Small Ruminant CRSP

LATIN AMERICA

REGIONAL LIVESTOCK ASSESSMENT

WORKSHOP PROCEEDINGS

San José, Costa Rica
April 15 - 18, 1996

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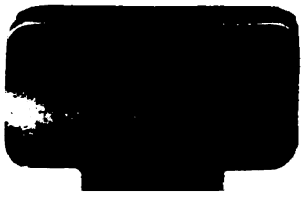

LATIN AMERICA LIVESTOCK REGIONAL ASSESSMENT WORKSHOP

SAN JOSÉ, COSTA RICA

APRIL 15 - 18, 1996

Sponsored by the Small Ruminant Collaborative Research Support Program (SR-CRSP)
In collaboration with the Inter-American Institute for Cooperation on Agriculture (IICA)

Published by the Management Entity,
Small Ruminant CRSP, University of
California, Davis, California 95616

This publication was made possible through support provided by the Office of Agriculture and Food Security, Global Bureau, United States Agency for International Development, under Grant No. DAN-1328-G-00-0046-00.

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FOREWORD

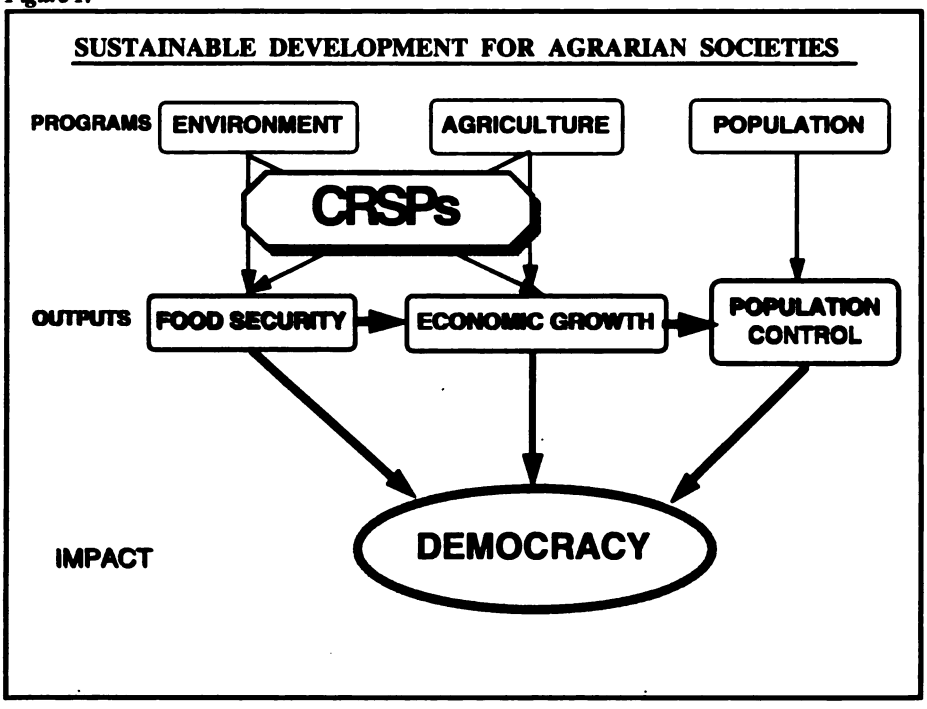
By Montague W. Demment
Small Ruminant CRSP Program Director

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

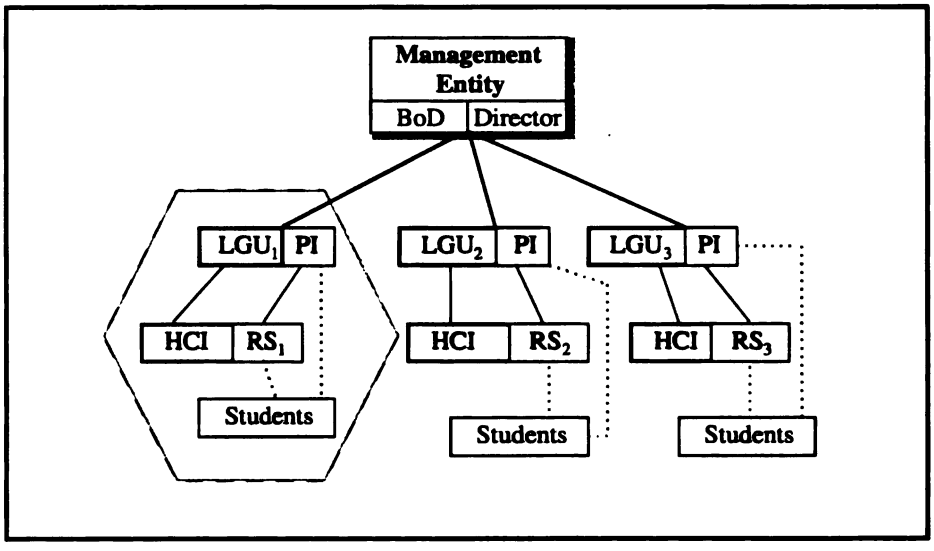
"...in order to prevent famine and establish freedom from hunger the U.S. should strenthen the capacities of U.S. land grant...universities to improve their participation in the U.S. government's international efforts to apply more effective agricultural sciences to the goal of increasing world food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

