ecological zones where smallholder farming enterprises are prevalent. The KDPG can also be bred and adapted to low and high production areas by varying the proportions of

exotic and local genes. The KDPG has been registered as a breed with the Kenya Stud Book to enhance community awareness of the breed.

Besides maintaining a nucleus flock at Ol'Magogo, Naivasha for upgrading the goats to the planned synthetic KDPG, the breeding project has also provided F1 crosses for on-farm trials in western Kenya. A total of 455 DPGs have been transferred to Maseno since 1986 for on-farm and on-station trials. The project has also provided 429 goats for animal health trials at Kabete and Ukunda. For the ongoing impact assessment study of the KDPG, the Breeding Project has also supplied 71 KDPGs.

SOCIO-ECONOMICS PROJECT

It is now commonly recognized and accepted that agricultural research results must not only be technically feasible but must also be socioeconomically sound to be widely adopted by farmers. In addition to asking whether or not the new technology will work, it is necessary to know whether or not it is economically viable, socially acceptable, and whether it will make a contribution to food security and the economy at large. Over these past years, the Socioeconomic Project has been struggling to answer such questions. An ongoing impact assessment of the KDPG is expected to demonstrate

- Impact of the KDPG package on the household income (cash and kind)
- Impact of the KDPG package on the production system (herd size/ structure, crop mixes, livestock-crops interaction, etc.)
- Impact of the KDPG package on the gender relations (division of labour, access/control of resources, decision making process, etc.).

Livestock Production and Wildlife Conservation: Opportunities for Compatible Management and Integrated Production

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SUMMARY

Conflict between wildlife and livestock production has increased in recent decades, partly as a result of increasing human populations with increasing demands for resources, and partly due to the protectionist policies of governments. Farmers have been forced to bear the costs of wildlife without being able to derive any tangible benefits. Consequently wildlife has steadily declined on rangelands outside of protected areas. Where policies have allowed landowners to benefit from wildlife, however, it has increased. Potential roles for the integration of wildlife into production systems in the east African region are examined, and ways in which livestock development could promote the conservation of wildlife are discussed. It is suggested that the conflicts between wildlife and livestock actually present opportunities to both conservationists and farmers, and that there is a significant degree of mutual interest between these two groups.

INTRODUCTION

Certain forms of livestock production and associated management practices clearly conflict directly with the conservation of biodiversity in general and large mammals in particular. High intensity dairy farming on improved and irrigated pastures, for example, would not be generally compatible with biodiversity conservation. The investment cost and thus the required level of production does not leave room for the kinds of compromise that would be required to support the conservation of biodiversity on such highly modified land. There are, however, other forms of livestock production that are highly compatible with wildlife, notably the extensive production systems employed by traditional pastoralists in semi-arid or marginal lands. The close synchronicity between the lands of traditional pastoralists and the remaining large mammal wildlife concentrations in Africa makes this evident. Ways of reducing conflicts between the needs of wildlife conservation and those

of livestock production will be examined by reinterpreting conflicts as opportunities for the development of innovative practices for the management of natural resources.

As human populations grow, governments and economic planners are required to examine ways of raising agricultural production to feed the increasing number of mouths, and to boost economic performance to meet the growing expectations of the people for a comfortable and secure existence. At the same time, however, many countries in Africa are looking towards wildlife based tourism to contribute to the national wealth, and therefore need to retain the wildlife habitats, biodiversity, especially large mammals, and natural landscapes on which the industry is based. Furthermore, most governments are signatories to various international conventions, such as the World Heritage Convention and the Ramsar Convention, obliging them to support the conservation of biodiversity within their countries. The development of land-uses that can combine these seemingly conflicting requirements and build an African landscape that is productive, rich in biodiversity, and an attractive and safe environment for people to live in is therefore an important and urgent challenge.

By moving away from a concentration on the issues from the perspective of conflict, and attempting to discuss the opportunities that exist for wildlife conservationists, livestock producers and land-use planners to work together, it is hoped that a positive picture of potential areas of collaboration will be presented. Areas of collaboration that will enhance the conservation of biodiversity will be discussed primarily in relation to lands outside of protected areas. However, the implications for the management of the protected areas themselves and the importance of developing compatible approaches to the management of natural resources both inside and outside protected areas needs to be recognised and incorporated into the planning of development interventions.

A regional perspective will be employed to discuss ways in which the needs of both livestock production and wildlife conservation may be partially reconciled. Several examples drawn from the Ugandan experience will be given. The paper will be presented through the following sections:

- A short discussion of the historical background of the conflict between wildlife and livestock interests will be followed by an

overview of recent developments in wildlife conservation theory and practice.

- Various areas of conflict between wildlife and livestock will be presented.

- Potentials for the inclusion of wildlife within livestock production systems which would increase economic returns to landowners are discussed.

- Livestock development initiatives that would also support wildlife conservation are proposed.

- Information needs and research priorities to achieve the closer integration of livestock development and wildlife conservation are identified.

Historical people/wildlife relations

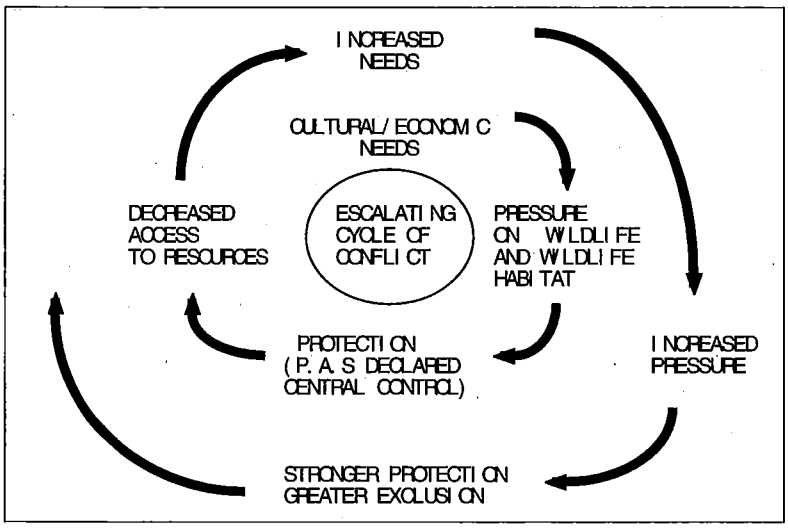
Livestock and wildlife have coexisted in Africa since people first arrived with their livestock. This is not to say that there has been comanagement, however, as there is no evidence that the pastoralists and farmers actively managed the wildlife, although hunting-gathering peoples quite possibly did. Wildlife was, however, used in various ways. Meat was an important resource for which wild animals were hunted. Masai hunted lions to prove their manhood and made shields out of rhinoceros skin. Ivory was used as a sign of wealth and power by the chiefs of many peoples. Historical levels of use, however, had minimal impact on wildlife populations. There was also conflict between wildlife, man and his livestock. Large grazing animals and primates damaged crops then as they do today, and predators killed both livestock and people. Predators which attacked livestock were hunted and destroyed. This also had minimal impact on populations, except in areas of intense human settlement and farming where large mammals were excluded.

The rise of conflict

Conflict between man and wildlife is thus not a new phenomenon. In quite recent years, however, conflict has intensified and become a major issue for both rural farming communities and for wildlife conservationists. This has resulted from increasing human populations, and their

requirement for larger herds of livestock and greater areas of cultivation. As human needs for resources increased, perceptions of the negative aspects of wildlife, and old tolerances of wildlife, began to diminish. The conflict can be viewed from two perspectives. Pastoralists and farmers view the conflict in largely economic terms. Wildlife conservationists look at the loss of habitat resulting from the increasing human and livestock populations. The response was for governments to create exclusive wildlife preserves and to promulgate laws controlling the killing of wildlife, although it is interesting to note that the original steps taken in this direction where motivated by the desire to control the use of valuable, tradable commodities and not from a sense of the intrinsic or aesthetic value of nature. The removal of large areas of land containing rich natural resources by the creation of national parks and reserves sharpened resource shortages. The Masai pastoralists of East Africa, for example, had originally occupied some 80,000 square miles of land. Colonial authorities broke up this land and expropriated large areas for white settlement. It is not surprising, therefore, that the 500,000 strong Masai people would perceive a shortage of land and resources, and that the establishment of the Serengeti National Park, which excluded them from 5,000 square miles of land in the 1950s, would be interpreted very negatively. It actually did increase competition for land and grazing. Actions such as this combined with increasing human demands for resources, both as a result of increasing numbers and increasing requirements for resources to support more sophisticated lifestyles, resulted in a cycle of increasing conflict between rural people and wildlife and its supporters (Figure 1).

Figure 1: Community based approaches to wildlife conservation



Wildlife conservation as a discipline has increasingly rejected traditional protected area approaches (IIED, 1995; West and Brechin, 1991; Wells and Brandon, 1992). Drawing on lessons learned by rural development practitioners, wildlife conservationists gradually began to appreciate that excluding people from the benefits of nature conservation was not sustainable in the long term, and that protected areas would not survive without the active support of neighbouring communities (e.g. MacKinnon, et al, 1985; McNeely and Pitt, 1985; Western, et al, 1994). Furthermore, it is increasingly understood that depending exclusively on protected areas to safeguard the continent's biological diversity is inadequate. Much of Uganda' biological diversity, for example, only exists outside conservation areas, whilst in Kenya, as much as 70% of the country s large mammals lives outside protected areas. In many cases wildlife populations, especially large mammals, depended on access to natural resources outside of the specified and demarcated wildlife reserves at various times of the year. Prevention of migration of wildlife by incompatible land uses such as arable farming or by fencing can lead to dramatic losses of wildlife, and can result in the stabilisation of wildlife populations at a lower level.

Community based approaches to wildlife conservation concentrate on building economic and non-economic linkages between wildlife both inside and outside protected areas and local communities. A wide variety of tools have been examined and are being used to change the traditionally negative relations between protected area managers and the communities living around them. In Uganda, for example, there has been a long history of controlled access by local people to forest reserves for the collection of natural resources. This approach has been adopted by the Uganda National Parks, who are currently in the process of developing structures to permit consumptive use of resources within national parks, ranging from bamboo to medicinal plants, to fish and water. Changes in legislation to establish ownership or user-rights to wildlife have also been important, especially in Zimbabwe. The concept of sharing resources has been widened to the idea of sharing benefits. Both Kenyan and Ugandan wildlife authorities have established policies of sharing revenues earned by national parks through tourism with neighbouring communities. To avoid the problems that might be caused by the passive receipt of benefits by local communities, efforts are being made to involve communities actively in the management of national parks, through structures such as Uganda's Park Management Advisory Committees, which also play a critical role in conflict resolution. Environmental education programmes

are seen as increasingly important to build an awareness of the value of natural resources and to equip rural communities to develop sustainable means of using them.

Areas of conflict

Several significant areas of conflict exist between wildlife and agriculturalists. These will not be discussed here, however, and the paper will concentrate on the areas of conflict between producers of livestock and wildlife. Naturally, differing perspectives will lead to different interpretations of conflict. There is no intrinsic difference in a lion eating a cow than a lion eating a buffalo, except that the cow belongs to someone who endows it with a range of cultural and economic significance. To argue that the significance accorded to the cow results from its economic value over-simplifies the picture, because economic valuations exist within the context of culture. "Economic man always operates within a cultural framework that is logically prior to his existence as economic man; ...." (Cancian, 1972; quoted in Grandin, 1985). Man does not take decisions based on pure economics, as the use of high fuel consuming "prestige" cars rather than "modest" fuel efficient cars makes plain. To view livestock simply as a commodity convertible into cash is not the same as viewing it as potential bride price, even if the marriage contemplated may have wider economic significance.

In the same way that livestock may be viewed differently by the commercial rancher and the subsistence pastoralist, so too wildlife is perceived differently by different people. Rural communities living in wildlife areas, where they are daily confronted by the dangers of and damage caused by wildlife, have a radically different perspective to urban living people who are insulated from negative aspects of wildlife and are thus free to experience them in aesthetic or spiritual terms.

Disease transmission

Considerable research has been carried out on the transmission of several important diseases between livestock and wildlife and has been reviewed elsewhere (Karstad, 1985). A key issue has been to determine the direction of transmission. This is important to the development of control strategies, so that, for example, data indicating that foot and mouth passed from wildlife populations to cattle led to the construction of hundreds of miles of game fencing in Botswana. The concentration on this issue, however, seems to have been partly the desire of either livestock

owners or wildlife conservationists to "lay the blame" for the problem on the other party, and thus strengthens the argument in support of one sector or the other. This exemplifies the continuing conflict between livestock and wildlife interests and how it has influenced research. Examination of mixed livestock/wildlife production systems, and thus the adoption of an opportunities rather than a conflict perspective, would change the emphasis of disease transmission research undertaken.

Differences in resistance to diseases between livestock and wildlife is a critical issue. Trypanosomiasis, for example, affects livestock and indeed man, and is the most serious of the parasitic diseases of domestic animals in Africa (Grootenhuis, 1985). Several species of wildlife, however, are largely immune to its effects, carrying the parasite without showing the tell-tell symptom of anemia shown by domestic animals. Thus, wildlife species such as buffalo (Syncerus caffer), eland (Tragelaphus oryx) and bushbuck (Tragelaphus scriptus) act as reservoirs of the disease which is transmitted to livestock through a variety of insect vectors, most notably tsetse flies.

Not all domestic animals are equally prone to endemic diseases, and this may be important when examining opportunities for reducing conflict with wildlife. With respect to cattle, for example, it is well known that introduced exotic breeds are highly susceptible, and without intensive veterinary care show high levels of mortality. Cattle species which have existed for centuries under the challenge of endemic disease show levels of resistance. Some West Africa breeds, for example, show some resistance to trypanosomiasis, whilst the Long-horned Ankole cow is much less affected by East Coast Fever, a tick-borne disease that is invariably fatal to exotic breeds. Goats in general appear to be less susceptible than other domestic animals to trypanosomiasis, apparently because they are less subject to attack by tsetse fly (Siefert, pers comm).

Many other diseases are recorded in both livestock and wildlife and have a similarly negative effect on both. Both goats and impala (Aepyceros melampus), for example, are affected by the same species of lung worm. Rinderpest, which was probably introduced to Africa by livestock imported into Ethiopia during the Italian colonial period, causes devastating mortality rates in most species of wildlife and most types of domestic animal. The great epidemic of the late nineteenth century is thought to have caused mortality rates as high as 90% in both wildlife and cattle herds.

Predators

Rural people, especially pastoralists, generally put the fear of predators as their top concern when questioned about their attitudes towards wildlife (Aboud, 1985; Infield, 1986; Marquardt, et al, 1994). The high level of concern relating to attacks by predators on livestock and on humans is often far greater than the actual incidence of problems. However, lions (Panthera leo), leopards (Panthera pardus) and hyenas (Hyaena hyaena) all cause destruction of livestock, and are known to attack people on occasion, and this is enough to create a strong impression on rural people.

The conflict caused by attacks on livestock can be examined and dealt with in various ways. The economic effects of predators can be estimated, and various ways can be suggested for off-setting this. In Namibia, for example, high cheetah populations were tolerated on private farms despite the loss of livestock, because farmers were able to capture and sell cheetahs to off-set their losses and even turn a profit. This avenue was closed with the international ban on the sale of cheetahs and unverified reports indicate a reduction in cheetah numbers since that time. Leopards were tolerated by farmers in Kenya and were even encouraged by the colonial government since it was estimated that the value of damage caused to crops by bush pigs (Potamochoerus porcus) and baboons (Papio cynocephalus) was greater than the value of losses caused by leopards to livestock, and leopards helped to control the numbers of the bush pigs and baboons (Bonner, 1993).

Measures can be taken to improve the protection of livestock. Better watch of animals during the day, and more substantial housing for animals at night, will both reduce predation. Both measures of course have financial implications, but if farmers are required to tolerate predators on their land, investments to improve the protection of livestock are quite likely to bring financial returns as better housing and care will result in improved performance as well as reduced losses to predators.

Concerns over the danger posed to people by large carnivores cannot be dealt with using the same mechanisms. Aboud (1985), for example, found that Masai listed predation of humans as their second greatest concern about wildlife. The fact that fear of attack plays such a large role in people's attitudes, far in excess of actual cases of attack, indicates that only by dealing with people's perceptions can this source of conflict be reduced. People are unlikely to be convinced of the desirability of

living with dangerous carnivores by economic arguments, and other strategies need to be examined. In the final analysis, it may be necessary for wildlife conservationists to agree that in many cases, large carnivores and human habitation do not mix, and to be content to conserve representative populations of these species in exclusive wildlife reserves, or in areas where land-use planning specifies wildlife conservation and use as the primary land-use.

Damage to infrastructure

Livestock production requires investment in infrastructure and inputs. These include fencing, provision of water, provision of salt, and veterinary measures. It is well recorded that wildlife cause considerable damage to these. Elephants (Loxodonta africana), for example, can totally destroy water pumps and wells in their efforts to reach the water, and large mammals such as buffalo and zebra (Hippotigris quagga) cause great damage to fencing by simply walking through it. It is thus not surprising that farmers view the damage caused in negative terms and identify this as a source of conflict with wildlife. Mechanisms can be developed to reduce this conflict, but these in themselves are generally experienced as costs to the farmer.

Competition

Aboud (1985) found that Masai pastoralists put trampling and competition for forage as their greatest concern with regard to conflict with wildlife. From the wildlife conservationist's perspective, livestock populations displace certain species from grazing areas, and when their density reaches a high level, livestock seem to displace most large mammals and convert the habitat to a less productive and biologically diverse state.