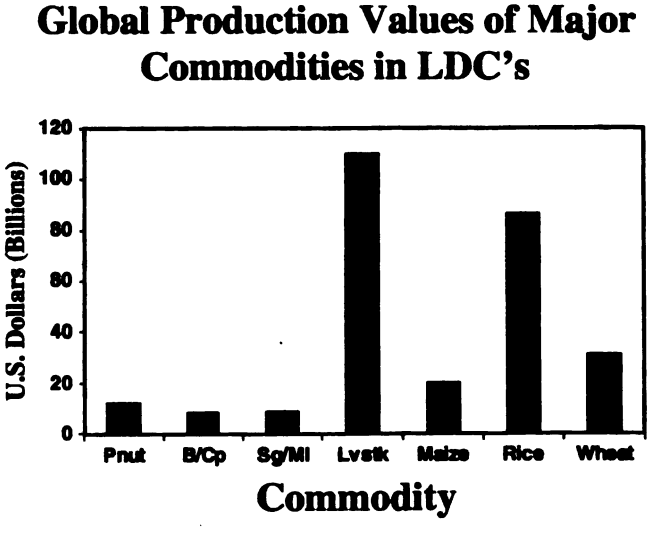
A series of meetings and discussions, initiated at Winrock International in May 1995, produced an agenda of change for the SR-CRSP. The new characteristics were developed in response to identified weaknesses in the present CRSP program, to new visions for the operations of federal programs (Vice President 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.

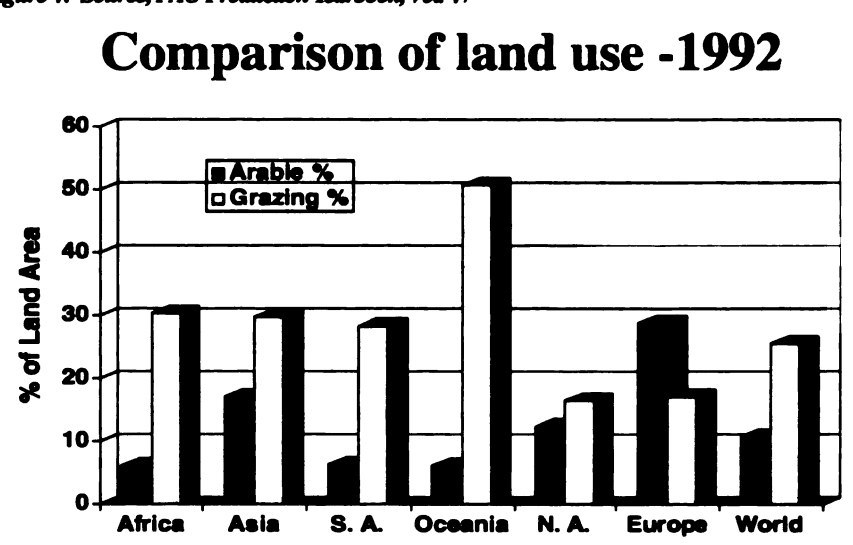
Customer Oriented. A major emphasis of the reengineering effort has been to provide more grass roots input into the identification of research/ development problems. In our planning process we attempted to have input at all levels, but gave considerable resources to middle level and grass roots. By combining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

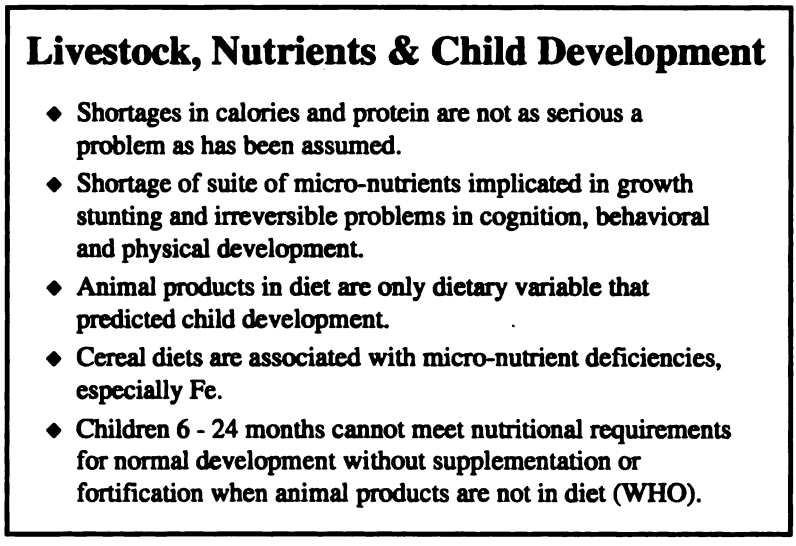


agrarian based economies, even if they are to become more industrial based, agriculture must be more productive and profitable. The impact of improved economic growth from the agricultural sector has benefits beyond just profits. The security of that growth and the increases in human nutrition affect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



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

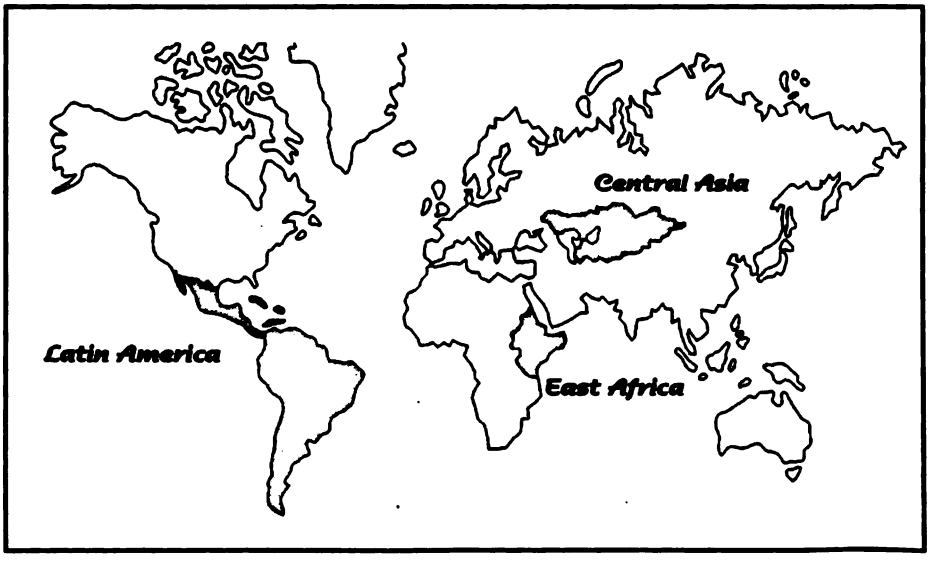
The first step in involving the customer is to identify the customers. In the CRSP we have three sets of customers: programmatic level customers, the first is the Agency itself, Congress and the domestic livestock industry; the next level are the national research institutes in the developing countries,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

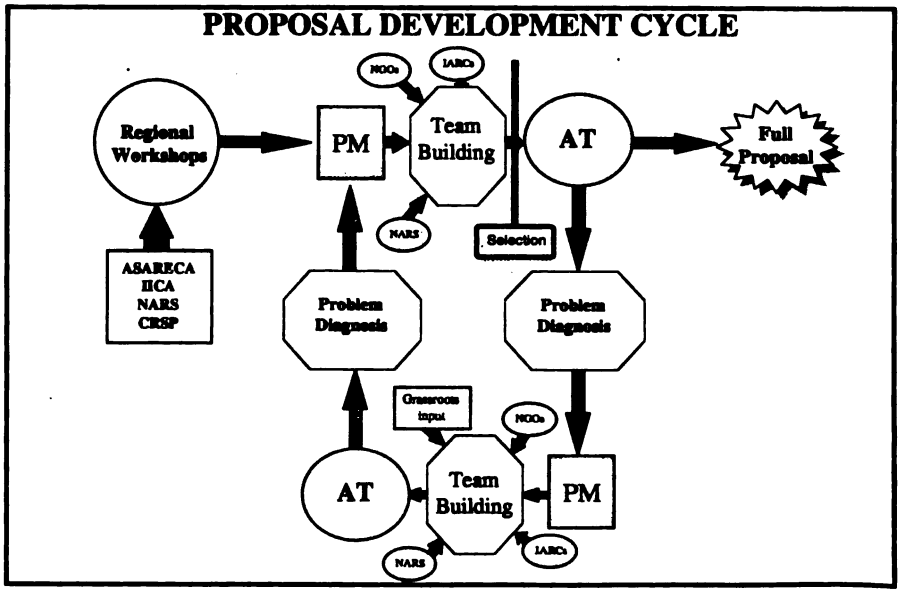
program to topics with shorter time horizons, the CRSP needs to develop mechanisms that provide both continuity for long-term research and also the opportunity for attracting new participants. To achieve this goal, sub-contracts will be restructured to make the relationship between the ME and US Land 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.

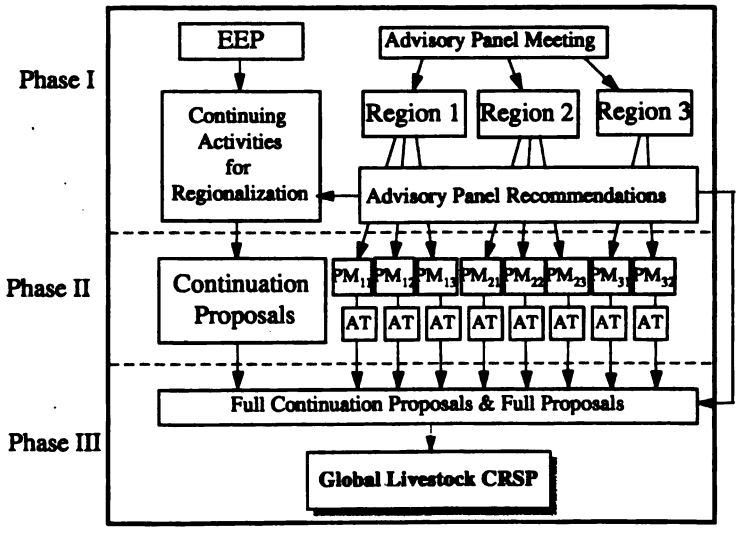
The first process has been described in detail above. The second avenue to funding was initiated with the report of the External Evaluation Panel on continuing activities. The Kenya project was recommended for consideration. The project, focused around the CRSP/ KARI breed of goat (Kenya Dual Purpose 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



LATIN AMERICA

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 role 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 Inter-American Institute for Cooperation on Agriculture (IICA), the Small Ruminant CRSP sponsored the East African Regional Livestock Assessment Workshop April 15 - 18, 1996 in San José, Costa Rica. Nine countries of Latin America were represented at the workshop: Belize, Guatemala, Mexico, Honduras, Costa Rica, Peru, Bolivia, Ecuador, and Trinidad. Participants were from NGOs, NARs, IARCs, FAO, local universities and the private sector.

THEMATIC GROUPS

Three workgroups were formed around the following themes: Human Nutrition, Livestock/Environment 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.

The results of the group discussions are presented below.