A farmer attempting to maximise returns from livestock, either in terms of protein production or herd size, correctly perceives wildlife as competing for available fodder, thus limiting the sustainable stocking rate for livestock. This is certainly the case with respect to cattle farming and large wild grazing herbivores such as buffalo, zebra or hippopotamus. These animals compete directly with cattle for the same grazing resource. However, it has been frequently pointed out that there are a wide variety of wild herbivores in Africa, and their physiological and behavioural evolution has equipped them to exploit separate (though often

overlapping) ecological niches to reduce competition between themselves. Hopcraft (1985) pointed out that different species of wild ungulate tended to occupy different areas of his ranch. Even with such closely related animals as the cow and the buffalo, Harrington (1974) observed during grazing trials that the animals spent differing amounts of time grazing on different pasture species which were associated with slight variations in the aspect and drainage of the paddocks they were confined to. No single species can fully exploit rangeland resources and these adaptations and specialisations can thus be exploited by farmers to increase the level of efficiency with which they exploit their land.

Cultural aspects

Different people see wildlife and livestock differently and this underlies many of the conflicts between the two. The very high importance accorded to wildlife by some people, particularly urban dwellers, is not generally matched in people of rural communities. There are many reasons for this, not the least being the various real conflicts that exist between rural people and wildlife, which are not experienced by those living in towns and cities. Separation from the realities of living amongst large and potentially dangerous wild animals has enabled urban people to develop a romantic and idealised view of wildlife that people co-existing with wildlife cannot afford to adopt.

Farmers, and especially pastoralists, endow their livestock with high levels of significance. Traditionally, subsistence farmers preferred to eat meat from wild animals if they were able to, as domestic animals had several other important roles to play in their lives (Aerni, 1970). Domestic animals were needed for dowries, festivals, entertaining guests, celebrating important occasions, making gifts, sacrifices, demonstrating social status, and ensuring a measure of security in an uncertain world. Slaughtering a domestic animal simply to provide a meal was almost unthinkable, whilst wild animals had little other use except to provide meat. Today, this attitude has changed considerably. Many people are now unfamiliar with eating wild animals but are quite accustomed to purchasing and consuming meat from domestic animals.

Though many pastoralist communities are now well integrated into the cash society, and have material needs ranging from educating children, to buying acaricide, to buying batteries for torches and cassette players, livestock continues to play important symbolic and economic roles in

their cultures, and are generally sold only in response to a specific need for cash. The Long Horned Ankole cow played a central role in every aspect of life amongst the Bahima pastoralists of Uganda (Mackintosh, 1935), and despite the dramatic changes experienced in their conditions of existence over the past fifty years, continues to do so. It is difficult for a traditional pastoralist to decide to reduce his herd as this will have many social and economic ramifications and this will be the case whether the argument is based on the need to match herd size to available grazing, or to enable more wildlife to exist. Even the potential for establishing a higher total stocking rate and thus higher protein production, would not necessarily lead to a decision to reduce herd size, as wild animals would not replace the multiple social and economic roles of livestock. Lusigi (1985) suggests that including wildlife in the production system would actually increase overgrazing as pastoralists would be able to reduce their off-take of cattle by meeting their cash requirements from wildlife.

Ownership is an important cultural (rather than economic) aspect of the valuation of livestock compared to wildlife. The desire to possess things is a common phenomenon. Ownership of livestock is a central aspect of pastoralist culture, though ownership of land is not and livestock is generally grazed on common lands. The ownership of wildlife is problematic, as in most cases; the ownership of wildlife remains with the state. Even if changes in policy allowed landowners to own the wildlife on their land, or have user-rights which gave effective ownership, the behaviour of wildlife and its ecological requirements make ownership by individuals difficult. Except where land holdings are very large, it is difficult to retain wildlife populations exclusively on individual land holdings. The need for wildlife to migrate between parts of the range in response to seasonal changes in rainfall and grazing, and the very large range requirements of animals such as eland, mean that, in most cases, it would be necessary for neighbouring land owners to organise to join their lands together to manage wildlife. This would compromise the more generally accepted and simple idea of possession that most people hold.

INTEGRATING WILDLIFE INTO LIVESTOCK PRODUCTION SYSTEMS

The discussion of conflicts between wildlife and livestock presented above should not prevent an examination of the opportunities for improving livestock production systems presented by wildlife. A considerable body of data exists on production figures for wildlife,

including population dynamics, dressing-out rations, weight gains, etc. These have been ably summarised along with detailed analyses of various harvesting and cropping schemes by Eltringham (1984). However, for the potential of profiting from wildlife to be realised, policies must be put in place to allow farmers to exploit wildlife. In brief, it is necessary to allow farmers to directly benefit from wildlife so that the costs associated with it can be off-set. This is already the case in some southern countries such as Zimbabwe and South Africa, while at present, Eastern African countries are lagging behind in this respect.

Adaptations of wildlife to the environment

A body of knowledge exists showing that wildlife, through its adaptations to the natural environment, can exploit part of the natural production of rangeland more efficiently than livestock (Skinner, 1989). Thousands of years of evolution have enabled wildlife to exploit a wider range of rangeland browse and grazing than domestic animals, which have had a far shorter time to adapt to the conditions of the natural environment. Differences between the physiology of wildlife and livestock mean that wildlife cause less damage to vegetation as they move across rangeland, resulting in less formation of tracks, less damage to vegetation and less soil erosion.

Many wildlife species have a low requirement for water (Taylor, 1968). Some species adapted to arid lands do not need to drink water at all, gaining their needs directly from the vegetation they consume. Others require standing water only during the dry season, whilst others have a much lower water demand than cattle. Though some breeds can manage with being watered only once every two or three days, notably local breeds, most cattle generally require to drink water on a daily basis. Hopcraft (1985) indicated that cattle on his ranch required ten to fifteen gallons of water per day per animal. The need to provide permanent water throughout the year for cattle is one of the largest costs of ranching operations. Including wildlife within a ranching system can thus increase production with reduced costs. There is also less environmental damage caused by the often extensive tracking and erosion caused by livestock around watering points.

Mixed species production systems

As indicated earlier, the long history of coexistence of wildlife and livestock on the same rangeland has changed. Zoning of the rangeland

to areas of exclusive use by either wildlife or livestock has increasingly been the model as farmers attempt to maximise their returns from their land and wildlife conservationists attempt to create an illusion of pristine Africa. This process has been encouraged by government strategies that embodied the ownership of wildlife in the state, often preventing landowners from deriving any direct benefit from the wildlife on their land. In this situation it is hardly surprising that wildlife has been increasingly viewed in negative terms by landowners, who remained saddled with the negative economic impacts caused by direct competition with and damage caused by wildlife, but were unable to off-set these losses by any legal means of deriving economic benefits from them.

It has been shown, quite dramatically, that where laws and policies allow private landowners to use the wildlife on their land, wildlife has persisted and even increased. In some cases, farmers have even moved away entirely from the raising of livestock and converted their ranches entirely to raising wildlife. In these cases, however, it should be noted that the decision to do so was not based on the relatively simple economics of meat production, but on a more complex land use involving tourism and safari hunting as well. Examples from southern Africa, notably Zimbabwe and South Africa are well known. The contrary example of Kenya and Uganda may be given where long standing hunting bans have resulted in a general reduction in wildlife on most rangelands outside of protected areas, and increasingly negative perceptions of wildlife amongst landowners in rangeland areas.

Introduction of wildlife into livestock production systems could both spread risk and increase production through more efficient use of both natural and financial resources. Furthermore, the establishment of a multiple species mix which included animals capable of exploiting all parts of the rangeland, would allow a more precise and flexible management of the rangeland. As Heady (1985) has pointed out, "... browsing animals in combined herds will tend to keep the woody plants in check, while those that eat only grasses promote the woody species ...." As well as producing salable commodities, the animals themselves can be used to bring about desired changes to the rangeland, increasing future productivity at little cost. The role of animals in rangeland management, especially wildlife, is an area that needs greater research.

Considerable research has been carried out in Zimbabwe, Kenya and elsewhere to demonstrate the ecological and economic feasibility of

mixing wildlife with domestic animals. Collinson (1979) showed that both production and profitability were increased by introducing impala into cattle ranching in the mixed grass and woodland range of Natal in South Africa. His research showed that a mixture of cattle and impala was more profitable than raising either cattle or impala. Impala could not match the productivity of cattle when considered alone, even considering the savings that could be made in infrastructure development and veterinary costs. However, the investment required for cattle ranching could be off-set by exploiting impala that lived on the ranch and for which minimal additional investment was required. The cost of managing the impala had been largely covered already by the investments made for cattle production. Several other authors have documented the ecological and economic advantages of raising wildlife and livestock together (e.g. Dasmann and Mossman, 1960; Child, 1985; Hopcraft, 1985).

Traditional pastoralists in many parts of Africa have long known the advantages of raising mixed livestock herds. Various combinations of cattle, goats, sheep, donkeys and camels are known. Such mixed herds allow greater production from heterogeneous rangeland than single animal herds, and contribute to risk reduction strategies employed by pastoralists in areas of uncertain rainfall (Njoka, 1985). Introduction of wildlife into the production system could further increase productivity.

Carrying capacity

The concept of carrying capacity and its application in the management of African rangelands has undergone extensive revision in recent years. There remains no clear consensus on its definition or on how the concept can be used in determining appropriate management of rangelands. Heady (1985) defines it as "... that point where the population number stays steady and number of recruits declines to zero." This has been termed the ecological carrying capacity and has more relevance to wildlife conservation that aims to maintain large standing population in the interests of satisfying tourist expectations, and wishes to keep management intervention to a minimum.

The concept of ecological carrying capacity is not terribly useful to the landowner attempting to establish an appropriate stocking rate for his land. Most beef production farmers wish to maximise the recruitment rate of their herds, for these are the animals that are sold off to make

profits, and this would be the same for the commercial wildlife rancher. This carrying capacity, often referred to as the economic carrying capacity, requires herds to be kept well below the ecological carrying capacity as this encourages recruitment, and enables a maximum sustainable yield to be taken (Dasmann, 1964). Subsistence pastoralists also manage their herds to maximise outputs, but for historical and ecological reasons they are attempting to achieve this over both the short-term and the long-term as a means of risk avoidance. This is achieved by accumulating animals, and is combined with other risk avoidance strategies such as splitting herds, development of social networks of mutual obligation, and nomadism.

Carrying capacity, or the number of livestock unit equivalents, can be increased through management of the rangeland. For example, carrying capacity may be increased through pasture improvements (e.g. seeding with pasture legumes), through removal of woody vegetation, and through provision of water sources. It may also be increased by adopting a multispecies management strategy. As short-term production becomes the most pressing issue for farmers, farmers will look to ways of increasing carrying capacity. In Kenya, both Njoka (1985) and Grandin (1985) have shown that Masai, traditional pastoralists with a strong cultural attachment to cattle, increased their small stock holdings (goats and sheep) dramatically in response to the pressures of increasing human population on a decreasing land base. This is not to say that they decreased their cattle holdings, but that they introduced a new component to their production system which could exploit a natural resource not used by cattle.

As has already been discussed above, the adaptation of wildlife to avoid competition by exploiting different niches within the rangeland environment can be made use of by the farmer. In the same way that the Masai diversified their stock holdings to include goats and sheep, there is every reason to suggest that with appropriate government policies, adequate extension support, and marketing channels, both pastoralists and settled farmers would diversify their production systems to include wild herbivores.

Farming of wildlife

There has long been interest in the domestication and farming of wildlife species in Africa. Despite evidence that the ancient Egyptians

domesticated the oryx (Oryx gazella), little progress has been made in more recent times. In Europe, however, farming of red deer (Cervis elaphus) and fallow deer (Dama dama) has developed into a thriving industry (Fletcher, 1989), and bison (Bison bison) are now being farmed in North America (Hawley, 1989). Efforts to farm eland failed, apparently because of their very specific feeding requirements which could only be met by very extensive areas to range over. Speculation that small antelope and even warthog (Phacochoerus aethiopicus) could be domesticated have not been turned in to practice. Even the farming of medium sized mammals such as the cane rat (Thryonomys swinderianus), which provides meat which is highly favoured over much of West Africa and which has been studied extensively, or blue duiker (Cephalophus monticola), has not progressed. The domestication of warthogs might be particularly important as they show very favourable production figures in terms of growth and dressing percentages (Mason, 1982 quoted in Skinner, 1989), and, of great significance, are not affected by African Swine Fever, which is invariably fatal to domestic pigs. Furthermore, warthogs are known to feed on plants such as Sporobolus spp. not consumed by any domestic stock, including pigs (Siefert, pers comm.)

A word of caution should be noted concerning domestication. Much of the conservation value of incorporating wild animals into production systems lies in the retention of wildlife habitat under natural or semi-natural conditions. Successful domestication of wild animals might promote the spread of that species (albeit in an increasingly distinct form from its wild relatives) but would not contribute to the wider needs of biodiversity conservation.

The role of livestock development in wildlife conservation

It is unrealistic to expect the majority of farmers to convert from livestock to wildlife. Even in Zimbabwe, which was the location of some of the earliest research in wildlife ranching and which altered legislation to allow private ownership of wildlife in 1974, the area devoted to game ranching increased by only 62% in a decade (Skinner, 1989). The variety of constraints to this, both cultural and economic, have been discussed above. There is, however, a sufficient body of knowledge and experience both within Africa and elsewhere to indicate that incorporation of wildlife into farming systems is viable. In the short-term, however, development of livestock can be pursued in such a way as to promote the interests of wildlife conservation. The research that is needed is not to

determine whether livestock and wildlife are compatible or not, but rather to develop management strategies that support both and provide resources for the increasing human population. Conservation of wildlife requires that provision of food for human consumption be given the highest priority (Mwangi and Zulberti, 1985).

Land use around protected areas

Discussions of land use depend largely on economic factors, though these are often or even generally compounded by cultural factors. As human populations increase and their expectations are more and more founded on a western model of consumerism, there is an increasing tendency to maximise production from the available land. Where rainfall permits, this is demonstrated by the steady conversion of rangeland to arable land. Former population movements from rural to urban environments are now being replaced by migrations from rural arable areas to rural rangeland areas. Conversion of rangeland (and forests) to farmland is the worst scenario for the conservation of wildlife, especially of large mammals, but also of biodiversity in general. Development of more productive and profitable livestock systems will encourage the retention of rangeland with positive implications for wildlife conservation.

The creation of exclusive wildlife areas in the form of national parks and wildlife reserves has created a problem of conflict between wildlife and the communities living on their periphery. These conflicts are intensified where the land use on the periphery is arable farming, as cultivators tend to have a low tolerance of wildlife that causes damage to their crops. Other than fencing, which is expensive and not always effective, there is little that can be done to reduce this conflict.

As a general rule, there is a lesser requirement to modify the habitat to raise livestock, whereas crop production requires an almost total modification of the habitat, generally excluding most forms of wildlife almost entirely. Land under livestock production can still provide a habitat for a wide range of wildlife such as birds, both large and small mammals, reptiles, and a wide range of plants and their associated invertebrate fauna. By promoting and encouraging livestock production, we are also supporting the retention of wildlife and wildlife habitats outside of conservation areas, and, by association, may well have a positive impact on wildlife inside conservation areas as well.

Livestock production is thus, in general, a more compatible use of land around wildlife reserves, and the development of livestock industries in these areas as a form of buffer zone can be important in promoting the conservation of wildlife.

Livestock health campaigns

Programmes to improve the health of domestic animals by protecting them against specific endemic diseases have a direct impact on the well-being of rural communities. By targeting such programmes in areas around wildlife reserves, or in areas where there is a high level of contact between domestic animals and wild animals, benefits to wildlife conservation may be predicted.

In the first instance, the improved health of livestock and reduced incidence of transmissible diseases should also improve the health of the wildlife. As discussed above, many diseases are transmitted from domestic stock to wildlife as well as in the other, more commonly discussed, direction. Strategies could be adopted to provide disease free cordons around wildlife areas, thus isolating vulnerable wildlife populations from potentially damaging diseases such as rinderpest or brucellosis. Attempts to inoculate the wildlife itself would also be positive from both the wildlife and the livestock production perspective.

At the same time, such programmes would support the conservation status of wildlife by altering typically negative attitudes towards wildlife amongst farmers. If they were introduced to clients with an explanation that part of the intention was to promote the conservation of wildlife, and that areas surrounding wildlife reserves were being targeted specifically, it might be expected that this would alter perceptions of wildlife to some extent. Furthermore, as the health of their domestic animals improved, and farmers could see the effectiveness of the programmes, their perceptions of conflict with wildlife should be influenced, leading to a greater tolerance of wildlife. Educational and awareness activities could also be carried out providing farmers with a more factual understanding of the relationship between wildlife and disease transmission, to "...lay to rest conflicts that are imagined and deal only with those that are real" (Teer, 1985).

Protected areas themselves have an important role in the study of endemic diseases. Only in protected areas, where disease control

measures do not take place, can disease life cycles and transmission patterns be studied in a natural state.

Livestock development which concentrated on the use of domestic animals which are less affected by endemic diseases would also enhance wildlife conservation, as perceived and real conflicts of disease transmission would be reduced.

NEW STRATEGIES FOR IMPROVED RANGELAND MANAGEMENT AND ANIMAL NUTRITION

Though one must view with caution the commonly held views on traditional pastoralist management systems and their presumed role in environmental damage, generally based on analyses using western models of carrying capacity and production economics and misinterpreting both the ecological data and the production goals of the pastoralists, it is clear that in many parts of Africa, poor rangeland management has led to both a decline in animal nutrition and an increase in environmental degradation. Investment in programmes to improve animal nutrition, through the development of new management strategies based on local circumstances and the needs of local farmers, could have a positive impact on wildlife conservation.

To give an example, it is believed that rangeland in Nyabushozi in southwestern Uganda has been severely degraded in recent decades through a combination of over-grazing and excessive burning. Invasion of grasslands by Acacia hockii and the unpalatable Cymbopogon nardus over large areas have considerably reduced the production of the rangeland for cattle, which are the traditionally raised stock animal of the Bahima people. Currently, attempts are being made to improve production by means of physical removal of these weed species. The investment costs of clearing the rangeland are high, and there is an inevitable negative effect on biological diversity in the area. Furthermore, the low productivity of the rangeland has sharpened perceptions of the competition between cattle and wildlife which disperses out of the nearby Lake Mburo National Park and has created highly negative attitudes towards wildlife amongst the Bahima pastoralists (Marquardt, et al. 1995).

A rangeland production system based on a cattle/goat/wild browser mix would probably be the most productive land use for the area. Adoption of such a regime would enable increased production with little

additional investment costs being required. As experience grew in the management of this mixed species system, selection of different stocking rates for the different species could be employed to alter the rangeland configuration itself (Teer, 1985; Heady, 1985). If, for example, there was a desire to increase cattle numbers, this could be achieved over time at little cost by reducing the woody plant cover by heavy browsing by goats and impala. There is the need for considerably more research into these dynamics. The traditional disdain towards small stock would have to be broken down but the rapid changes in lifestyle currently being undertaken by the Bahima people suggests that this could be achieved (Marquardt et al, 1995).

The role of domestic stock in conservation area management

The use of human activities, including grazing of domestic stock, as a management tool in protected areas is widely known in Europe but largely rejected in Africa. This is probably to some extent the recognition in Europe that the majority of conservation areas there are largely man-made or man-influenced landscapes which support valuable biological diversity (and cultural values). In Africa, however, conservation areas tend to be viewed as relics of pristine nature, untouched by man, and therefore best conserved without the presence of man and his livestock. That this perception is almost entirely false (Teer, 1985) has not changed the strong protectionist philosophy behind the management of most of Africa's protected areas. This is the case even when historical records show human use and settlement going back hundreds of years, such as in the Simen Mountains National Park in Ethiopia. In some cases, however, it has been recognised that human interventions are necessary for the retention of biodiversity within protected areas. In the Central Complex Reserve in South Africa, for example, physical removal of woody vegetation has been used as a management strategy to replicate the traditional practices of the local people. In historical times cutting bush for construction of houses and cattle bomas, and for fuelwood, resulted in the diverse habitat mosaic which was the reason for the declaration of the reserve but which was steadily being lost by bush encroachment.

The role of livestock in the management of protected areas needs considerable research. Clearly, the impact of livestock on the habitat and thus the biological diversity is critical. The highland pastures in the Simen Mountains National Park are the product of hundreds of years of

grazing by cattle and horses. Their removal would certainly result in changes in the composition of pasture species. There are also, however, a range of other issues to be examined including the impact of domestic animals on tourism in protected areas, disease transmission implications, and cultural questions.

GENERAL AREAS FOR RESEARCH

The discussions presented above have highlighted several areas where integration of wildlife and livestock could have positive impacts on both production and on biodiversity conservation. Considerable research in several fields will be necessary to provide the information necessary to convince governments of the need for policy changes, to convince farmers of the advantages of including wildlife in their production systems, and to provide practical guidance on the management of mixed species production systems.

The following list identifies specific research topics which have been indicated above as being necessary:

- Disease transmission between wildlife and domestic stock; the role of cordons around wildlife areas and the role of protected areas for the study of endemic diseases.

- The viability of inoculation of wildlife, both as a conservation measure and as a component of commercial management of wildlife.

- The economics of mixed species production systems in East Africa.

- The advantages of endemic breeds of livestock in mixed wildlife/ livestock production systems.

- The role of mixed species production systems as a "buffer zone" land use around protected areas.

- The use of livestock as a habitat management tool, both in protect areas and on commercial ranches or common rangeland.

- Policy, institutional, and commercial requirements for integration of wildlife into livestock production systems in East Africa.

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Livestock and Wildlife Interaction: Competition for Natural Resources

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ABSTRACT

In this age of very high environmental awareness, the issue of the interaction between the domestic and sylvatic ecosystems has become one of the foremost preoccupations of ecologists and environmentalists. The subject of interacting wildlife and livestock populations is however complex and could be approached from many different aspects. This paper is a review of some of the work done on this subject and it is in no way exhaustive. A general overview of the subject is given and a few specific areas of competition between wildlife and livestock are discussed.

The conflict between conservation and human population growth is also broached. The current policy and management strategy in dealing with human-wildlife conflicts in Kenya is discussed and some recommendations for further research are outlined.

COMPETITION BETWEEN WILDLIFE AND LIVESTOCK FOR RESOURCES AT THE PRIMARY TROPHIC LEVEL

General aspects

The free roaming wild animals of the African continent are an important natural resource. Rapid population growth and underdevelopment in rural areas of Africa have a highly destructive impact on this natural resource base. This is especially noticeable in marginal areas. It is in these marginal lands that wild animals seek shelter (Richter, 1990). With few exceptions, the potential for developing sustainable management strategies for wild animals has yet to be explored. The development of wild animal management systems offers an opportunity to sustain marginal areas in an optimum manner without negative effect on productivity. Presently and in the past, the conservation of wild animals has been jeopardized by the expanding human population and competition for available resources has become severe. The question that needs to be answered is whether it is possible for a wild animal management system to co-exist with domestic animal production systems.

Apart from commercial ranches, the livestock production system most in competition with wildlife in marginal areas is the pastoral system. This is true in most parts of the East African region. The development of protected areas for wildlife has reduced the interaction between wildlife and livestock to some extent but the increase in human population pressure in areas bordering game parks has led to increased conflict between man and wildlife. The conflict is highest in parks that border on or are in areas of arable land. In the past, there was less conflict between pastoralists and wildlife but this has changed as human population increases and more people settle in what was formerly exclusively wildlife areas. In some areas like the Amboseli ecosystem, pastoralism and wildlife have probably co-existed for a millennia (A.L.Jacobs, 1972).

This paper reviews some of the work done to assess the interaction between wildlife and livestock in pastoralist systems in terms of

- water
- pasture
- land occupancy
- allocation of resources.

Competition for each of these resources is not distinct and independent but interrelated. For instance, in some ecosystems where water is scarce, it becomes the most important determinant of biomass distribution as well as seasonal movements and extent of grazing range (Western, 1973). This in turn affects the pasture consumed and consequently the amount of environmental degradation, where animal biomass exceeds the carrying capacity of the land.

Animal activity patterns

In order to study competition between different wildlife and domestic species, it is important to understand the activity patterns of these animals in the rangelands. Competition is most noticeable during the seasons of scarcity. The availability of water during the wet season allows both the wild herbivores and domestic stock to forage larger areas and competition between the two is less obvious.

Localized availability of water during the dry season results in a concentration of water dependent species in and around areas of permanent water. Western (1973) found that some species of wildlife in the Amboseli area in Kenya appear to go without free water and that the

Table 1: Distribution of species in relation to water during the dry season. Data summed for the months of February, August, September and October, 1968, and June and August, 1969 (Density/Km²)
Distance from Water (Km)

SPECIES	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16
ZEBRA	10.6	7.1	2.9	5.9	3.9	0.5	0.6	1.1
W/BEEST	13.9	23.2	5.4	3.4	1.6	0.1	0	0
KONGONI	0.5	0	0.4	0	0.1	0	0	0
T.GAZELLE	2.6	1.8	0.2	0	0	0	0	0
G.GAZELLE	1.8	1.5	1.2	1.2	2.4	1.5	0	0.6
IMPALA	1.9	0.2	0	1.0	0	0	0	0
ORYX	0	0	1.7	0.2	0.9	0	0.8	0
LAND	0	0	0	0	0	0	0	0
BUFFALO	0.7	0	0	0	0	0	0	0
ELEPHANT	0.5	0	0	0.3	0	0	0	0
GIRAFFE	0.4	0.3	0.1	0.1	0.1	0	0	0
CATTLE	40	18.4	6.4	7.0	1.0	29.3	0	0
SHOAT	5.2	2.2	17.0	0	22.4	0	1.6	0
OSTRICH	0.1	0.8	0.2	0.1	0	0	0.1	0
DONKEY	1.6	0	0	0.2	0.2	1.9	0	0

(ADAPTED FROM WESTERN, D. 1973, Ph.D. THESIS, UoN)

availability of standing water is not a determinant of their movements. Species that seemed less water dependent were the giraffe, gerenuk, oryx, eland and lesser kudu, found throughout the Ilkisongo area during the dry season.

The area of concentration for each species varies as a function of its water requirements and in relation to the distribution of food resources within the range. (See Table 1 on the density distribution of each species in relation to water during the dry season).

Most species show a progressive fall in density with increasing distance from water. The distribution is significantly different from that expected if a random distribution is assumed. In all species, except oryx, the observed distribution is closer to water than expected. Western (1973), found a linear decline of water dependent biomass to approximately 12 km from water. Beyond 18 km, only the species appreciably independent of water were found. Distribution of large mammals in relation to water shows a separation between water dependent and water independent species. Grazers were found to be generally more water dependent than browsers. Beyond the range of water dependent species, grasslands were found to be less heavily utilized.

In comparison, livestock were found to be water dependent but the correlation of livestock biomass with climatic parameters was found to

be weaker than that of other water dependent species of wildlife (P/ET best correlated at 50 days ($r = -0.437$, d.f = 10 $p > 0.1$) for livestock but 40 days ($r = -0.691$, d.f = 10 $p > 0.02$) for wildlife). This finding was probably due to the fact that livestock remain in wet season grazing areas for a longer period than wildlife due to availability of boreholes, a source of water unavailable to wildlife. It can be seen from this that where borehole water was available to livestock but not wildlife, the former had an edge over plains game in that they were able to remain in wet season grazing areas for a longer period and therefore could utilize available pastures more effectively.

The corollary to this is that in the absence of borehole water, more standing forage would be left as both the domestic and wild animals moved to areas near water during the dry season. Forage plants would then have more time for regeneration before animal returns to these areas at the end of the dry season. This keeps a balance in the ecosystem and reduces the rate of ecosystem degeneration. Poorly conceived water development programmes can have a disastrous impact on vegetation, as evidenced in various borehole developments in the Amboseli and other rangelands of Kenya.

SPECIES SEPARATION

Western (1973) showed that, for each species examined, there was a significant difference from other species in respect to their distribution relative to distance from water, habitat, grass height, growth stage and extent of grazing.

Animal distribution in relation to habitat

All animal species showed a percentage distribution in relation to habitat that was significantly different from that which would be expected if the distribution was assumed to be random. The giraffe, buffalo, elephant and rhino were found to have a similar dry season distribution. The giraffe was found to feed on young *Acacia xanthophloea* and mature trees, as well as on *Sasbania goetzei* to some extent. It therefore competes little with the buffalo, which is a grazer. The black rhino has been found to be a browser but at a substantially lower level than the giraffe. Only the elephant seems to compete with the giraffe, rhino, and buffalo; however, elephants were not found to concentrate much on the herb layer. Although feeding at the same vertical strata as the giraffe, they seem to

Table 2: Distribution of animal species in the amboseli ecosystem during the dry season

SPECIES	RELATIVE HABITAT SPECIFICITY*	PREFFERED HABITAT	DENSITY	MOST USED HABITAT	% OF OBSERVATIONS
ELAND	240	5	0.33	5	81
ELEPHANT	206	4	1.87	4	82
IMPALA	201	7	3.98	7	69
BUFFALO	157	4	2.09	4	55
RHINO	150	4	0.10	4	55
KONGONI	133	2	0.83	2	52
ORYX	118	5	1.27	5	47
GIRAFFE	106	4	0.53	7	36
WILDBEEST	87	6	11.64	6	28
DONKEY	77	4	1.50	4	31
T.GAZELLE	69	2	2.59	2	33
ZEBRA	68	2	9.39	2	33
SHOAT	66	5	6.02	3	25
G.GAZELLE	65	5	3.39	5	32
OSTRICH	42	3	0.29	3	26
CATTLE	38	4	25.01	5	20

2 = GRASSLAND 3 = BUSHLAND 4 = SWAMPS 5 = OPEN BUSHLAND 6 = OPEN WOODLANDS
7 = DENSER WOODLANDS

(* Specificity given as coefficient of variation of mean density (%)) (Adapted from Western, D. Ph.D. Thesis, 1973, UoN)

feed more on twigs and bark than giraffes. The giraffe feeds more on young shoots and leaves.

Grazers show similar differences in habitat preference. For domestic livestock, cattle were found to be the least habitat selective. Sheep and goats are more habitat specific and donkeys are the most selective of all domestic species. (In Table 2 above, species of animals found in the Amboseli ecosystem are shown ranked in order of habitat specificity.) In comparison, of all wildlife species, the zebra and the Grant's gazelle were found to be least selective. Indeed the zebra, wildebeest and Grant's gazelle seem to use all habitats. These are species of wildlife in direct competition with domestic stock. Western (1973) found clear differences in species distribution on a spatial basis even within a habitat such as the plains.

Grazing succession

Western (1973) showed a succession of grazing for the different species of animals according to grass type and height. In general, the larger herbivores move into an area earlier than the smaller herbivores provided

that the grass is of sufficient height. The standing crop is not the only determinant. There are large variations in protein intake between different species of animals and once the protein availability in a grassland falls below a given level, a species is induced to search for new pastures with higher protein availability.

The need to maintain both the energy balance and protein level means that both the standing crop and the protein content of grasslands are critical to grazing by a given species. This pattern determines grazing cycles where the larger herbivores with higher energy requirements and less selectivity move into the taller grass first. Species like the zebra and other herbivores overlap areas already grazed by the elephant and buffalo. Among smaller herbivores, zebras are seen to move into ungrazed pasture first followed by the wildebeest and Thomson's gazelle. The Grant's gazelle follows closely after the zebra.

In the Amboseli ecosystem with swamp areas which animals move into during the dry season, the movement of the elephant and the buffalo into swamp areas relatively early is said to be due to the falling standing crop/protein factor. This trend is probably accelerated by the ingress of livestock.

PASTORALIST ACTIVITY PATTERNS THAT ALLOW EFFECTIVE COMPETITION BETWEEN LIVESTOCK AND WILDLIFE

Domestic livestock are not free ranging but return to settlement at night. This factor affects the distance and route taken to resources and the time taken to consume them. However, pastoralists have adapted activity patterns to enable domestic stock to compete successfully with indigenous fauna. Factors contributing to the efficacy of livestock in these areas are mobility, grazing succession, diversity and selectivity and competitive displacement.

Mobility

One of the most efficient features of pastoralist ecology is their high degree of mobility; however, the domestic stock have a similar pattern of seasonal movement to that of wildlife. Western (1973) estimated that had the stock in the Amboseli ecosystem been static with no seasonal movement, the overall biomass supported by the ecosystem would have been reduced appreciably probably by up to 50%.

In most rangelands occupied by wildlife and livestock, low rainfall and high variability in distribution results in localized areas of high grass abundance and quality. Wildlife have a high degree of mobility and quickly take advantage of the flushes. The pastoralists' mobility helps them compete effectively with wildlife. The pastoralists are light travellers, using donkeys as transport, and have a high rate of transmission of acquired information all working to make them very competitive with wildlife.

Grazing succession

Domestic livestock show a sequential utilization of vegetation zones corresponding generally to that characterizing wildlife. For instance, the Maasai practice a form of successive occupance. Any deviation from this kind of pattern would lead to a sub-optimal intake of pasture.

Grazing range

In order to maximize the distance their animals have to travel before returning to water the Maasai pastoralists leave juveniles behind. This is because females in calf usually reduce the distance a herd can travel to and from pasture and water. By making their settlements a few hours journey from water rather than very near water, the pastoralists increase the grazing range for their livestock.

Diversity and selectivity

High species diversity in a community reflects a high level of specialization and results in higher food chain efficiency and stability than low diversity communities (Western, 1973). Compared to commercial ranches that often have a predominance of cattle, the pastoralist system usually has at least four species of herbivores: the donkey, which in terms of protein selectivity corresponds to the zebra; cattle, which correspond to the wildebeest in being moderately selective of less coarse and shorter grass than the donkey; sheep, which are highly selective of protein and correspond to the Thomson's gazelle; and goats, which are less selective than sheep. This mix provides a fairly broad spectrum of competition between domestic stock and wildlife.

Competitive displacement

In wild herbivores, spatial tolerance occurs between feeding animals of different species. The grazing of most other species is tolerated at a

distance of a few feet. Domestic animals, however, displace other herbivores in close proximity. In areas of uniform food availability this proximity confers no special advantage on domestic stock, but in cases of limited good pasture, competitive displacement offers considerable advantage. This advantage probably occurs due to the presence of herders. One would expect this advantage to be reversed during darkness due to the domestic stock's restriction to daytime grazing, but in many areas the predation risk forces wild herbivores to remain in more open grounds at night and prevents them from taking advantage of certain areas of good pasture. The presence of herders also decreases the predation risk, which allows domestic stock to forage larger areas than their wild counterparts.

FACTORS IN FAVOUR OF WILDLIFE

The above factors, however, do not give domestic stock an overall advantage over wildlife at the primary trophic level. There are several factors that are in favour of wildlife. These are diversity and food competition, activity patterns, settlement limitations and human constraints.

Diversity and food competition

Though the pastoralist system shows a higher degree of diversity than say other commercial enterprises found in the African savannah, neither the diversity nor specialization of the domestic livestock are adequate to present a fully overlapping competition with indigenous fauna. There is an area of non-overlap which limits the complete substitution of wild herbivores with livestock. Anatomically and physiologically the domestic stock are not equipped to tackle extremely coarse material like that consumed by the rhino or elephant. Even where there is an overlap, the higher degree of specialization confers on wildlife species an edge in competition for sparse resources; e.g., the Thomson's gazelle will kick up and eat grass roots during times of pasture scarcity unlike domestic stock or the Grant's gazelle, which will browse on plants past over by domestic livestock like the *Trianthema tetracantha*.

Activity patterns

Daily activity patterns have an important bearing on food and water intake, energy expenditure of locomotion and physiological stress.