Problem Models

PRIORITY RESEARCH TOPIC ON ECONOMIC GROWTH/POLICY

(1) Livestock Production Systems For Ecoregions

Introduction: There continues to be a large population of rural low-resource farmers in all countries of the LAC. These persons have a) little income, b) few employment opportunities, c) have a diet low in protein and nutrients especially those from animal origin and hence are prone to major nutritional deficiencies and generally have problems of food security. Yet there exist low-resource production and marketing systems of animal production of various species which feed well on shrubs and other forest trees under intensive/semi-intensive systems of production which are environmentally friendly.

Objective: To identify, characterize, adapt, test and validate these animal systems and transfer them to these low-resource farmers.

Hypothesis: If low-resource farmers work with these systems, help adapt them and demonstrate them to other farmers, there would be a high adoption rate that will generate employment, increase income, improve nutrition and food security.

Activities:

- Identification of target groups and their agro-socio-economic characterization using a sondeo approach to establish baselines and determine needs, constraints and opportunities.
- Identify, analyse and characterize the named technologies and understand the reasons for their successful performance.
- Adapt, test, validate and transfer such technologies into other interested areas in similar ecoregions and groups of farmers.
- Develop information packages and recommendations and continue to provide technical backstopping.
- Monitor and evaluate farmers' adoption, adaptation and performance under their conditions and their criteria.
- Upgrade capacity of the clients through relevant training.

Outputs:

- Tested, adapted and validated production and marketing livestock systems successfully developed.
- Systems transferred to wider groups of farmers and being uitlized by farmers to achieve their objectives and to train other farmers.
- Farmers trained on technology management, adaptation and evaluation.
- Farmers having gainful employment and cash income, and having animal products in the daily diets of their family.
- Information packages, recommendations and training materials for technology transfer and use by other groups.

Regional relevance: Low-resource farmers constitute a significant population of most LAC countries and face the same problems of food security, employment, icome and nutrition.

Actors:

- Land grant universities in USA
- CATIE in Costa Rica
- National and subnational R&D organizations
- Institutes in LAC, e.g. CARDI, CFNI in the Caribbean
- Farmers' Associations in the LAC
- NGOs

Active Projects:

- EDF funded goat project in the Caribbean
- EDF funded feed and feeding systems in the Caribbean
- CATIE goat project

(2) Impact of Macro-Economic and Trade Globalization

Introduction: LAC is endowed with a productive resource base for livestock production superior to that of the other major regions of the developing world. Furthermore, the LAC region provides an expanding market for livestock products which can be attractive for highly productive regions, i.e. Oceania, and also for the livestock commodity surpluses from the developed countries. Accordingly, it is critical to understand the effects and trends induced by these economic changes in order to direct the structural adjustments to effectively exploit the created opportunities and mitigate the negative impacts of globalized trade.

Objective: To determine the potential short and long term impact and trends of the economic globalization policies and the downsizing of the public sector on the livestock industry, rural development and natural resources under under different scenarios.

Hypothesis: According to economic and trade trends during the last 2 decades, present macro-economic and trade liberalization changes will bring about substantial repercussions on livestock product flows within and among countries, the actors involved in livestock production and trade, technology demand, labor employment, input markets, natural resources and the institutional modalities for providing support services (i.e. research and extension), to the livestock industry.

Activities:

- Review previous research results in each country to define the specific objectives and final methodology for the regional analysis.
- Constitute a multi-national and multi-disciplinary team to conduct the proposed research.
- Compare and contrast the predicted impacts with what has been occurring in the region as a whole and specifically within some countries leading in international trade liberalization and others lagging behind in such process.

- Study the impact trends and implications for other regions of the world which are potential competitors or clients of LAC countries with respect to the major livestock commodities.
- Evaluate in selected countries and in the LAC region as a whole the impact of economic globalization policies, public sector downsizing, privatization of selected livestock-related services.
- Interview key informants involved in the production-to-consumption chain of the major livestock commodities.
- Identify market niches for livestock products, even though of small size, which can be supplied advantageously by LAC countries.
- Construct short and long-term scenarios considering market forces and potential government adjustment policies to determine the expected impact on employment, producer incomes, natural resource use, and production systems with major advantages.

Outputs:

- Analysis of impact and trends associated with the globalization, privatization and public sector downsizing processes on the livestock industry, the participating actors and resource use.
- Empririically supported results and recommendations for public and private sector decision-making in LAC countries, regional fora and regional organizations.

Regional relevance: Intra-regional free trade decisions, the integration of most LAC countries into the World Trade Organization and the economic and social importance of the livestock industry make it imperative to render the highest priority of this project for all countries of the LAC region and indeed for the rest of the world.

Actors:

- USA Universities, e.g. UC-Davis
- Education and research institutions in LAC
- Multi-national organizations in LAC: IICA, CEPAL and SELA
- Producer organizations, processors, marketers of LAC countries.
- Ministries of Agriculture of LAC.

(3) Livestock Product Market Intelligence and Development

Introduction: Instigated by a) the mounting negative national balance of payments and the weakening value of national currencies and b) economic stabilization and structural adjustment pressures, many LAC

countries have taken the "fast track" approach to liberalizing their economy, adopting policies which lead to:

- Greater trade globalization,
- Stimulation of increased private sector participation
- Increased reliance on market forces to drive and regulate economic activity.

In the context of this new environment, a market-led approach must be applied to develop the livestock industry, hence enabling the sector to make notable a contribution to economic growth with equity. Most LAC countries lack an adequate information system and service for domestic and international livestock markets.

Objective: To provide producers, processors, marketers, policy makers, researchers and developers with timely market intelligence, to promote access to national and international livestock product markets, and to enable/facilitate effective competition in the livestock industry in representative countries of LAC.

Hypothesis: Poor market intelligence and poor delivery of relevant market information on livestock products (including niche ethnic markets) constrain the development and adoption of technological innovations for production and processing, development of appropriate effective marketing policies , and the generation of greater household income and foreign exchange from the livestock industry.