Enclosure of livestock at night is a major difference between livestock and wildlife species and confers upon livestock the following limitations:

- Feeding and watering are restricted to daylight hours.
- Distance walked between grazing grounds and settlement each day decreases the potential grazing period.
- The restricted grazing regime necessitates grazing during periods of highest solar radiation and lowest plant water, which imposes additional physiological stress and increases water dependence. This compares unfavourably with wildlife, which use less energy for locomotion and regulate grazing duration and timing to optimize intake and minimize physiological stress.

Settlement limitation

Though settlement offers nightly protection from predation, the high density of stock corralled in a small enclosure provides disease transmission opportunities and favours the spread of disease. Additional human settlement requirements result in sub-optimal location for livestock in terms of canopy cover, grass production, gradient and soil texture.

Human constraints

The maintenance of large herd sizes reduces the area an individual animal can forage. This factor is especially important during drought, when the palatable forage is already heavily grazed and individual animals need to be more selective and forage over a larger area. The herder has to limit the area of individual dispersion to keep protection effective.

Though pastoralists usually increase the number of herders per herd and reduce herd sizes during drought, minimum herd sizes are still far larger than those of wildlife. The larger herd size imposes a severe limitation on livestock grazing efficiency during drought. Indeed a differential mortality during drought between livestock and wild herbivores was observed in the Amboseli ecosystem with the highest and the earliest mortalities occurring in livestock. Food limitations are more apparent in livestock than in wildlife.

DISCUSSION

One of the most interesting questions on the subject of intermixing wildlife and livestock populations is whether such mixtures increase or decrease ecological efficiency. The answer is not general for all areas. In some circumstances, ecological efficiency seems to increase while in other circumstances the reverse appears to be true. For instance, in the Amboseli in the early seventies, where heavy grazing pressure induced a more palatable spectrum of grasses (Bell, 1971), mixtures seemed to increase ecological efficiency. However, the same may not be true for other areas or even the same area at a different time, as the ecological characteristics of an area change over time. The issue of competition between wildlife and livestock must be assessed in terms of specific areas in relation to local ecological conditions, and should not be generalized for all areas.

LAND OCCUPANCY, RESOURCE ALLOCATION AND HUMAN CONFLICTS

In Kenya, wildlife conservation is administered through a system of twenty-six national parks and thirty national reserves. Although the system of conservation would appear adequate for the protection of wildlife, the growing competition with other forms of land use is a key problem for conservation in Kenya. It is estimated that 70% of Kenya's wildlife moves freely outside protected areas. This trend has led to acute conflict between wildlife and other forms of land use, especially the pastoralist livestock production system.

The creation of protected areas for wildlife, where livestock are prohibited from grazing, combined with the free movement of wildlife outside protected areas has given wildlife species an unfair edge in competition for resources in these areas.

In the Amboseli and Tsavo ecosystems, wild animals tend to move out of protected areas during rainy seasons and compete with livestock in pastoral grazing areas, especially group ranches. During the dry season, they return to protected areas where pastures are in plenty (KWS reports). Livestock have been restricted from these areas by an Act of Parliament (the Conservation and Management (Amendment) Act of 1989). This has led to controversies with political overtones. Almost all protected areas have similar problems. One of the most contentious issues is the destruction of food crops by wild animals, especially the elephant. In

areas like the Taita hills which border the Tsavo national park, small scale farmers have been known to lose entire maize crops to marauding elephants and other wildlife herds.

The tremendous increase in human population, along with the increase in wildlife populations in some areas, since the hunting ban of 1977 and the control of poaching in the 1989-1990 period, has led to an escalation of the human-wildlife conflict. The issue of land has always been politically explosive and this is perhaps the biggest threat to wildlife conservation in Kenya.

Opinions differ as to whether there can be a sustainable and harmonious co-existence between wildlife and livestock. Some have suggested that if indigenous populations managed wildlife in their habitats in the past, they could once again. They argue that protected areas could be opened up without detriment to wildlife. Others, however, like Prins (1992) have found that livestock in fact out-compete wildlife. He maintains that the high rate of human population growth is at the root of the call for more land and that "even if, for instance, the whole of Serengeti were to be handed over to the local Maasai population, it would only sustain the growth of Maasai population for some forty years" (Prins, 1992).

Attention to biodiversity has been growing nationally as well as globally, but its value is limited within the context of diminishing land resources. There is a sharp divergence of opinion between those who are for and against wildlife conservation. Surveys conducted by the Department of Remote Sensing and other resource surveys have shown that wildlife populations declined by a third to one-half between 1977, when the hunting ban, was enacted and 1993. This would seem to indicate that the protectionist policy ushered in by the hunting and trophy ban has failed to alleviate the threat to wildlife.

CURRENT POLICY AND MANAGEMENT STRATEGY IN DEALING WITH WILDLIFE-HUMAN CONFLICTS IN KENYA

From the point of view of biodiversity and conservation, the significance of human activity within an ecosystem has come to be seen differently. Formerly, human activity was viewed solely in negative terms and early conservation policies were geared towards the separation of wildlife from other human activities like pastoralism. More recent

research shows that human impact can be a positive as well as a negative force ecologically, depending on the type and level of exploitation. The removal of certain human activities like burning, pastoralism and shifting cultivation can be as prejudicial to biodiversity as overuse, particularly in ecosystems where human activity has played a large role in shaping the ecology for a millennia.

The Kenya Wildlife Service (KWS) is a state corporation which has been mandated to conserve and manage the wildlife resources in Kenya as spelt out by the Wildlife Act of 1989. The corporation is in a unique position to deal with wildlife-livestock (human) conflicts. In the past, KWS and its predecessors have addressed conflict by maintaining expensive control operations so as to eliminate problem animals as the need arises. KWS now prefers a strategy that encourages integration of wildlife management objectives with those of land owners. It aims to establish sustainable wildlife utilization as a viable land use option in areas outside national parks and reserves. KWS believes that conservation of wildlife outside protected areas cannot be achieved by protecting animals and ignoring issues of human need and human rights.

The Community Wildlife Service within the KWS is a pilot extension service which has been set up to encourage and train landowners within certain districts to cultivate wildlife on their land. These landowners are delegated certain responsibilities by KWS. In return, participants in the programme receive certain wildlife related benefits including revenue sharing rights, rights to consumptive utilization of wildlife and assistance with non-consumptive enterprises such as tourism. In other areas, KWS encourages conservation by assisting land owners and local people living near parks in obtaining various tangible benefits from their tolerance of wildlife, including sharing of park revenue, promotion of wildlife based economic activities, principally tourism, and certain forms of wildlife utilization. KWS in addition seeks to minimize conflict through land use planning and by constructing animal barriers such as fences.

Within the Community Wildlife Pilot Project, a new unit known as the Problem Animal Management Unit (PAMU) has been set up, bringing the activities of "fencing" and "problem animal control" under one umbrella. Problem animals are those animals that cause human injury and the destruction of crops or other livestock. The policy of this new unit is still in its draft form. It has also been recognized that management strategies for livestock (human)/wildlife conflicts must be based on

environmental impact assessments done prior to the implementation of any remedial measures.

Research findings should anticipate potential conflicts and provide data to be used as a basis for future planning and projections of problem animal management. PAMU is set up to encourage participatory research involving the local communities who co-exist with problem animals. Collaboration with other organisations will be promoted. It is envisaged that this type of research will develop methodologies and techniques to facilitate the monitoring of problem animals and their movements before and after raids on crops, property and/or injury or death to human beings.

Research should also explore barrier maintenance issues and assess the effectiveness of various measures adopted to resolve conflicts. Research in the use of locally available technologies and materials will be encouraged to enhance indigenous knowledge and expertise which will reduce dependency on imported technologies and materials currently in use.

OTHER RESEARCH AREAS

The current wildlife policy paper, still in its draft form, calls for detailed national inventories of species and habitats and their vulnerability, in order to define biodiversity priorities in terms of society's needs. These inventories will be done through an inter-agency national biodiversity survey. The matter is urgent and is seen as the highest priority for future planning. The need for research to help in formulating future management strategies is enormous. Currently only six of the fifty conservation areas managed by KWS are revenue generating, which often leads to financial constraints in running the organisation. Donor funding is going to continue to be necessary for effective research to continue.

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Tsetse and Trypanosomiasis and Wildlife/Livestock Interactions

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ABSTRACT

An overview is given of the changing role of the tsetse fly in the conservation of wildlife and wild ecosystems in East Africa in light of future projections of human population growth and increasing levels of conflict between wildlife and livestock. Conventional wisdom that the tsetse fly is "Africa's best conservationist" is challenged as a result of the recent massive invasion of Akagera Park by livestock. An argument is also made for the inevitable conflict between conservation and utilisation of unprotected wildlife habitats related to technical advances in effective tsetse control. These ongoing changes in the landscape ecology of East Africa suggest that livestock development may no longer be accepted as an end unto itself without critical assessment of other alternatives for African rural development.

INTRODUCTION

In Africa, about one third of the continent, or 10 million km^2, is infested with the tsetse fly (genus Glossina, consisting of 23 species). Tsetse flies feed exclusively on vertebrate blood and are responsible for transmission to livestock of a number of species of protozoan parasites of the genus Trypanosoma. The disease caused by these parasites, trypanosomiasis, is often fatal, especially in cattle, but normally has only minimal effects on natural wildlife hosts. Direct losses in animal production have been estimated at between US$ 0.6 and 1.2 billion each year; indirect effects are difficult to estimate, but probably run into the billions of dollars. From 60 to 90 million cattle are at risk, as well as tens of millions of goats, sheep, camels, etc. Hence, trypanosomiasis is considered by the Food and Agriculture Organisation of the United Nations to be the most important livestock disease in sub-Saharan Africa. About US$ 200 million is spent per annum by various governments and international organisations on trypanosomiasis research and control.

By the year 2025, Africa will need to feed 800 million additional people as a result of continuing unabated human population growth. Just

to maintain current nutritional standards (which are by no means acceptable), overall food production in Africa will have to increase at a rate of 2.75% per annum. To improve the quality of life, a growth rate of about 4% is required. If the livestock sector is to contribute to food security, production will have to be improved dramatically. Projected needs for growth are in stark contrast to the 1.7% growth rate per annum achieved in the livestock sector from 1961 to 1988 (WIIAD, 1992). Growth in the livestock sector is already constrained in a multitude of ways. In particular, stocking rates in suitable agricultural zones are approaching the theoretical maximum carrying capacity of the environment. Hence, increased production will have to take place in many formerly unsuitable areas (occupied by tsetse), particularly in the humid and subhumid parts of the continent. How this will be achieved is the subject of considerable debate, as well as the formulation of a new coordinated global programme to tackle the problem (FAO, 1994).

WILDLIFE/LIVESTOCK CONFLICT

For those interested in boosting livestock numbers and productivity, the tsetse fly has been labeled "Africa's bane", the one pest largely preventing full utilisation of the best grazing lands on the continent. In contrast, for those interested in conservation, the tsetse fly has been considered as Africa's best conservationist. These conflicting views are most evident in East Africa, where areas encompassing large ecosystems (e.g., Serengeti-Mara, Selous, Tsav) have been set aside as parks or reserves. Today, these areas remain as havens for tsetse and wildlife, and are often viewed with disdain by livestock owners as "wasted land" and as a reservoir of disease. To site just one of many examples of this type of conflict, consider Ruma National Park in the Lambwe Valley in western Kenya. This small park is now completely encircled by settlement; forty years ago it was a small part of the larger Mara-Serengeti ecosystem. Farmers view the park with disdain for three reasons: (1) it is perceived to be a source of disease for their animals, (2) it is one of the few remaining foci of sleeping sickness in Kenya for humans, and (3) it is located in a particularly fertile area for both cultivation and livestock rearing. At the best of times, there is only an easy truce between conservationists and farmers. At the worst of times, the park is threatened with being degazetted. This was the case in early 1990, when heavy rains appeared to facilitate tsetse population growth and tsetse dispersed out of the park into surrounding areas. Farmers lost most of their cattle to trypanosomiasis at this time; for unknown reasons no new sleeping

sickness epidemic occurred. The park was not degazetted only because of considerable public debate, with the conservationists winning.

Issues of wildlife/livestock conflict related to tsetse and trypanosomiasis are not new, and have been debated throughout the century (Molyneux, 1982). Along with other disease issues, these conflicts have been the subject of recent symposia in East Africa (MacMillan, 1985; Grootenhuis et al., 1991). These and other meetings have discussed mostly scientific issues, but have also debated the role of tsetse in conservation. In the face of exponential human population growth, scientists have naturally been concerned with the immense pressures that are likely to be placed on protected areas. Ormerod (1990) in a tsetse workshop held at ICIPE, Nairobi in 1989 warned: "...tsetse and trypanosomiasis no longer hold the importance to the future of Africa that they held previously. The important things are increasing population, land degradation, climatic change, and famine..." These words of wisdom from a senior scientist were recorded and duly noted in a publication, but did not receive the attention they deserved. Since then, events have taken their inevitable course in one of the worst scenarios imaginable in Akagera Park in Rwanda. Following the collapse of civil order in 1994, tremendous numbers of refugees occupied Akagera Park with the sanction of the new government. The park now harbours perhaps as many as two million cattle as well as unknown numbers of settlers. This encroachment began on a small scale on the outskirts of the park during work done by ICIPE in 1990 (Mihok et al., 1992). Currently, Wolanski (1995) states: "The Rwandan army has been sent in to destroy the lions who were attacking cattle, and then to slaughter vast herds of animals who could pass on disease to the cattle. Hunting wildlife with guns and automatic weapons is common and large scale". These recent events in Rwanda, the most densely-populated country in Africa, may simply reflect what is about to happen in the year 2025, when there is not enough food to feed an additional 800 million people.

Given this bleak scenario, what can be done to prevent the eventual occupation by people and by livestock of the many tsetse-infested, wildlife habitats in East Africa? Is the ultimate goal of increased livestock production realistic in the face of constraints such as trypanosomiasis, or should the region pursue alternatives such as game ranching, wildlife tourism, hunting, and other methods of utilising wildlife, as in southern Africa (Bothma, 1990)? In Kenya, for example, roughly 70% of the country's wildlife are not protected under the auspices of national parks

or reserves. What will be their fate if disease and economic issues are not resolved? These broad policy questions are not easy to answer, even within a country such as Kenya, let alone an entire region such as East Africa. However, some scientific issues can be addressed in a rational way. For example, there is now sufficient data to assess the viability of tsetse control in areas with high potential for contact between wildlife and livestock. Many projects have in fact demonstrated that trypanosomiasis in livestock can be reduced to acceptable levels in diverse settings with simple and economical technologies. Altogether, the field of tsetse control has reached the level of a mature science, with many available methods based on what can loosely be termed "attractive bait" technologies (Green, 1994).

Control methods of this type are now being implemented on an ever-increasing scale throughout Africa for many savannah and riverine tsetse. Even where there were chronic, seemingly intractable problems, such as the situation near Ruma National Park in the Lambwe Valley, successful vector, and hence disease, control has been achieved through methods ranging from the use of insecticide-impregnated cloth target or traps (with or without odour baits, Freen, 1994) to the use of residual synthetic insecticides applied to the skin of animals (a moving target or a "live bait", Leak et al., 1995). Although bait methods are by no means perfect, and residual populations of tsetse remain, disease control is usually achieved in a short period of time. This occurs because tsetse have a strong innate preference for feeding on wildlife rather than livestock (Moloo, 1993), and because the strains of many disease-causing organisms often differ from those adapted to livestock (Grootenhuis & Olubayo, 1993). Hence, disease control does not necessarily require eradication of tsetse or wildlife; instead it simply requires a significant break in the disease transmission cycle. In the long-term, if these simple control methods can be combined with limited tolerance for trypanosomiasis, as in some indigenous breeds of cattle (Rowlands & Teale, 1994), coexistence of wildlife, livestock and tsetse may be possible. This optimistic outcome would be a substantial improvement on the historical status quo where pastoralists lived with the disease simply by minimising contact between livestock and tsetse.

To date, nearly all major tsetse control projects have been government or donor-funded, with few examples of communities being mobilised to control tsetse using their own resources, e.g. with simple devices such as odour-baited traps (Ssenyonga, 1994). Hence, a major issue raised by

these projects has been their long-term sustainability in the absence of continuing external inputs. Similarly, as pilot projects have been scaled up to larger and larger geographic scales, environmental impacts of increasing livestock and human populations have become a major concern to scientists and donors alike. Guidelines for assessing environmental impacts of tsetse control have therefore been drafted and will presumably become part and parcel of new projects. Finally, there has been a shift in the donor community from funding studies of science underlying tsetse control to funding the implementation of tsetse control. Under the auspices of the European Union, an extensive regional project has been underway in southern African based in Zimbabwe (the RTTCP - Regional Tsetse and Trypanosomiasis Control Programme). This project will shortly be supplemented by a similar regional activity in East Africa (FITA - Farming in Tsetse Areas). The FITA project will devote considerable resources to address issues of land use, environmental impact, sustainability, community participation, etc. Overall, the donor and scientific community recognize that tsetse control has to be integrated into the general milieu of development. This is a significant change in philosophy from previous tsetse control "campaigns", which were literally waged as part of a war against the fly and the disease. In 1996, one can only be amazed at attitudes earlier in the century that led to wanton environmental destruction and elimination of wildlife, in total disregard for future consequences (Gamassa, 1986).

CONCLUSION

Successful tsetse control on a large scale is obviously going to have major impacts on the existing, essentially separate, status of livestock and wildlife in East Africa. Effective control near protected areas, combined with the inevitable establishment of mixed wildlife and livestock ranches, will grossly affect how wildlife are viewed by farmers, conservationists and tourists. The present physical separation of livestock and wildlife will become increasingly muddled, and there will be an increased debate on the value of conservation as opposed to utilisation. Outside of protected areas (where most wildlife are now found in Kenya), tsetse control will bring livestock and wildlife into direct competition for grazing resources. Up till now, tsetse have kept these resources largely in the domain of wildlife. Many developmental issues outside the realm of science will therefore come to the forefront. These issues have yet to be fully defined, let alone debated. Researchers, policy makers and donors will have to genuinely cooperate to set priorities for the rational

implementation of tsetse control in East Africa. I can suggest three key areas that need attention:

(1) The appropriateness and sustainability of different techniques of tsetse control for different cultures and farming systems need to be defined. Techniques suitable for Maasai pastoralists are likely to be different from those used by farmers practicing mixed agriculture in a village setting. Although many techniques are now technically effective, they are guaranteed to fail if social and cultural issues are not taken into account. The enthusiasm of donors, scientists and communities naturally wanes once control is achieved. How to sustain achievements when external inputs are withdrawn is perhaps the most critical issue in tsetse and trypanosomiasis control. This one issue may in fact be responsible for the embarrassing fact that after roughly 50 years of continent-wide tsetse control, the distribution of tsetse in Africa has hardly changed.

(2) The assumptions of improved livestock production in areas to be cleared of tsetse and trypanosomiasis need to be assessed, both economically, and scientifically in terms of other production constraints (including diseases caused by ticks, helminths, etc.). Tsetse control should also be considered in terms of the broader context of agricultural and social development. Is increased cattle, goat, camel, etc. production really the best strategy when compared with radically different alternatives (e.g., ostrich farming)? Alternatives for land use are particularly critical in arid and semi-arid ecosystems, where net benefits from increased traditional livestock production are likely to be marginal. Even in productive ecosystems such as the Serengeti-Mara, options such as wildlife tourism, or even wheat farming, may be more profitable. These issues should be addressed before control is attempted, and not assumed as self-evident. For whatever reason, the economic benefits of trypanosomiasis control have been given only the most cursory treatment in the literature.

(3) Environmental degradation and loss of biodiversity resulting from successful tsetse control and increased livestock and human populations must be prevented through coordinated land-use planning by governments. Tsetse control should be considered as only one of many components of African rural development. It should therefore be integrated into rural development schemes that address numerous social issues, including population control. For many years, tsetse control has been considered an end unto itself, and the benefits accruing from tsetse

control have been assumed to be self-evident. This attitude fortunately appears to be changing with a new awareness (at least for Africa) of environmental issues. Unfortunately, it will not be sufficient to simply record and assess the environmental impacts of tsetse control in order to ameliorate future problems. The fundamental imbalance in the equation between predictions of human population growth and the ability of the continent to feed itself must be addressed in the broader context of agricultural development.

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Livestock in Uganda: Importance, Production Systems, Institutions and Proposed SR-CRSP Impact Areas

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INTRODUCTION

Uganda, like most developing countries, has an economy that is heavily dependent on agriculture. Agriculture contributes 90% of foreign earnings, and the same percentage of the population lives in rural areas where 80% depend on agriculture as a way of life. Agriculture contributes 49.5% of the GDP and 50% of the raw material requirements for industries. The population is estimated at 17 million people with a growth rate of 2.6 per annum, a per capita income of about US $200 and a life expectancy of 45 years. Since 1986, the economy has grown at a rate of 4 to 5% of real GDP, and inflation has been controlled at less than 10%. However, Uganda is globally classified 4th from the bottom of the poorest countries. About 50 to 60% of the population is below the poverty line, and the top 25% of the population receives over 50% of total income. Though unemployment is considered to be low at .5-1%, there is a high level of unemployment among youth and women. Farm sizes are small (2 ha) and only rudimentary tools are used (hoe and panga). Malnutrition is high with periodic famine in a few areas.

The government's policy objectives in agriculture are to:

- Supply adequate and balanced food to all parts of the country (food security)
- Raise incomes and improve the quality of rural life
- Supply raw materials for local industries (import substitution)
- Stimulate production for export (export diversification)
- Conserve the natural resource base for sustainable production.

These objectives are similar to the goals of the SR-CRSP.

The government of Uganda has already enacted the macro-economic policy measures necessary for agricultural development:

- Liberalization of the marketing of agricultural products and inputs
- Liberalization of exchange rate control
- Establishment of a national agricultural research organization

- Restructuring of ministries, especially the merger of crop and livestock-related ministries into one ministry
- Improvement of the infrastructure (road, electricity, telephone) in major regions.

The purpose of this paper is to provide a basis for defining possible interventions in livestock production to maximize the contribution of the sector in order to meet national agricultural objectives. Basic information on production systems, institutions and areas for possible interventions are presented. These areas cover aspects of extension, research, training, micro-enterprises and institutional development.

IMPORTANCE OF LIVESTOCK

Livestock contributes 30% of the agricultural GDP and 20-25% of the total GDP. One third of households depend on livestock for the major part of their income. The per capita consumption of beef and milk is estimated at 9 kg and 20 kg, respectively. This is a low rate relative to other developing countries and established human requirements. In this paper, livestock is defined to include cattle, sheep, goats, pigs and poultry. The livestock population is structured as follows:

- Cattle 3.4 (5.1) ml
- Goats 2.5 (3.4) ml
- Sheep 0.7 (1.2) ml
- Pigs 0.5 ml
- Poultry 10 ml.

Beef cattle

The cattle population has fallen from a high of over 5 ml heads in the early 70s to about 3.4 ml as a result of looting and cattle rustling (especially in the north) and disease. Most of the damage and slow recovery has been in northern Uganda which has about 70% of the cattle population. A full 90% of the cattle are indigenous breeds and are kept on mixed holdings or by pastoral communities. Productivity of the indigenous cattle is low, with the following characteristic parameters:

- Maturity: 3-4 years
- Calving: every second year
- Calf mortality: 25-30%

- Lactation: 350 litres of milk
- Herd offtake: 10%
- 42 kg/TLU beef; 300 mt net exports per annum
- 100 kg/TLU milk.

The major diseases prevalent among cattle in Uganda are Rinderpest, Contagious Bovine Pleuropneumonia (CBPP), Trypanosomiasis, East Coast Fever and Foot and Mouth Disease.

In the 1960s, a beef ranching strategy was carried out with about 400 ranches established in areas that had been infected with tsetse fly. The project was supported by the World Bank (IDA). However the political instability of the 1970s and early 1980s resulted in destruction and looting, and currently only about 50 ranches still exist.

Dairy cattle

There are about 130,000 imported breeds and crosses of dairy cattle which produce a significant amount of the marketed milk. Half of the dairy farmers with exotic cattle own only one or two cattle, practice zero grazing and are women managers. Marketed milk is produced almost exclusively in southwestern Uganda. Of milk consumed, 95% is domestically produced and 5% is imported.

Goats and Sheep

Goats and sheep are kept in small numbers by most households. They are used for income generation, for food on special occasions, or for cultural obligations, including dowry payments, etc. In most households, less than 10 goats and sheep are kept. However, on some ranches and in the pastoral areas of Mbarara/Masaka and Karamoja, higher numbers are kept.

Pigs

Pigs are primarily kept near urban areas where there is an assured market. The major factors influencing production are markets, feed availability, and religion. (Muslims do not eat pork.) There has not been an effective production and extension policy for pigs and this has also contributed to low production.

Table 1: Priority scoring for selected commodities.

COMMODITY	ASARECA RANK	NARO SCORE (RANK)	
MAIZE	1	7.5	(4)
BEANS	2	7.4	(5)
SORGHUM	3	7.6	(2)
BANANA	4	6.5	(9)
DAIRY CATTLE	7	7.6	(2)
BEEF CATTLE	9	8.0	(1)
COFFEE	11	6.4	(10)
GOATS	12	7.4	(5)
SHEEP	12	5.8	(11)
COTTON	13	6.9	(8)
CHICKEN	-	7.3	(7)
DRAUGHT CATTLE	-	5.2	(12)

Poultry

Most of the 10 ml poultry are indigenous and scavenge around homesteads. There is, however, a growing trend towards commercialization in urban areas where the main production constraints have been feed availability, lack of replacement stock, disease and restrictive marketing systems. Recently a private company, Ugachick, has set up an infrastructure to promote the raising of poultry in the country. It has a breeding farm for chicks, cultivates mixed feeds, and distributes chicks and feed countrywide.

The importance of livestock in Uganda is shown in Table 1 above. The commodities were ranked during priority setting exercises conducted recently.

LIVESTOCK PRODUCTION SYSTEMS

Table 2 shows the major agro-systems within which livestock are raised. The humid/sub-humid zone constitutes about 77% of land area. It is also described as a banana-coffee-maize-livestock zone. The main livestock systems are dairy, poultry, pigs and small ruminants. The main

Table 2: Livestock agro-systems

System	% Land Mass	LGP (Days)	Rainfall (mm)
Humid/sub humid	77	180+	1500+
Semi-arid	12	60-179	250-750
Humid highlands	7	120+	750-1500
Arid lowlands	4	1-59	0-250
Urban agriculture	---	---	---

production constraints are low productivity of the breeds, poor feeds, disease and poor marketing systems. The semi-arid zone constitutes about 12% of the total land mass with rainfall of about 250 to 750 mm and savanna vegetation. The zone supports most of the beef stock and small ruminants (goats and sheep) raised. It is also described as the cereals-root/tubers-oil crops-livestock system. Livestock is kept mainly by agro-pastoralists with potential for commercial farming. The main constraints are the seasonality of water and forage supply, low productivity of breeds, disease and poor marketing infrastructure and institutions.

The humid highlands, located at the extreme borders of the country (south, west, northwest and east), constitute about 7% of the total land mass. The zone receives high rainfall, 750 to 1500 mm, and the soil is fertile. The area is characterized as a coffee-cereals-potatoes-livestock system. Bananas, sorghum, cassava and beans are also grown.

Dairying is also practiced in this region through zero grazing and limited commercial farming. Inter-cropping is common, where farmers combine the growing of crops and the rearing of animals. Population density is high, and this has resulted in land fragmentation. The major constraints in this zone are land fragmentation, lack of feed availability, disease, soil erosion and poor marketing systems.

The arid lowland system, constituting only 4% of land area, is located in the northwest and minimally in the southwest. The area is characterized by nomadic pastoralism based on beef cattle and small ruminants. The main constraints of the region are the availability of water and feed, which leads to movements of stock over long distances, a lack of market infrastructure and a high illiteracy level among the population.

Urban agriculture is practiced in key urban areas and is characterized by zero grazing, small units of livestock-poultry, pigs and small ruminants. Small ruminants are usually tethered in back yards. The system is

constrained by the low productivity of breeds, the availability of feed, limited technologies for handling feed and animal waste and a restricted by-products market.

INSTITUTIONS INFLUENCING LIVESTOCK PRODUCTION

There are a number of institutions that play a significant role in the development of livestock policies, information dissemination, research and extension (Chart 1).

The following are relevant to this presentation:

- Agricultural Policy Committee (APC)
- Ministry of Agriculture Animal Industry and Fisheries (MAAIF)
- National Agriculture Research Organization (NARO)
- Makerere University (MU)
- Non-governmental organizations (NGOs) and farmers' organizations, and parastatal organizations
- International and regional institutions including ASARECA, IARCs and various donors.

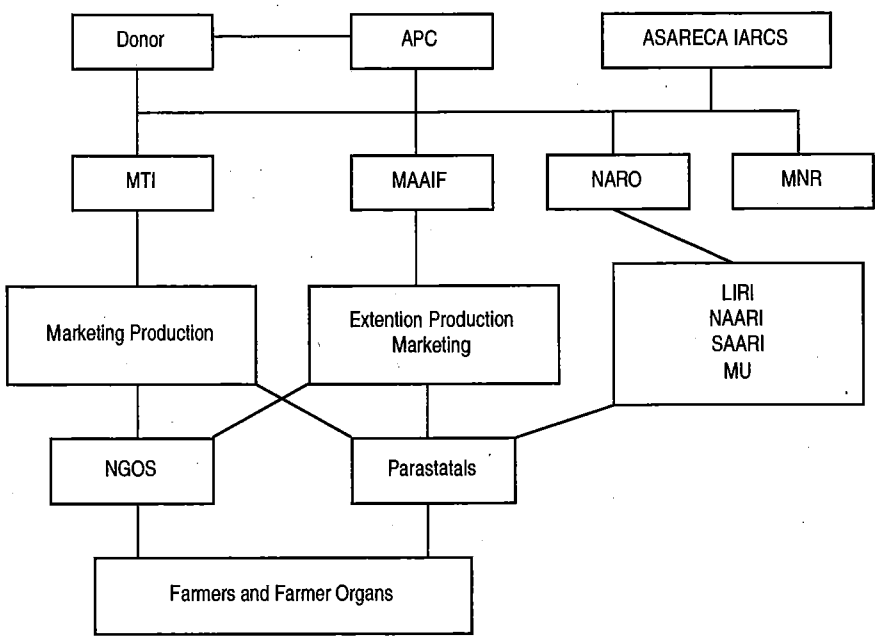
Agricultural Policy Committee (APC):

The Agricultural Policy Committee is an agricultural research body that includes representatives of the agricultural sector, permanent secretaries and heads of institutions (both private and public). The APC is charged with the coordination of national agricultural policies. The body has been in existence since 1982 and has a secretariat housed in the Bank of Uganda.

Ministry of Agriculture (MAAIF)

MAAIF's mandate is to support, promote and guide all crop, livestock and fisheries production by ensuring that all producers are assisted in raising the quality and quantity of their produce so as to sustain food security and sustainable economic development. The ministry is engaged

Chart 1: Livestock related institutions



Key

APC: Agricultural Policy Committee
MTI: Ministry of Trade and Industry
MAAIF: Ministry of Agriculture Animal Industry and Fisheries
NARO: National Agriculture Research Organisation
MNR: Ministry of Natural Resources
LILI: Livestock Research Institute
NAARI: Namulonge Agricultural and Animal Research
SAARI: Serere Agricultural and Animal Research Institute
MU: Makarere University
NGO: Non-Governmental Organisation

in policy analysis and formulation, as well as monitoring and advising. In its regulatory role, it oversees regulations governing the control of diseases and animal pests, including the importation, exportation and quarantine of animals, and the use of agricultural chemicals. The ministry provides extension services countrywide and works closely with private organizations and NGOs to provide technical information. The organization also works closely with NARO to promote the adoption of new technologies. Within the Ministry, livestock-specific services are provided under four divisions:

- Department of Animal Production and Marketing (51 staff)

- Department of Veterinary Services (31 staff)
- Department of Entomology (6 staff)
- Other departments, such as Training and Information, Land Resources, Development and Planning , etc., which also serve the livestock sector.

Constraints include but are not limited to the following:

- Receipt of only 3% of the national budget, whereas MAAIF contributes 49% of the GDP
- Inadequate staff and high turnover of skilled personnel
- Poor horizontal and vertical coordination of functions.

These constraints are further complicated by:

- Widespread rural poverty and a high rate of illiteracy, making technology adoption difficult
- Poor information flow
- Land fragmentation, ineffective research dissemination, a poor technological base and the use of archaic farming methods.

The National Agricultural Research Organization (NARO)

NARO is a semi-autonomous institution under MAAIF responsible for agricultural research (livestock, crop, fisheries, and forests). It has six established commodity - oriented institutes, three of which have a mandate for livestock research. These are:

- Livestock Research Institute (LIRA) in the Tororo district
- Namulonge Agricultural and Animal Research Institute (NAARI) near Kampala
- Serere Agricultural and Animal Research (SAARI) in the Soroti district.

LIRA

LIRA is located in Tororo in the former premises of the East African Tryapanosomiasis Research Organization (EATRO). The institute is focused mainly on the following programmes:

- Microbiology (viral and bacterial diseases)

- Tick and tick borne diseases
- Tsetse fly and Trypanosomiasis.

The staff of about 19 scientists includes two Ph.D.s, and a handful of Msc and Bachelor degree holders. Four of the staff work on Sleeping Sickness. Six are training abroad (3 Ph.D.s and 3 Mscs). No social scientist is on the staff.

SAARI

SAARI is located in Soroti, which is in the savanna zone. Among its programmes are livestock production, animal traction and pasture agronomy; however, only two staff members are active on these. NAARI is located at Namulonge, about 20 km from Kampala. The institute has about 10 staff working on livestock-related research. The majority are Msc holders with a bias towards nutrition and pasture agronomy.

Research constraints:

- Limited funding: Research receives less than 0.5% of national budgetary allocations.
- Insufficient staff

There is no breeding specialist or economist at either LIRA or SAARI.

- Disease
- Limited coordination of programmes and poor facilities.

Makerere University

The University hosts two relevant faculties; namely, the Faculty of Agriculture and Forestry and the Faculty of Veterinary Medicine. The two faculties offer training at the undergraduate and graduate levels and some of the faculty on staff are engaged in livestock research. The main constraints of the university system are insufficient funding, leading to inadequate staffing, low morale, and limited facilities for research, teaching and extension.

Other local institutions

There are a number of other institutions relevant to livestock. Some

are public, while others are private. Mention will be made only of the Dairy Corporation, the Veterinary Association, and the Uganda National Farmers Association.

International and regional institutions

A number of international and regional organizations play key roles in the livestock industry in Uganda. Among these are:

- Donors, including the World Bank (IDA), UNDP, GTZ, USAID and IFAD
- IARCs, such as ILRI, CYMMIT and ICRAF
- Regional Initiatives, like IGADD and ASARECA.

ILRI has had collaborative linkages with Makerere University in the areas of livestock pasture, disease control, credit and staff training. CYMMIT, supported by the European Union, is an initiative for strengthening economic and policy research in NARS in Eastern and Central Africa. ASARECA is likely to play a key role in the coordination of research programmes in the eastern and central region, as donors are currently demanding that IARCs and other institutions coordinate research funding and programme implementation in the areas they serve.