Activities:

- Analysis of quality, pricing, health, stratification and relevant conditions in local, national and international markets for major and promising livestock products.
- Diagnosis of the existing market policies, intelligence, information delivery systems and technical capacity in each country.
- Analysis and implementation of proposed interventions to address identified constraints and piorities in 2 above.
- Design and communication of market information packages to the specific target audiences (producers, processors, researchers, developers, policy makers) through appropriate media.
- Monitoring and evaluation of the utilization and impact of market information on production, research and extension programs and income generation.
- Training of local personnel in market intelligence, information delivery, M&E, etc.

Outputs: This research project will produce:

- Periodic market information bulletins, news releases and training manuals tailored to the targetted groups.
- Improved systems and human capacity for market intelligence, delivery, M&E.
- Increased production, productivity and income for producers, processors and forex from the livestock industry.
- Tested research methodologies for livestock market intelligence and delivery, etc.
- Publications for national and international audiences.

Regional relevance: Many countries (i.e. Mexico, Trinidad & Tobago, Costa Rica, Honduras and Belize) have established market-led approaches and will benefit directly from the results of this research.

Actors/Collaborators:

- International/Regional: IICA, IFPRI, ILRI, CARDI, CATIE and the Caribbean Export Development Agency.
- Universities: UC-Davis, UNAM, UCR, UWI
- NARs: Ministries of Agric and Livestock, Research and extension departments
- NGOs: Chamber of Commerce, Development-oriented agencies, Extension and credit groups.
- Organizations: Livestock producers organizations, etc.
- Media: radio stations, TV stations, newpapers
- Funding: CRSP, Governments, IDB, IFAD, country-USAID

Active Projects:

- IICA?, IFPRI?, ILRI?, CARDI?, CATIE?
- Mexico
- T&T
- Costa Rica
- Honduras
- Belize: Marketing Intelligence Service (Contact: Mr Jose Castellanos or Dr M. Avila, MAF, Belmopan, Tel: 501-2-22242, Fax 22409)

(4) Empowerment of Producers

Introduction: The vast majority of livestock producers are small farmers with mixed farming systems in which decision making responsibilities

on resource allocation, technology adoption, product utilization, and access to technical information are spread out and dynamic among various members of the household and community organizations. Improving their farming and livestock systems requires clear strategies and methods for empowerment and effective participation of the real decision makers in the research and development efforts.

Objective: To determine intra- and inter-household decision making processes and evaluate cost effective methods to empower them in order to increase livestock production and productivity.

Hypothesis: Empowering resource-limited livestock producers producers, i.e. participation of the real decision makers in livestock research, extension and support services, will lead to higher rates of technological adoption and substantial gains in livestock productivity, hence on enhancing household food security and nutrition, gainful employment and the sustainable development of the livestock industry.

Activities:

- Characterize the principal livestock production systems (e.g. cattle, dairy, pig, small ruminants, homeyard, honey bees systems) to determine the roles, knowledge, perspectives, priorities and decision making power of household members.
- Determination of the labor requirements and contribution and access, distribution of benefits from livestock production enterprises and activities, and social indicators, according to intra- and inter-household gender and age classes.
- Development and/or adaptation of appropriate participatory methods to involve the relevant household decision makers and beneficiaries in strategic activities, e.g.: selection and evaluation of technological innovations (e.g. agroforestry, dual purpose cattle, household value adding activities), setting priorities for research and extension, and livestock system management (i.e. resource allocation, choice of technologies, product utilization and marketing strategies).
- Training of change agents, service support agents and researchers in participatory methods to empower producers.
- Monitoring and evaluation of impacts of participatory approaches on technology adoption, livestock production, household nutrition, labor productivity, and natural resource conservation.

Outputs: This research project will produce:

- Improved human capacity for participatory research and development in the public and privates sectors.
- Increased livestock technology adoption and production, household income, employment and quality of natural resources.
- Tested research methodologies and training manuals on participatory approaches and methods for resource limited households.
- Publications for national and international audiences.

Relevance: Many countries (i.e. Mexico, Trinidad & Tobago, Costa Rica, Honduras and Belize) will benefit directly from the results of this research.

Actors:

- International/Regional: CIAT, CARDI, CATIE.
- Universities: UC-Davis, UACH, UADY, UWI
- NARs: Ministries of Agric and Livestock, Research and extension departments, Comision Nacional Caprina de Costa Rica.
- NGOs: Development-oriented agencies, Extension and credit groups.
- Organizations: Livestock producers organizations, etc.

Active Projects:

- Asociacion Costarricence Creadores de Cabras, (Contact person: Ing. Alejandra Jimenez Salas, Apartado 141-2250, San Jose Costa Rica, Tel: 506-279-6314 Fax: 506-279-6519.
- Belize Enterprise for Sustained Technology (BEST), (Contact: Ms Bridgitte Cullerton, Director, Belmopan, Tel: 501-2-22242, Fax 22409)
- Sheep and Goat Project, EDF Funded, Jamaica and Guyana (Dr S Parasram, Director of Research, CARDI, Trinidad and Tobago.

PRIORITY RESEARCH TOPICS ON LIVESTOCK/ENVIRONMENT

(1) Improvement Of Small Scale Agro-Processing Of Livestock Products

Introduction: Rural poverty has been associated with over exploitation and degradation of natural resources. Income generation at the farm level is often limited by inappropriate timing of sales and poor quality presentation of primary livestock products; encouragement of on-farm

and village level processing operations could generate a significant increase in farm revenues.