CONSTRAINTS TO LIVESTOCK PRODUCTION

Pastures/feeds and water

Most livestock are kept by smallholder peasant agro-pastoralists. Animals are grazed on natural pastures which are of low nutritional value. The deterioration of quality, especially during the dry season, results in reduced production (weight gain and milk output).

For more intensive production systems like dairy and poultry production, the main constraint is the availability and cost of feeds. The main resource is maize bran, supplemented by other feeds.

Silage and hay production systems are generally non-existent. Yet there is excess forage during wet periods, when preservation for the dry season would be possible. There is a need for research to generate an inventory of available resources, to conduct cost-benefit analyses of alternative feed and forage systems, and to develop different species and

production systems. This research could provide a foundation for commercial feed and forage seed production.

In the sub-humid, semi-arid and arid production systems water is a major constraint to livestock production and productivity, especially during the dry season. Efforts by the government to construct valley dams in most of these areas are ongoing but more needs to be done. Water problems have been made worse by the use of pastoral grazing-lands, limiting animal access to drinking water. In some semi-arid areas, livestock die from lack of water during dry periods.

In the humid zones and especially with zero grazing systems for dairy cattle, water is also a constraint because, although water is generally available, access by the animal is limited due to inability to collect and transport water. There is a need for affordable water-preserving technologies for small farmers.

Animal disease

Animal disease is a major constraint to production as the main cause of deaths, weight reduction, and reproduction loss. Although there exists knowledge of diseases and possible control measures, work is still needed to achieve effective control of major diseases. There is a need for studies to establish the magnitude of losses due to specific diseases (death, weight loss and reproductive efficiency) and the influence of other factors like nutrition, environment, etc. Also needed are comparative studies on the effect of alternative treatment or control measures.

Breeding and production stock

The productivity of existing stock could be substantially improved through breeding programmes, including selection and cross breeding. Artificial insemination and breeding services need to be improved. Research is limited by human, financial and infrastructural constraints.

The dairy industry is constrained by the high cost of in-calf heifers, currently at over US $1,000 each. This cost is exorbitant, given rural income levels.

With respect to poultry, day-old chicks have been imported until just recently. Increased private sector investments have contributed to

development in this area. However, breeding for small ruminants and pigs is generally non-existent.

Socio-economic constraints

Among socio-economic constraints mention will be made only of extension services and marketing: Extension services are provided under the new Agricultural Extension Programme (AEP), known as the unified extension system. As a result of poor staff training incentives and the heterogeneous nature of farmers and livestock systems, extension services are still weak in terms of technologies and services offered. Currently, there is a project for privatizing animal health delivery services. This project may provide a model for all livestock extension services, with the MAAIF providing a supervisory, promotional and regulatory role. The production and distribution of vaccines and drugs is an area of particular need.

Infrastructure for the marketing of livestock is also an area which is relatively undeveloped. Live animals have to be transported long distances to urban centres to sell. This demand results in substantial animals losses and losses in animal weight. In addition, the cost of transportation increases marketing costs and results in lower prices to the producer. Livestock markets also have limited infrastructure in terms of providing land, water and feed. There is need for public investment in this area.

Increasing numbers of cooling and packaging facilities are being setup in upcountry trading centres, which is a positive trend in the dairy industry. However, the processing industry is still undeveloped. Most hides and skins never enter the processing sector. The situation is the same for other livestock by-products such as horns, hooves, etc.

PROPOSED RESEARCH AREAS FOR THE SR-CRSP

Research

Livestock research is generally weak in Uganda, with a particular need for research in breeding, nutrition, reproduction, diseases and the social sciences. The Livestock Research Institute would benefit from SR-CRSP collaboration in all of the above areas, especially in breeding and the social sciences. Collaboration which included back-stopping

- Comparative studies on rangeland versus planted pasture
- Costs and benefits for different aspects of dry season cattle feeding in different production systems
- The economics of alternative animal health delivery systems and the implications of the privatization of animal health delivery systems
- Cost of production for livestock products
- Economic potential for livestock by-products based industries
- Socio-economic benefits of zero grazing and urban farming
- Cost-benefit analysis of animal health control

(human) and facilities research on rural poverty, unemployment, nutrition and other such critical areas would be particularly valuable. Collaboration must also provide a mechanism for policy interventions that would improve rural conditions and livestock production. Annex 1 shows some of the livestock research gaps within the broad area of the social sciences.

Institutional development

Modern trends in agricultural development are based on activities in the private sector. There exists a high potential for the development of livestock institutions and organizations that can support farmers in the delivery of animal health services, the marketing and processing of livestock products, the development of new markets for goat milk, sheep wool, hooves, horns etc.; the provision of livestock credit, and feed production. Possibilities in this area are not limited to any one species or agro-system.

Policy interventions

Whereas overarching macro-economic policies have been put into place, as mentioned earlier, there are a number of policy issues which need to be addressed by relevant institutions. These issues are partly research-related and partly extension-related. They include policies relative to livestock breeding, livestock trade (national and regional), rural poverty, income inequality and unemployment, natural resource use and environmental sustainability, rural credit, and delivery of

technology and extension services. Policies in these areas have considerable impact on livestock production in the country.

CONCLUSIONS AND RECOMMENDATIONS

Uganda is an agricultural country with livestock contributing significantly to the national GDP. The country has a favourable production environment for many types of livestock; however, production is still undeveloped and characterized by low input/low output production systems. Constraints persist in the areas of nutrition, breeding, disease, policy and institutions; and infrastructure.

The SR-CRSP, interfacing through ASARECA, could contribute significantly to:

- Research and building research capacity (both human and material)
- Development of livestock production institutions and viable micro-enterprises
- Institutional development for inputs, such as credit and extension delivery systems initiated by the private sector
- Evolution of effective policies in the area of breeding, trade, research and extension, rural poverty and natural resource use.

The key collaborative institutions would be NARO, MU, the private sector and MAAIF. ASARECA would provide an important link to ongoing research at the regional and international levels.

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A Greater Intake of Animal Products Could Improve the Micronutrient Status and Development of Children in East Africa

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Malnutrition continues to be a problem worldwide, and children suffer disproportionately because of their increased nutrient requirement for growth. General malnutrition (inadequate quantity of food) in developing countries is declining in percentage terms but is still high. Although the percent of children with weight less than two standard deviations below the reference fell from 42% in 1974-76 to 34% in 1988-90 (UN AAC/SCN, 1992), the actual number of children with low weight has increased (from 168 million to 184 million) due to population growth. As we begin to address the problem of general malnutrition, we have become aware of a concurrent and even more widespread problem: micronutrient malnutrition. Anemia, due primarily to inadequate intake and poor absorption of iron, is estimated to affect 42% of women and up to 70% of older infants and preschoolers. Iodine deficiency resulting in goiter, and vitamin A deficiency, continue to affect millions. About 10% of iron deficiency and 20% of iodine and vitamin A deficiency in the world occur in Africa. In recent years, attention has focused primarily on these three micronutrients, but I believe there are other micronutrient deficiencies whose effects may not be as dramatic as blindness and anemia, but whose long-term consequences may also have significant impacts on child development.

THE NUTRITION COLLABORATIVE RESEARCH SUPPORT PROGRAM

Many of the findings that I will present today are based on analyses of data from the Nutrition Collaborative Research Support Program (NCRSP). The NCRSP was an observational study conducted in village sites in Egypt, Kenya, and Mexico. Data were collected from late 1983 through early 1986 (Calloway et al., 1988). Investigators were from six U.S. universities and three developing country institutions. I was associated with the Management Entity at the University of California at Berkeley, and Dr. Allen was a Principal Investigator for the Mexico NCRSP project. One of the strengths of the NCRSP was its multicountry approach, using the same protocol in each of the three country sites.

Today I will show you some of the cross-country findings as well as specific findings for the Kenya project site located in the Embu district on the slopes of Mount Kenya. The Principal Investigators for the Kenya NCRSP were Charlotte Neumann from the University of California at Los Angeles, and Nimrod Bwibo at the University of Nairobi.

Another strength of the NCRSP was its emphasis on collection of comprehensive dietary data. Two days of measure intake data were collected each month on up to 5 targeted members of each household: lead male, lead female, schooler (7 to 9 years old), toddler (18 to 30 months old), and infant (up to 6 months old). Extensive measures of anthropometry, morbidity, and cognitive performance also were made. The goal was to collect one full year of data for 100 of each target type in each site, resulting in data from approximately 800 households and nearly 3000 individuals. As childhood development is the topic of this paper, I will discuss findings primarily for toddlers and schoolers. Not only were comprehensive dietary data collected for the NCRSP, but the development of an extensive food composition table for each country location allowed us to estimate intakes of a wide variety of nutrients, and thus calculate the probability of deficiency for those nutrients with recommended intake levels (Murphy & Calloway, 1991). To my knowledge, the NCRSP was the first study to calculate the predicted prevalence of low intakes of such a wide variety of micronutrients.

THE KENYA NCRSP IDENTIFIED NUMEROUS NUTRIENTS LIKELY TO BE LOW IN THE DIETS OF CHILDREN

Several important observations were made by the Kenya NCRSP investigators. Energy intakes were low primarily in the Kenya site (due at least in part to a drought that occurred in 1984), while protein intakes, even after adjustment for quality and digestibility, were mostly adequate (Beaton et al., 1992). However, all three projects found widespread stunting in the first year of life, which apparently persisted throughout childhood and appears to track into adulthood as well (Calloway et al., 1988; Allen, 1993).

We believe that at least some of this stunting is likely to be due to micronutrient deficiencies. Iron and zinc intakes were low in all locations, and for toddlers more than for schoolers (Murphy et al., 1992; Murphy et al., 1995). Calcium intakes were low, particularly in Kenya. Intakes of several vitamins also appeared to be low; vitamin B12 was particularly

problematic for the Kenya schoolers (Calloway et al., 1993; Murphy et al., 1995). Although pervasive vitamin A deficiency was not identified at the Kenya site, vitamin A is known to be a problem in other parts of East Africa, and indeed, in other parts of Kenya. Several nutrients were not of concern in any location: most of the B vitamins other than B12 and riboflavin; phosphorus, magnesium, and copper.

When considering interventions to improve micronutrient intakes, it is important to note that deficiencies seldom occur one at a time (Calloway, 1995). Thus, it is often difficult to know the exact cause of observed functional deficits. For nutrients found in the staple foods, intakes are likely to rise as energy intakes increase. Other nutrients are found primarily in occasionally consumed foods, so low intakes can occur even when energy intakes are high. Thus we see children with adequate macronutrient (energy and protein) intakes, but intakes of micronutrients that are almost certainly inadequate for normal growth and development. Because multiple deficiencies are common, interventions that focus on only one or two micronutrients may not alleviate functional deficits.

In the NCRSP sites, dietary quality, as measured by intakes of micronutrients, appeared to be a household characteristic: for households with both a toddler and a schooler, micronutrient intakes (adjusted for energy intake) were highly correlated (Murphy et al., 1995). Thus it appears that interventions could focus on providing more adequate foods to the household, and reach multiple ages of children.

MICRONUTRIENT MALNUTRITION HAS MANY FUNCTIONAL CONSEQUENCES

There are many functional deficits that occur with inadequate micronutrient intakes. I will briefly mention some which have been identified for the nutrients that were low in the NCRSP sites. Not only were iron intakes low among the NCRSP toddlers, but anemia (based on low hemoglobin levels) was widespread. The anemia could occur in part due to low vitamin B12, vitamin A, or riboflavin intakes or from parasitic infections, as well as from low iron intakes. The consequences of anemia are well-known: poor pregnancy outcomes, reduced growth rates, impaired cognitive performance, and reduced work performance in adults (and presumably in children as well). Vitamin A deficiency can result in vision deficits and blindness, as well as significantly increased chances of mortality (a recent meta-analysis estimated a 23% increase in

mortality from infections (Beaton et al., 1993)). Zinc deficiency also can affect growth as well as morbidity from diarrhea. Both vitamin B12 deficiency and riboflavin deficiency have a spectrum of undesirable consequences (poor growth, developmental delays, lack of responsiveness, anemia, dementia/sensory loss, and psychiatric disorders for B12; decreased neuromuscular control, decreased hand grip strength, and adverse personality changes for riboflavin). Calcium is needed not only for normal growth, but also to delay the onset of osteoporosis—an increasing concern as life expectancy increases in developing countries.

We can probably use food intake data to predict the prevalence of nutrient deficiencies. A comparison of the probability of inadequate intakes as predicted from food intake data (from the Mexico NCRSP) with the observed prevalence of biochemical deficiencies of specific vitamins and minerals (in the same community and for the same group of children five years later) shows a remarkable correspondence (LH Allen, unpublished data).

ANIMAL PRODUCTS ARE GOOD SOURCES OF MICRONUTRIENTS

Animal products have the potential to increase intakes of virtually all the nutrients of concern in the NCRSP. Foods such as milk and meat provide a package of highly available micronutrients that are frequently low in the diets of children living in developing countries. Indeed, one reason for the low micronutrient intakes may be the low consumption of animal products and high consumption of maize and beans. The toddlers in Embu obtained over 50% of their energy intakes from maize and beans, but only 7% from milk (averaging 59 grams per day) and less than one percent from meat (5 grams per day) (Calloway et al., 1992). Schoolers had even lower intakes of animal products: over 75% of their energy intake came from maize and beans, one percent from milk (35 grams per day), and less than one percent from meat (11 grams per day). One reason for the lower than recommended energy intakes may be the bulk of the diet. To meet their energy recommendations entirely from cooked maize would require consumption of over 1.7 kilograms by toddlers and 2.5 kilograms by schoolers. By comparison, to meet their energy needs entirely from meat would require consumption of less than 0.5 kilograms—a much more reasonable level for a child. It seems likely to many nutritionists that providing more of the same foods as the usual diet is not a reasonable solution to low nutrient intakes; young children cannot consume such a large volume of cereal and legume staples.

Meat products are high in iron, but more importantly, the iron has a high bioavailability. For example, cooked maize contains about 0.5 mg of iron per 100 grams, but only about 5% is absorbed, giving only 0.03 mg available to the body. Although cooked beans have about 2.9 mg iron per 100 grams, absorption is equally low, yielding only 0.15 mg available iron. However, beef, which contains about 1.7 mg iron per 100 grams, yields about 0.34 mg available iron (over twice as much as the beans) because absorption is much higher. The heme iron is easily absorbed (about 25%) and the availability of the rest of the iron (non-heme) is increased to about 15% (from the 5% for the maize and beans), giving an overall average of about 20% absorption. Furthermore, the availability of the non-heme iron in other foods can be doubled or even tripled if they are consumed at the same meal as the meat. It would take a lot of maize and beans to meet children s iron requirements of 0.53 mg/d (for toddlers in Embu) to 0.88 mg/d (for schoolers). Thus, livestock consumption could be an important factor in reducing anemia rates.

For the same reasons, consumption of animal products also could improve zinc status. Beef has more than twice the zinc per 100 grams of maize and beans, and it is up to three times more available. Zinc availability is very low in whole grain cereal-based diets—probably 10% or less, due to their high phytate content. The end result is that the absorbed zinc from beef is almost ten times greater than from equal weights of cooked maize or beans. It is important to note that the availability of zinc in plant products can be substantially increased by simultaneous consumption of animal protein. As with iron, it would take more maize and beans than a child is likely to eat to meet the mean requirement for zinc (0.70 mg/d for toddlers and 0.90 mg/d for schoolers in Embu), while 50 grams of beef per day would completely satisfy the average zinc requirement of a toddler.

Vitamins of concern in developing counties include vitamin A, vitamin B12, and riboflavin. Of these, only vitamin B12 was low in Embu because maize supplied adequate riboflavin and vegetables supplied adequate vitamin A precursors. Again, animal products are good sources of these nutrients. Milk can be a good source of well-absorbed vitamin A—not as good as leafy green vegetables, but there is increasing concern that the carotenoids in these vegetables are poorly absorbed (dePee et al., 1995). Animal products, of course, are the only source of vitamin B12. Both meat and milk supply substantial amounts of riboflavin. Dairy products are also an important source of calcium; it is difficult for a child

to approach the average calcium requirement (estimated as 346 mg/d) on a cereal-based diet. Even the calcium in leafy vegetables is poorly absorbed if the vegetables are high in oxalates.

We have looked at the diets of children on days when they consumed animal products, compared to days when they did not eat any animal products (there were 49 toddlers in the Kenya NCRSP with at least 6 days in each of these categories) (Calloway et al., 1992). Energy intake was very similar (about 830 kcal/d) from both types of diets. Although animal products supplied only 80 kcal on the days they were consumed, these diets had significantly greater levels of riboflavin, vitamin B12, calcium, phosphorus, vitamin D, fat, protein, and essential amino acids.

NCRSP FINDINGS PROVIDE EVIDENCE THAT ANIMAL PRODUCTS IN THE DIET ARE ASSOCIATED WITH BETTER CHILD DEVELOPMENT

When we examined predictors of child development, we looked at food intakes as well as nutrient intakes (Calloway et al., 1992). Animal-source foods were consistently associated with a variety of measures of child development. For example, milk and animal fat consumption, as well as intake of concentrated sources of energy (such as sugar and vegetable fat), were associated with attained height at two years in Embu. There were notable similarities in the predictors of the rate of height gain in the Kenya and Mexico NCRSPs: milk was a positive predictor, while maize was a negative predictor in both locations. Furthermore, milk intake was positively associated with the socioeconomic status (SES) of the household, while maize intake was negatively associated. This led us to consider dietary patterns, determined using principal component analyses. Indeed, in all three sites there was an animal product pattern that was higher in animal foods and lower in maize. In all countries, this pattern was positively associated with SES level. In Embu, the pattern was strongly associated with height and height gain for children. Even when adjusted for a variety of non-dietary factors (SES, sanitation, gender, and mother's size), most of the associations remained statistically significant, although somewhat lower in magnitude. Associations of growth with dietary patterns were almost always stronger than associations with SES, implying that diet, rather than some other characteristic of families with higher socioeconomic status, is responsible for better growth.

Normal child development includes mental as well as physical

development. Dr. Marian Sigman and her colleagues at UCLA have published impressive findings from the Kenya NCRSP showing that cognitive scores for schoolers (verbal comprehension and Raven s matrices) are higher for children who consume more animal protein (a measure of animal product intake) (Sigman et al., 1989). After duration of schooling, the next strongest predictor of cognitive performance was animal protein intake; both were much stronger predictors than SES level. Also, schoolers who consumed more energy, animal protein, and fat in their diets were heavier, more active, and showed more leadership behavior. In a related longitudinal study, the animal protein intake of toddlers predicted their cognitive scores 2-3 years later (at 5 years of age), even when adjusted for a variety of environmental effects (Neumann et al., 1992). Thus, it is important to remember that poor nutrition can have multiple functional consequences—there may be cognitive and behavioral costs in addition to reduced body size.

IMPROVEMENTS IN HUMAN NUTRITION MAY BE IMPORTANT OUTCOMES OF LIVESTOCK DEVELOPMENT PROJECTS

There is ample evidence that consumption of animal products contributes to child development. The measurement of improvements in child development could provide additional motivation for livestock development projects. The issues involved are not simple: food intake is influenced by a complex interaction of economic, social, and productivity variables. Investigation of the true effects of animal product consumption on child development requires an intervention study—a significant extension of the observational study design of the NCRSP. I look forward to discussing with you how such hypotheses might be stated and investigated.

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The Role of NGOs in Livestock Development in East Africa and the Potential for SR-CRSP/NGO Collaboration

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FARM Africa

INTRODUCTION

Over the last 10 years, there has been an increasing interest among donors of official development assistance to channel funds through non-governmental organisations (NGOs). This interest has arisen as a result of frustration at the perceived failure of much official bi- and multi- lateral assistance to developing countries and the apparent success of many NGO development efforts. NGOs are believed to be efficient at reaching the poorest (countries, people) and channelling funds through them is considered the most cost-effective method of delivering assistance to the poor. As a result, there has been a rapid expansion of the NGO sector and a concomitant shift of resources from government to non-governmental organisations. Currently, there are an estimated 4,000 development NGOs in OECD member states alone, dispersing nearly three billion US dollars worth of assistance every year. (OECD, 1995; Clark, 1991). These northern NGOs work with 10,000-20,000 southern NGOs who are estimated to assist up to 100 million people (Clark, 1991). Despite this expansion the impact of NGOs remains limited and, although it may be of high quality, it remains very localised and of short duration. In contrast, government programmes tend to be large-scale but of limited impact.

There are very few NGOs specialising in agricultural development. Most NGOs cover several sectors; agricultural programmes are usually one component of a wider community development programme. The level of technical competence within NGOs is generally low, making it difficult for them to plan and implement highly technical programmes.

The involvement of NGOs in agricultural research has been extremely limited. In keeping with general donor interest, consideration has been given to ways of involving NGOs in the whole research process. The Consultative Group on International Agricultural Research (CGIAR) has recently held several regional consultations with NGOs to seek ways of involving them in the research programmes of the International Agricultural Research Centres (IARCs). National Agricultural Research

Stations (NARS) are starting to see the value of local-level collaboration with NGOs for problem identification and technology testing. This SR-CRSP workshop is a further manifestation of this process of incorporating NGOs into mainstream agricultural development.

The channelling of bilateral and multilateral funds through NGOs may appear a perfect arrangement but caution should be observed by both parties to realistically assess the nature of their new partner. This paper aims to provide an honest assessment of the current state of NGOs, their current activities in the field of livestock development in East Africa, and, based on this assessment, to make some realistic suggestions for collaboration with the SR-CRSP.

THE CHARACTERISTICS OF NGOS

Probably the most important characteristic of NGOs to understand is their variability. Each NGO has its own particular character and no two are alike. NGOs vary in several important areas:

Origin

NGOs are often classified into international, national and grassroots organisations. This reflects their origin in the, so-called, developed or developing world. NGOs originating in the northern hemisphere often, but not always, have some sort of religious motivation, while those from the south are often started by a highly-motivated individual who sees a particular need in their country or community.

NGOs are usually started by a small number of highly committed individuals whose ideals set the objectives and approach of the organisation. The founding of the NGO is fundamental to determining its sense of identity and cultural ethos; making the history of the organisation very important to it. If the original sense of mission is ever lost those involved with it will return to the original intentions of the founders. This is why growth, with the accompanying changes to the culture of the organisation, can be painful.

Objectives

Each NGO will have its own set of objectives. These objectives can be broadly classified into the following categories:

- poverty alleviation (focused on marginalised groups such as pastoralists, farmers of land marginal for cropping, the urban poor, etc.)

- empowerment of marginalised groups (poor, women, disabled etc.)

- advocacy (in the northern hemisphere to governments, companies and the general public; in the southern hemisphere to local/national governments and donors)

Most NGOs would aspire to all three objectives to varying degrees, with the majority placing greatest emphasis, naturally, on poverty alleviation. Many agencies specialise in relief work in emergency situations. Several have developed a high public profile through the publicity gained for heroic work under difficult circumstances and have attracted substantial extra funds as a result.

Many NGOs see their greatest priority as being to empower the poor and to campaign on their behalf.

Competence

There is a huge variability in the technical competence of the staff of NGOs. NGO staff are usually highly motivated through idealism and a sense of mission, but may not always have the professional qualifications and experience required to plan, implement, monitor and evaluate highly technical programmes. Most NGO staff are generalists and NGOs may not be able to afford to employ experienced technical specialists. This situation seems to be changing as working for a NGO becomes more respectable and many professionals are joining NGOs for the greater freedom and job satisfaction it gives. Many highly experienced professionals now value their new working environment and would not return to public employment.

Size and scope

NGOs vary tremendously in size, from Oxfam UK/I having an annual turnover of over $100 million, to small grassroots organisations supported by the contributions of their members. The scope of NGOs may extend from a small village group to a large international NGO with specialist technical departments perhaps operating in several continents. NGOs

tend to cover several sectors but there appears to be an increasing trend to specialise in one in order to fill a perceived gap.

Methods

The methods used by NGOs to achieve their objectives also vary. Some NGOs fiercely guard their independence and refuse to collaborate in any way with government organisations. Others may chose to work very closely with government departments seeing this as the best way to achieve long-term sustainability. Most NGOs have adopted the community development approach with community participation seen as vital to its success. Participatory planning, commonly using Participatory Rural Appraisal (PRA) techniques, is used to identify a community s problems, which are then tackled with assistance of the NGO. The programme of activities is usually implemented through an intensive effort by the NGO with formal or informal community groups. This intensity of effort is a common feature of NGO projects and is often, together with the community s genuine participation in the project, the reason for their apparent success. An NGO project might have a ratio of community workers/staff to farmers of perhaps 1:100-200, while staff in government agencies struggle with 1:1,000-2,000 or more.

Funding

NGOs obtain funds from a variety of sources. Funds may be raised from individual or corporate supporters, or from larger official donors. Often, NGOs have rules about the proportion of total funding they will accept from government bodies to ensure that their independent status is maintained in the eyes of their supporters, staff and the people they assist.

Legitimacy

NGOs must exist for a legitimate humanitarian reason and be accountable for the funds they receive. Ideally there should be regular independent evaluations carried out of NGO activities. Unfortunately the scale of resources now available to NGOs has attracted unscrupulous people who have set up NGOs purely for reasons of self interest. There are now many entirely bogus NGOs, the so-called briefcase NGOs operating in the developing world, and donors are cautioned to check the bona fide status and track record of any NGO they consider donating to. Naturally, throughout this paper, only reputable NGOs engaged in serious development work are considered.

It is clear that the diversity of NGOs makes generalisations about them difficult. In addition, the role of NGOs is changing rapidly. The new-found interest of donors has created its own set of problems for NGOs. Many NGOs fear that accepting official donor funds will compromise their integrity and ability to innovate. In many cases, the additional resources provided by governments to NGOs and the terms under which support is given is having the effect of blurring the past distinction between NGOs and other service providers (GOs, commercial, etc.). In some circumstances, NGOs have become nothing more than agents under contract to their governments. In pursuit of money, it is easy for NGOs to lose sight of their original mission. There is a clear danger that as NGOs accept more and more official aid, their ability to innovate will be compromised. This trend will only continue as aid funding contracts.

NGO LIVESTOCK PROGRAMMES IN EAST AFRICA

With the exception of Heifer Project International, FARM-Africa, ITDG, VETAID and Send-a Cow, there are very few NGOs in East Africa specialising in livestock development. Few NGOs have livestock specialists on their staff and so few are able to tackle the complexities of a livestock project. NGOs operating in marginal, drought-prone, farming areas are starting to appreciate the role of livestock as an insurance against crop failure. Keeping a mixture of crops and livestock has been a traditional drought survival strategy for generations in Africa. Many of East Africa s famines arise when this strategy breaks down. Many NGOs working in emergency situations now understand the importance of livestock to the people they are helping. Livestock programmes are often designed as a rehabilitation measure in these circumstances and interest in livestock development within NGOs often starts in this way.

Current NGO livestock programmes can broadly be classified into rehabilitation, improvement of family nutrition, and income generation programmes.

REHABILITATION PROGRAMMES

It is unfortunate that the incidence of human destitution from civil war, drought, disease epidemics, and banditry has been very high in East Africa in recent years. Countries such as Ethiopia, Uganda, Somalia, Sudan and northern Kenya have all experienced human crises of various

sorts. As a result, NGOs operating in these countries have been predominantly engaged in relief work, trying to mitigate the worst effects of an emergency. Agencies such as Oxfam, Save the Children Fund, CARE, Medecins sans Frontieres have all developed expertise in relief work. Once the immediate crisis passes the destitute, for whom they care, need to be rehabilitated back to their former way of life, when feasible. Often, the worst affected are pastoralists who need to be restocked with livestock in order to return to the pastoral way of life. Hence restocking people with livestock has been targeted by agencies during the early stages of recovery after a disaster (Oxby, 1994). Restocking people with draught oxen has also been carried out by NGOs as part of a package to rehabilitate farmers (Jones, 1992).

It is often the case that veterinary programmes will be set up to accompany restocking programmes. Pastoralists may be trained by NGOs as barefoot vets, paravets or community animal health workers in order to take responsibility for the primary health care of their livestock (Grant, 1992).

While considering NGO rehabilitation programmes, it is appropriate to highlight an area where NGO thinking has been very slight; that is in soil and water conservation programmes. Typically, after a severe drought and famine, NGOs will support the nutritional needs of a community through food-for-work schemes. The labour mobilised in this way is normally used for construction to benefit the whole community, such as roads, stone terraces, check dams, together with some sort of reforestation. Few NGOs promote biological conservation methods, such as grass and grass/legume contour forage strips or oversowing of communal grazing areas; and even fewer appreciate the possibility for combining restocking programmes with biological conservation measures to increase livestock feed supply and conserve the soil. The potential for integration of livestock production into soil and water conservation programmes deserves greater attention from NGOs and researchers.

IMPROVEMENT OF FAMILY NUTRITION PROGRAMMES

The improvement of family nutrition, especially child nutrition, is fundamental to improving human welfare in East Africa. This improvement may take the form of improving the total quantity of food available to the household, the quality of the diet, or the reliability with which food is supplied to the household.

Livestock are rightly seen by NGOs as a means to increase the protein nutrition of malnourished families, particularly children. Among mixed farming communities, cereal or root-based diets are chronically deficient in protein as well as vital micronutrients, such as vitamin A. Many NGOs involved in nutrition monitoring work, e.g. Save the Children Fund, have seen the need to improve the supply of animal products, especially milk to families in this situation. Unfortunately all too often families are too poor to consume valuable animal products and are forced to sell them for cash.

Typical NGO projects to improve the quality of family nutrition are:

- dairy goat development
- dairy cow development
- chicken, esp. egg production
- rabbit production

CASE STUDY: FARM-AFRICA DAIRY GOAT DEVELOPMENT PROGRAMME, ETHIOPIA

A short case study describing FARM-Africa s Dairy Goat Development Programme in Ethiopia is presented to show the range of activities with which NGOs can become involved. The Dairy Goat Development Programme involved the collaboration of FARM-Africa with both government and other non-governmental organisations and included the following elements:

- restocking/community credit management
- women s group development
- community goat health care
- forage development and biological conservation
- breed improvement
- breeding station development and management

- applied research on goat nutrition and health
- identification and description of goat genetic resources
- men and women farmer training
- extension staff training
- graduate student training (in-country and overseas)
- savings and credit
- women s numeracy and literacy training
- public awareness
- advocacy on behalf of goats and women

The highlands of Ethiopia are under immense pressure from an expanding human population trying to live on rapidly degrading resources. Soil erosion is severe as cultivation expands into increasingly marginal areas. Farms are small (0.3-0.5 ha) and are getting smaller with each generation. The cycle of drought, famine and distress is widely known. The opportunities for farmers to improve the lives of their families are extremely limited. Goats are kept on small farms in the highlands of the south, east and arid north of the country, and are often kept by the poorest members of Ethiopian society who milk them and sell them for cash. Goats can be a vital buffer against the vagaries of the environment and may be sold in times of hardship. There are an estimated 20 million goats in Ethiopia and yet virtually no effort had been made to develop this valuable resource until FARM-Africa started the Dairy Goat Development Programme in 1988, with funding from the Overseas Development Administration (ODA) of the British Government. The aim of the project was to increase the incomes and nutrition of families in the highlands by improving the productivity of goats managed by women. It was thought that a more intensive goat system providing milk, cash and security, would fit well into farms too small to support cattle. Women were chosen as the focus of the programme, not for any radical feminist reason, but simply because women, with their children, look after goats and traditionally milk livestock. They were considered the appropriate target group for extension efforts.

The Dairy Goat Development Programme found that it was having to break new ground in several areas. First, goats had a very bad reputation among government officers who appeared to blame them for the environmental destruction caused by man and his activities. Ignorance, misconceptions and cultural prejudices abounded at the start of the project, necessitating a public awareness campaign to inform government officials of the value of goats to some of the poorest members of their society. The second new area was involving women in a serious agricultural extension programme. Most of women s previous activities, whether under government or NGO programmes, had involved stove-making, sewing or possible vegetable growing. But they were carried out under the auspices of a home economics programme, and not part of mainstream agricultural extension. There was little understanding of the particular problems of women in order to design extension strategies appropriate to their needs. In addition, there was little experience of operating an extension programme through farmers voluntarily forming themselves into groups. The Dergue had operated in a dictatorial manner with participation more often coerced than invited. New attitudes had to be instilled in the minds of extension staff, so that they could not only work with women but work with them in an open and voluntary way.

Method of implementation—collaboration. FARM-Africa decided that it was most cost-effective and more sustainable to implement a national project through collaboration with existing organisations. The collaborators are the Ministry of Agriculture, Alemaya University of Agriculture, Awassa College of Agriculture and NGOs with field programmes including CARE, SOS Sahel, Action Aid and Redd Barna. The International Livestock Research Institute (ILRI) assisted with the analysis of the breed survey data. The project now works with 1400 families in eastern Hararge zone, Oromia Region and Konso, Welayta, and Gurage zones of the Southern Region.

Credit. The poorest women, often widows, are identified by the community and receive two goats on credit. The credit may be repaid in cash or in kind by passing on a weaned kid to a new family. The women form a group of 15-30, then elect a committee and draw-up by-laws. The group itself manages the credit repayment and selects new families who they think need to receive goats. Women involved with the project have shown themselves to be responsible in disbursing credit to appropriate families and accurate in maintaining records and receiving repayments.

Based on the success of its own women s credit programme, the project has played a major role in lobbying the Agricultural and Industrial Development Bank (AIDBANK) to supply credit funds to women who were not previously allowed to take loans. It is now possible for a women s group to receive funds directly from AIDBANK, with approval from the local Ministry of Agriculture extension staff.

Forage development. In the densely populated areas in which the project works, cultivation is encroaching on communal grazing areas, reducing livestock feed supply. There is an urgent need for forage development combined with increased control of grazing livestock. Cut-and-carry feeding systems have to be adopted soon. However, there is limited space available for growing forage. It has to be grown in areas of the farm that do not compete with grain crops—around the house, along the edges of fields, undersown in maize/sorghum, etc. The forage strategies promoted for goats are backyard pasture, forage strips and undersowing annual/perennial crops. Emphasis is given to legumes in order to improve the quality of the natural diet which may have a high proportion of poor quality crop residues.

Women are encouraged to allow a few trees to flower and set seed as a source of their own seed. These home-grown seeds can then be direct-sown or sown into the woman s own backyard nursery for later planting out. In this way, the women are not dependent on outside sources of seeds or tree seedlings.

Training. The women follow a basic training course in improved goat husbandry covering forage development, health care and general management. Extension staff are trained to use a simple extension package consisting of a set of flip charts and guidelines in their use. The package is designed to be used in a very interactive, participatory way, encouraging dialogue and discussion of issues while learning new ideas. The package can be divided into meetings of different lengths according to the wishes of the group. The package itself is continually revised in light of the experience of the groups.

Women paravets. Ethiopia, like most African countries, suffers from a chronic shortage of trained, mobile and equipped veterinary staff. Most farmers have limited or non-existent access to veterinary services. However perhaps as much as 80-90% of livestock diseases can be controlled through the simple means of vaccination and the use of

anthelmintics and acaricides. These drugs do not have to be administered by highly trained professionals; they can be properly administered by trained farmers, including women farmers. It was considered vital to the success of the programme to have a more effective goat health programme than the limitations of the existing veterinary service allowed. It took time to persuade the authorities that illiterate women could correctly use basic veterinary drugs and could learn simple veterinary techniques, but eventually the project was allowed to train women as barefoot vets or paravets.