Actual agroindustrial processing has concentrated in large scale units located at urban and peri-urban areas, often times associated with high risk of pollution and wide spread squalor among the labor force.

Objectives: To increase farm revenue while improving product quality and insuring better employment opportunities at the small farm level.

To reduce natural resource degradation through increased farm revenue and offer alternative decentralized small rural processing that would reduce the negative environmental impact of modern agroindustries in large cities.

Hypothesis: Increased farm income obtained through processing of primary livestock products will improve the living standard of small farmers through added value to their produce, creation of employment opportunities and increased hygene and quality levels offered to consumers; while reducing risks of over exploitation of natural resources. Better rural employment opportunities will reduce social degradation caused by emigration to cities.

Numerous decentralized processing units of small size will reduce large or significant pollution caused by agroindustries in large cities.

Activities:

- Determination of products to be processed and their end-products.
- Identification and preliminary assessment of processing technologies and marketing schemes.
- Research and validation of new processing technologies such as cheese making, toffee (cajeta), sausages, dry-salted meat, shearing and fleece classification, dehairing, spinning and weaving, raw-hide tanning, leather handicrafts, etc.
- Training of producers, processors and family members.
- Marketing research.
- People's organization.
- Supply contracts between consumers and producers (input-output).

Outputs:

- Appropriate, environmentally friendly processing technologies

applicable at the small farm/village level, being used.
- Marketing schemes in place.
- Trained families and professionals.
- Increased farm revenues and higher/better nutritional intake.
- Increased job opportunities and reduced rural emigration.
- Utilization of processing by-products at village and on-farm level.
- Improved quality and sanitary standards of livestock products offered to consumers.
- Training material and technical reports.
- Reduced city pollution levels caused by large agroindustries.

Relevance: Particularly important for small farmers located in distant areas (difficult access) throughout the LAC Region.

Actors:
- INCAP, EARTH, ECAG, ZAMORANO, CITA (ucr)
- CIPAV, IMCA, DSEC
- FAO, IICA

(2) Adjusting Improved Technologies To Resource-Poor Farmers

Introduction: Many efforts have been made to develop improved tecnologies, which in many cases have resulted in interventions with proven capacity to increase productivity of production systems. Unfortunately, resource-poor farmers, due to specific constrains, have not been able to access the benefits of these technologies. Nevertheless, these tecnologies have the potential to assist these farmers if adequate adjustments are made.

Objective: To identify available improved technologies and adjust them to the circumstances of resource-poor farmers.

Hypothesis: Improved technologies capable of improving productivity that are available, but which require adjustment and validation under the specific conditions of resource-poor farmers.

Activities:
- Definition of pertinent indicators related to productivity, sustainability, equity and empowerment.
- Identification (inventory) and preliminary assessment of available technologies.

- Definition of validation method.
- Confirmation of preliminary assessment with farmer's participation.
- Implementation at farm level. Monitoring and evaluation.
- Analysis and definition of technology transfer (TT) approach.
- Implementation of TT. Monitoring and evaluation.

Outputs:

- A validated TT methodology
- Validated tecnologies
- Trained farmers and professionals
- Sets of indicators
- Support system for T.T. in place
- Training material and technical reports

Relevance: Particularly on the Pacific Slopes of Mexico and the Central America Isthmus, the Andean Highlands, the flooded savahannas of the Orinoco and Amazon Basin and the Caribbean Islands.

Actors:

- INIFAP, ICTA, BELIZE, ZAMORANO, DICTA, MAG-Nic, EARTH, ECAG, UCR, IDIAP, ICA, INIA, LA MOLINA, IVITA, IBTA
- CIPAV, IMCA, DESEC
- IICA, CATIE, CIAT, ILRI, ICRAF, FAO, CARDI

(3) Evaluation, protection and equitable rational use of wildlife in livestock production systems.

Introduction: A lack of knowledge exists among rural ranchers on how to carry out sustainable harvests of wildlife. There is also a lack of knowledge concerning the positive and negative interactions between livestock and wildlife. The rural community, many times, fails to perceive economic benefits from wildlife because of this lack of knowledge, and many wildlife species fail to receive protection from the rural community because of this lack of economic value.

Objective: To identify and determine the degree of ecological and economical compatibility between wildlife and livestock and to design potential methods that permit the rational management and/or sustainable harvest of wildlife in association with livestock, by the rural community.

Hypothesis: A rational management/use of wildlife will contribute to the conservation of these species and their habitats, since the rural community will receive a direct economic benefit from such species.

Activities:

- Literature review and other sources of information to identify actual cases and other new potential uses and/or interactions.
- Characterize actual relations (positive and negative) between wildlife and livestock.
- Evaluate the success and effectiveness of actual projects in the region.
- Evaluate environmental-, social- and economic impact of actual projects in the region.
- Design new models of rational use of wildlife associated with livestock.
- Propose research to fill existing voids in information.
- Training of extensionists and ranchers
- Implementation of models in selected sites.
- Periodic evaluation and monitoring.

Outputs:

- An analytical description of actual systems and their capacity to improve life conditions of the rural community.
- The proposition of rational and economic management systems for wildlife in livestock operations.
- Research results publications.
- Political recommendations for improved management and conservation of wildlife.