Each goat group selects two women to be trained as paravets. They attend a 5-7 day initial training course which is organised in their own or a nearby village. Local goats from the village are invited to be brought to the training course so that trainees see a variety of cases. The training is very practical and participatory in nature, allowing practical skills to be taught and practised in a familiar environment. The paravets are trained to examine a sick goat, use anthelmintics and acaricides, dress wounds, trim feet and castrate. The women are also trained to keep simple pictorial records requiring them to make a mark on the page under the appropriate picture. This allows the project to monitor the activity of the paravets. At the end of the course there is a small graduation ceremony where the trainees receive a basic veterinary kit and a certificate of attendance, and they publicly commit themselves to serving members of the goat group. The paravets charge a small mark-up on the price of drugs and a small reward for their work. The paravet programme is supervised jointly by the local Ministry of Agriculture veterinary officer and group committee. Follow-up training is organised to allow feed-back, discussion and problem solving. So far, the paravets have performed very well. Recent changes in legislation have allowed private veterinary drug shops to be established in rural areas. The project will help five paravets, or animal health assistants, to start drug shops in project areas and thereby ensure the continuity in the supply of drugs after the project ends in 1997.

Breed improvement. The project aims to gradually intensify the production of local goats to improving their management. But there comes a point beyond which local goats can not be improved and should be upgraded. Once a woman has achieved an acceptable level of management and has repaid her debt she receives a crossbred goat (Anglo-Nubian x Somali) on credit. At the start of the project, crossbreds were bred on an experimental basis at Alemaya University of Agriculture and Awassa College of Agriculture. However, as the groups became more

established and the demand for crossbreds outstripped the supply, local level crossbreeding was encouraged through community buck stations. One buck is allocated to a group who selects one family to look after it; group members then take their goats to this family for crossbreeding. Members of the group agree to take feed to the buck or help the buck keeper in other ways.

In order to ensure the sustainability of the breed improvement, local farmers with superior management skills and larger farms have been selected to be breeders of pure stock and to supply them to local groups. The Ethiopian Goat Improvement Association has been registered as a national organisation to promote improved goat farming throughout the country.

Savings associations. During the course of project activities, staff and collaborators learned of a traditional method by which women had to save money and help each other. Known locally as *eddir*, small amounts of money are saved regularly by a small, informal, group of women. The money can be allocated to women in the group, in turn, or given or lent to those in need. Members of goat groups in Areka, Welayta spontaneously organised themselves into a Women s Self-Help Goat Society, with each member contributing a small sum each week during their weekly meeting. Most members of the groups in this area are mature war widows who have a very serious attitude towards development opportunities. Some groups have decided to set aside a portion of their savings to purchase goats for other needy women. Project staff were so impressed with the efforts of these women that they were eager to suggest it to groups in other areas. The idea was shared with other extension staff during the regular project training courses and quickly spread to all project sites where it was enthusiastically adopted. Group leaders are now being instructed in leadership as well as trained in basic bookkeeping skills.

National Goat Breed Survey. A survey of goats in every region of Ethiopia and Eritrea was carried out by three graduate students. Each region was stratified by altitude and ethnic group. Morphological measurements were taken of 50,000 goats, together with information on parturition histories and offspring disposal. Data was also collected on husbandry methods and traditional uses of goats and goat products. The data was analysed at ILRI using principle component and cluster analysis. Four main clusters were identified including Nubian, Coastal, Somali

and the Small East African. These types can be broken down into 14 distinct sub-types. The survey is the first systematic description of the goat resources of a country and provides a unique basis for planning goat development in the future. Hair root samples have been taken for DNA analysis which will be used to validate the statistical analysis and determine the genetic distance between identified types.

Project impact. The Dairy Goat Development Programme has had an impact at many levels including individual family, government and non-governmental organisation, and of national policy levels. Most families have managed to increase their flock of goats to a size which they are able to manage with the labour and feed available. As the flock increases, excess males are sold for cash. The crossbred goats have so far performed very well and yield 1-2 litres of milk per day while rearing their kid. Several women have started to sell milk and earn the equivalent of the daily wage rate for it. In addition, male crossbreds command a premium price. Taken together the crossbred goats are making a considerable impact on child nutrition and family incomes.

The project was sorely tested during the drought in 1994 in southern Ethiopia. There was widespread famine in the Welayta area of the southern region but clear evidence that families owning goats were able to sell them and earn sufficient funds to feed their families until the next harvest. As the families selected were considered to be the poorest in their community the project has obviously had a major impact on some of the most vulnerable groups.

The increase in self-esteem and personal confidence among women involved in the project, at both the group and individual level, is not something that can be easily measured, yet it is plain to see. One group in Konso, the poorest of all the project sites, have constructed a tiny meeting hut for themselves which is turning into a small social centre for the community. Individual women tell countless stories of how their goats, or membership of their group, has helped them. A widowed grandmother in Hararge, struggling to bring up her orphaned grandson, now has milk for the child and enough left over to sell and buy grain. Other women have managed to start petty trading activities through borrowing money from their group.

The government institutions involved with the project have benefitted through infrastructural development as well as staff training. Over 200

extension staff have been trained in improved goat husbandry and extension methods. A total of 8 MSc and 1 Ph.D. have been completed under the project, which has considerably increased the capacity of these institutions to carry out teaching, research and development related to goat production. The newly-formed Ethiopian Goat Improvement Association will also support goat development efforts in the country. FARM-Africa will increasingly play an advisory and training role.

FOOD SECURITY

Issues of food security are at the forefront of donor thinking in the region. Yet the role of livestock in improving food security is all too often overlooked. The reliability of food supply in marginal cropping areas can be improved by extending livestock ownership through credit, if necessary. There is no doubt that families living in areas of low and erratic rainfall will have a much greater chance of surviving periods of crop failure if they have livestock to sell for the purchase of grain when needed. This strategy should be supported and enhanced by NGOs wherever possible. All livestock credit programmes should be accompanied by improvements in feed supply and veterinary care. Among pastoral groups there is no doubt that improvements in veterinary care is the best way to improve food security.

INCOME-GENERATION PROGRAMMES

The sale of livestock and livestock products can be a very important source of income for small-scale farmers and pastoralists. It is one way of transferring resources from the wealthier urban population to poorer rural communities. As incomes rise families tend to purchase and consume a greater proportion of animal products. This trend will continue and it is important that rural livestock producers take advantage of it. Livestock can supply a regular small income through the sale of milk and eggs, or less regular but larger income through the sale of whole animals. Generally, smaller animals, such as goats, sheep, chickens and rabbits, are better able to assist the poorest in rural societies.

Typical NGO income-generating livestock projects are:

- dairy goats
- sheep or goat fattening
- chicken development and marketing
- rabbit production
- bee production and honey marketing

POTENTIAL AREAS OF NGO COLLABORATION WITH THE SR-CRSP

Before considering some areas of potential collaboration between NGOs and the SR-CRSP, it might be useful to attempt a simple participation analysis of NGOs in order to identify areas of potential complementarity or possible conflict. A similar analysis of the SR-CRSP has not been attempted but should be by those who know it.

It is clear that NGOs have many strengths which could be taken advantage of in applied agricultural research programmes. The greatest benefit to research scientists is undoubtedly their access to rural communities and the trust NGOs are given by the communities with whom they work. Added to this is the flexibility possible in NGO programmes combined with NGO staffs interest to innovate where possible. The NGO stands to benefit from the technical expertise that might be brought by researchers to a collaborative effort.

However, the most important aspect of NGO culture to remember is undoubtedly their humanitarian motivation. Little support will be found from NGOs for any collaboration that does not offer predictable and tangible benefits to their clientele. The research process is inherently unpredictable in this regard and NGO collaboration is always likely to be most fruitful, for both parties, at the most applied end of the research spectrum.

The main areas of possible collaboration between NGOs and the SR-CRSP might be identified as:

- setting of research priorities
- field testing of new technologies
- training
- information dissemination through projects and NGO networks

Table 1: Participation analysis of NGOs

Strengths	Weaknesses	Interest	Fears
Ability to identify and reach poorest	Technical competence	Humanitarian	Interference
Community cooperation	Weak links with GO's expertise	Independence	Loss of identity
Efficiency	Partial technical intervention	Organisational development	Loss of independence
Flexibility	Limited scale		
Innovation	Weak project appraisal, M&E		
Staff motivation	Territorial		
Donor interest			
Stability through supporters funds			
Accountability			

Setting of research priorities

NGOs tend to have a very close relationship with their farmer or pastoralist clientele and are therefore more likely to be able to identify problems better than researchers who are usually at a greater physical and cultural distance. If NGOs are expected to be involved in the testing of technology, which is an obvious role for them, it is proper that they be involved in setting the research priorities that guide the research which generates the technology.

Field testing of new technologies

The NGOs interest to innovate and obtain the best technology for their clientele should make them eager to test new technologies whenever possible. However, as most NGOs tend to focus on the poorest in any community, often living in unpredictable environments, there may be reluctance to test technologies perceived to have risks associated with them.

Training

NGO field programmes are fertile areas for training both NGO and non-NGO staff. There is a huge scope for graduate attachments to NGO projects to help investigate problems or monitor the impact of interventions.

NGOs also offer a useful vehicle for arranging short course training on new technology. NGOs are usually experienced at organising informal, practical, training sessions for both NGO and GO staff. These training sessions could be one way of disseminating new technology.

Information dissemination

Researchers are always anxious to disseminate the results of their work and NGOs are one channel through which this can be done. This might be achieved through short course training of NGO and GO extension staff (see above) and through the numerous international and national NGO information networks and meetings. NGOs, although territorial in nature, are increasingly realising the need to exchange their experiences and information with other NGOs, as well as with a wider government and donor audience. There are now numerous NGO networks

functioning for a variety of purposes. Collaboration with NGOs would provide researchers with access to these networks.

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APPENDIX

APPENDIX A

AGENDA

Monday, January 29, 1996

9:00 - 9:15	Registration	
9:15 - 9:30	Welcome	Dr. Mrema Executive Secretary ASARECA
9:30 - 10:30	Introduction	Dr. Demment Program Director SR-CRSP
10:30 - 10:45	*Break*	
	Country Presentations	
11:00 - 11:30	Ethiopia	Dr. Alemu, IAR Holeta
11:30 - 11:45	Discussion	
11:45 - 12:15	Kenya	Dr. Abate, KARI
12:15 - 12:30	Discussion	
12:30 - 1:30	*Lunch Break*	
1:30 - 2:00	Tanzania	Dr. Lugenja
2:00 - 2:15	Discussion	Asst. Comm. Livestock Res.
2:15 - 2:45	Madagascar	Dr. Rasambainarivo, ERZV
2:45 - 3:00	Discussion	
3:00 - 3:15	*Break*	
3:30 - 4:00	Uganda	Dr. Kiwuwa, Makerere Univ.
4:00 - 4:15		Discussion
4:15 - 4:45	Livestock Dev. Policy	Dr. Ebong, NAARI
4:45 - 5:00	Discussion	
6:00 - 7:00	Meeting of Thematic Group Leaders with Dr. Demment	

East Africa Livestock Assessment Workshop Agenda (continued)

Tuesday, January 30, 1996

	Country Presentations (continued)	
9:00 - 9:30	Burundi	Dr. Maniramboni, ISABU
9:30 - 9:45		Discussion
	Resource Presentations	
9:45 - 10:30	Kenya CRSP	Dr. Semenye, SR-CRSP
10:30 - 10:45	*Break*	
11:00 - 11:30	NGO	Dr. Peacock, Farm Africa
11:30 - 11:45	Discussion	
11:45 - 12:15	Human Nutrition	Dr. Murphy
12:15 - 12:30	Discussion	University of California
12:30 - 1:30	*Lunch Break*	
1:30 - 2:00	Wildlife/Livestock	Dr. Infield
2:00 - 2:15	Discussion	African Wildlife Foundation
2:15 - 2:45	Wildlife/Disease	Dr. Mihok, ICIPE
2:45 - 3:00	Discussion	
3:00 - 3:15	*Break*	
3:30 - 4:00	Wildlife/Natural Res.	Dr. Githaiga
4:00 - 4:15	Discussion	Kenya Wildlife Services
4:15 - 4:45	Policy/Econ. Growth	Dr. Ngategize
4:45 - 5:00	Discussion	Uganda Coffee Dev. Auth.

East Africa Livestock Assessment Workshop Agenda (continued)

Wednesday, January 31, 1996

9:00 - 12:00	Thematic Workgroups	Group Leaders
	Livestock/Environment	Infield/Githaiga
	Human Nutrition	Murphy/Semenye
	Economic Growth	Von Kaufmann/Ngategize
10:00 - 10:15	*Break*	
12:00 - 12:45	Full Group Discussion	
12:45 - 2:00	*Lunch Break*	
2:00 - 4:00	Thematic Workgroups Regional Integration and Prioritizing	
4:00 - 5:30	Reporting and Discussion	
6:30 - 8:30	*ASARECA Reception*	*Lake View Terrace*

Thursday, February 1, 1996

9:00 - 10:00	Thematic Groups Revison and Finalize Report
10:00 - 11:30	Final Reporting and Regional Priority Setting
11:30 - 12:30	Meeting of ASARECA Country Participants

Appendix B

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APPENDIX C

SOURCE: Summary Report, Meeting of SRCRSP Advisory Panel, October 19-20, 1995

SR-CRSP PROGRAM GOAL AND OBJECTIVES

Goal Statement. After a review of statements related to previous activities, the Advisory Panel agreed on the following:

> Improve food security and quality of life in developing countries through collaborative partnerships with US land-grant institutions and national and international agencies (government, NGO, private sector) for research leading to sustainable improvements in animal agriculture.

Strategic Objectives. Discussion first focused on a review of USAID's statement of strategic objectives: To reach an international consensus on indicators of food availability, access and natural resource accounting through: (1) adequate quantities and qualities of food that become consistently available for target populations; (2) adequate access of food by poor households (via self-production or purchasing power); (3) agricultural practices that enhance the long-term conservation of natural resources.

This discussion led to setting forth the strategic objectives for the proposed new phase of the SR-CRSP:

- To strengthen ability of institutions to identify problems and constraints and develop appropriate solutions in production systems in which livestock play a role.
- To support decision makers in developing more effective policies and technologies to improve livestock production, marketing, processing, and natural resource conservation and management.
- To identify, study, and strengthen communication systems (including but not limited to extension) among livestock producers, businesses, researchers, and consumers.
- To enhance the nutritional status of targeted populations through consumption of livestock products.
- To increase employment and incomes among livestock producers and associated value-added agribusinesses.

Program Themes. Review of the strategic objectives led to a revision of the themes for work for the proposed new phase of the SR-CRSP and areas in which it would undertake technical and policy research with respect to:

- Impact of livestock on the environment.
- Conservation of biodiversity.
- Human nutrition.
- Economic growth.
- Nutrient recycling..

Appendix D

EAST AFRICAN LIVESTOCK ASSESSMENT WORKSHOP THEMATIC GROUPS

Goal: To produce a set of prioritized constraints (problem models) related to livestock production that are the assessment and description of the underlying processes responsible or connected to the identified problem model in your theme. Identify and characterize potential partners for US Land Grant Universities with the capabilities of addressing the problem model. Provide information for ASARECA to set their livestock research priorities.

Suggestions

1. Please survey your group, determine if there are critical perspectives not represented by the expertise in the membership, and if so, communicate that to Susan Johnson and we will attempt to make adjustments in group composition. Please ensure that someone in the group takes good notes of the discussions and the issues raised. The results of your discussions will be presented to the entire workshop for discussion.

2. Establish a list of issues raised by the presentations of the country representatives and resource people that are related to your theme. Add additional topics which group members feel are important but not raised in the presentations. The topics should be researchable issues. For example, CRSPs and ASARECA do not provide tractors or fertilizer, but they might well analyze why policies that affect their supply maybe constraints.

3. Organize this list of issues by either linking them functionally or grouping them by subject matter area. Then distill each grouping into an integrated problem description (Problem Model).

4. Use the expertise of the group to develop a detailed description of the problem. Most problems are, at the surface, the domain of a single discipline or area of interest. For example, trypanosomiasis has often been the domain of animal disease and veterinarian medicine. However, the surface problems are likely aggregated phenomena generated by a number of interacting lower level processes outside this domain. Trypanosomiasis infection is more than a problem of vaccine development. The constraints on its control are the product of macro and micro policies that control everything from land use patterns to the economics of vaccine development. At a minimum the disease's impact is a function of the ecology of host and vector, their genetics, and the management of livestock and wildlife populations. Furthermore the strategy for successful control is likely to be a multifaceted approach that combines vaccine development with the genetics of disease resistance and comprehensive land and animal management strategies.

5. Determine how regional the problem model is and identify the countries where this problem is particularly important.

6. Make a list of institutions in the region, including international institutions not located in the region but active in the relevant area of research, that could be potential partners with US. Land Grant universities for each of the problem models identified. Provide a description of their capabilities and their comparative advantages relative to other institutions who might work on the problem model. Keep in mind the continuum from research to technology development to extension of a product. Consider NARs, national universities, research institutions, IARCs, NGOs, women's groups, private sector businesses, farmers organizations, and others.

7. Make a list of active projects in the region or globally that address or are related to the problem model. Provide a brief description of the project, including, if possible, the collaborating institutions, the funding sources and a contact to allow SR-CRSP to gather information on the project.

THEMATIC WORK GROUPS:

Livestock/Environment

Mark Infield & K. Githaiga, Group Leaders

1. Jhon Rasambainarivo
2. Jean Ndikumana
3. Alemu Gebrewolde
4. Steve Mihok

Economic Growth

Ralph von Kaufmann & Peter Ngategize, Group Leaders

1. Christie Peacock
2. Ernest Manirambona
3. C. Ebong

Human Nutrition

Suzanne Murphy & Patterson Semenye, Group Leaders

1. G.H. Kiwuwa
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