Relevance: Central America, Caribbean Basin, Ecuador, Peru, Chile, Bolivia, Argentina

Actors:

- Land grant universities-USA
- Agricultural and natural resource universities of the Caribbean Basin and Andean region (PRMVS-UNA, Costa Rica, CATIE, EARTH, La Molina, Peru, Cordoba, Argentina, etc.
- Ministries of Agriculture, Environment, Natural Resources, CONACS, RAMSAR, USFWS
- ONG's, DESCO, CEDEP, Nature Conservancy, WWF
- Small Producers and Peasant Communities of the Andean region,

community organizations or associations,

- Private sector: (e.g. Textile Industry of Japan, Italy, Peru, England, Andean Mining Companies, Alpaca International Association)
- FAD (International Fund for Agricultural Development), InterAmerican Foundation,

Active Projects:

- Soil Conservation and water management project (IFAD)
- Vicuna Management and Conservation Project
- Cattle projects of MINAE-UNA-Ramsar-FAO, Costa Rica
- Duck egg production-harvest, El Jocotal, El Salvador

(4) Adjusting livestock production systems to environmental potentials and limitations

Introduction: Traditional livestock production is based on practices that in appearance are detrimental to the environment (e.g. deforestation, overgrazing and grazing on slopes) if management is not controlled. This has been reflected in poor and insufficient technical and financial support as well as in poor levels of productivity. In contrast it is also known that livestock production, relative to intensive agriculture, is more stable in particular under extreme environmental conditions. The social and economic role of livestock over all Latin American countries, the rate utilization of natural resources and the needs of a growing demand of animal products, requires new approaches and new technologies leading to sustainable production and resource management to achieve improvements not only in family income and farmer's well being but also in environmental stability.

Objective: To develop and adjust livestock production technologies in order to achieve sustainable and rational use of natural resources and the environment.

Hypothesis: Livestock can be productive and compatible with rational use and management of natural resources and the environment.

Activities:

- Assessment and development of alternatives to alleviate seasonal effects on livestock production, due to variations in quality and quantity of available forage resources.

- Assessment of indigenous livestock and forage genetic resources.
- Adjustment and development of agroforestry (silvopastoral) technologies as a means for rational and sustainable use of natural resources and the environment.
- Development of appropriate animal production technologies for fragile slope areas and tropical savannas.
- Organization and management of livestock production activities (health, reproduction, nutrition, grazing and infrastructure) in accordance to requirements of new developed technological approaches.
- Monitoring of the impact on water, soil and vegetation caused by livestock production practices.

Outputs:

- Sustainable alternatives of livestock production to improve productivity and family income on the basis of a rational use and management of natural resources and the environment.
- Increased knowledge, awareness and policy recommendations on the interaction of livestock and environment.

Relevance: Improvement of farmer's income and well being on the basis of rational utilization of in- place available resources.

Actors:

- Small and medium-scale farmers
- Private enterprises
- Foundations and NGO's
- National and international research centers (CATIE, EARTH, Universidad Nacional de Costa Rica, CIAT/Bolivia, Universidad Cochabamba/Bolivia, RERUMEN, IBTA/Bolivia y Universidad Central del Ecuador, INIAP/Ecuador, Universidad Catolica/ Ecuador

PRIORITY TOPIC FOR HUMAN NUTRITION

Animal Source Products: A Key Issue For Child Growth And Cognitive Development.

Objective: To introduce or increase intake of animal source products into poor rural household diets, it especially of young children and women,

in a sustainable way compatible with natural resources, the socio-economic realities and cultural values.

Hypothesis: Low intake of animal source products result in a poor quality diet (low micronutrients content), which in turn, affects reproductive outcome and physical growth, and mental development of children.

Issues:

- The activities will be related to the following three main issues:
- How to increase or introduce animal sources.
- How to ensure a steady household supply over time of the animal source products through proper preservation and processing.
- How to ensure household consumption of animal source products for dietary improvement, without excluding market opportunities.

Activities:

- To increase or introduce animal sources.
  a) Ethnographic studies in a regional basis:
  -Availability
  -Management
  -Utilization
  -Consumption
  -Acceptability of potential animal source foods

  b) Baseline studies (in planned intervention area and control area):
  -Household socio-economic status
  -Nutritional value of typical diet
  -Nutritional status of community

  c) Qualitative evaluation of the promising animal sources, alone and in combination with non animal foods (nutrient content analyses)

- To ensure a steady household supply over time of animal source products through proper preservation and processing.

  -Ethnographic studies (current and past practices) on food preservation and processing.
  -Improvement of current methods and/or development and introduction of new methods.
  -Post-processing nutrient content evaluation.

- To ensure household consumption of animal source products for dietary improvement without excluding market opportunities.

  -Education/information through formal and informal activities about value of animal source foods.
  -Development of mechanisms to overcome negative attitudes and beliefs toward diet improvement with animal sources.
  -Participatory "hands on" household preparation, recipe design and test consumption of improved or new dishes.
  -Periodic follow up of acceptability and continuation of dietary improvement.

- Controlled study of impact (outcome evaluation). In both, control and study areas:

Independent variables

-Diet pattern and food consumption and nutrient intake for macro and micro nutrients of family member

Dependant variables

-Growth (anthropometry) and nutritional status of family members (children, women)
-Cognitive function, motor and mental for infants and preschoolers, cognitive function and school performance in school children.
-Household evaluation (baseline vs. post intervention)
- Micro-environment analysis
- Household food intake
(all of above will be carried out on two occassions at least three months apart)

Intervening variables

-socio-economic status
-illness
-genetic/familial factors
-micro-environment, etc

Household evaluation (baseline vrs. post intervention)

-micro-economic analysis
-household food intake

Relevance: Mexico - Central America, Andean Region

Actors:

- Central America and Mexico Region
  - Instituto Mexicano de Nutricion. (Mexico)
  - Instituto de Nutricion para Centro America y Panama (INCAP). Guatemala.
  - University of California
  - ICAITI, Guatamala (meat and milk production)
- Andean Region
  - Instituto de Investigacion Nutricional (Lima, Peru)
  - Universidad Central, o Catolica, o San Francisco de Quito (Quito, Ecuador)
  - Univresidad Nacional de Cochabamba (Bolivia)
  - University of California
  - Cornell University
  - Carribean Region
  - Carribean Food and Nutrition Institute
  - University of the West Indies
- NGO's
- Women's Groups

RANKING BY WORKSHOP PARTICIPANTS

1. *Livestock Production Systems for Ecosystems.*

2. *Adjusting Livestock Production Systems to Environmental Potential and Limitations.*

3. *Animal Source Products Key to Child Development.*

4. *Improvement of Small Scale Agro-Processing of Livestock Products.*

5. *Adjusting Improved Technologies to Resource Product Farmers.*

6. *Impact of Macro-Economic and Trade Policy.*

7. *Empowerment of Producers*

8. *Livestock Product Market Intelligence.*

9. *Evaluation, Protection and Equitable Rational Use of Wildlife in Livestock Production Systems.*

WELCOME ADDRESS

WELCOME ADDRESS

By Larry M. Boone
Deputy Director General, Inter-American Institute for Cooperation on Agriculture

Ladies and gentlemen:

Let me welcome you to IICA and express my sincere wishes that your deliberations towards the design of a new livestock research agenda for the SR-CRSP program in our region and the identification of key institutional linkages necessary to ensure the total success of this agenda will be most fruitful.

This gathering of outstanding and experienced research leaders assures that you will proceed with a well-informed accounting of those factors and circumstances that affect the transformation of present livestock systems into systems that will add to our countries' search for food security, more equitable food distribution, competitiveness in local and international markets, long-term conservation and use of our natural resources and sensitivity to social issues such as the role of rural women in agriculture.

I can also envision that to reach a consensus in the design of a new research agenda, you will identify those constraints that impede development in the directions noted before, as well as the practical measures that will be necessary to remove such constraints. It is important to be aware, at the same time, that just as we have constraints to deal with, there are also opportunities which need to be identified, assessed and taken into our programs. Such efforts are necessary if we are to respond to present and future challenges with a more imaginative and modern animal agriculture that is socially, economically and environmentally sustainable.

Development priorities need to be re-examined in light of diminishing financial resources. In addition, we must take into account the fact that new research and development are required to help alleviate constraints on food production. Both research and development, particularly in the livestock field, must be designed in a way that deals with environmentalists' concerns. Contrary to popularized views, many of us know that livestock systems are not synonymous with environmentally

destructive practices. Contrary to the concept that livestock benefits only large ranchers, we know that the presence of livestock is one of the most important factors in making small farm production systems sustainable in the long term and is, for this reason alone, central and essential to the life of a farm.

Any technical initiative, on a regional basis, should consider agricultural policies, environmental policies, the institutional framework of our countries and the human resources. I am certainly impressed by the variety of organizations present at this meeting because this ensures that different angles, interests and capabilities will be taken into account in your deliberations. I am also pleased to see that universities in the united states, represented here by the University of California, are joining Latin American and Caribbean organizations in the search not only for a new research agenda but also for working partnerships. In this respect, IICA is prepared to participate in a proactive manner. We at IICA are in service to all 33 countries of this region and we have a long tradition of collaboration with research and development organizations from the private as well as from the public sector.

With particular reference to the livestock sector, since 1986 IICA has been very active in inter-institutional coordination, planning and follow-up of research and development projects in various countries from Mexico to Chile, through the Latin American research network for animal production systems (RISPAL). Also, cooperative programs, such as Procisur in the southern cone and Prociandino in the Andean region have included livestock research and development in their agendas.

Four years ago, IICA, through RISPAL and the collaboration of the international development research centre (IDRC) of Canada, organized a global workshop to assess the work on animal production systems worldwide. More recently, IICA has joined expertise and established strategic alliances with FAO, resulting in the establishment of an international animal genetic resources program. Six months ago, together with the international livestock research institute (ILRI) and IDRC, a regional consultation meeting was organized here, resulting in a set of recognized needs for research and development in sustainable animal agriculture.

Thus, it is no wonder why we at IICA are so enthusiastic and supportive of this new partnership with SR-CRSP which will help us all

to begin the process of modernization of animal agriculture in a sustainable manner.

Again, let me wish you great success in your efforts. Without intent to dilute your efforts, we will be participating and observing throughout the sessions and will also make every effort to make your stay and work here as enjoyable as possible through our fellowship, friendship, hospitality and professionalism.

Thank you very much

COUNTRY PRESENTATIONS

Livestock Production Systems in Costa Rica

By Juan A. Arias, Raul Botero, Carlos Murillo, Jorge C. Rodríguez & Richard Taylor
Escuela de Agricultura de la Región Tropical Húmeda (EARTH)

ABSTRACT

Costa Rica is a small country with a strong vocation towards livestock production, especially cattle production systems for beef and milk production. Of the 5 million hectares that comprise its territory, half are pastures.

Beef production is carried out under extensive and semi-extensive systems of grazing. Low prices of meat in the international markets, along with low production and productivity indexes per unit area, have led to a significant reduction in the cattle population, from 2.1 million head in 1988 to an estimated to 1.6 million in 1994, in contrast with the human population which continues to grow at a steady 2.5% per year. Since 1987, milk production has become a more important economic activity than beef production, mainly because Costa Rica became self-sufficient in milk production that year, generating a small but growing surplus of milk for export to neighboring countries.

On a smaller scale but in a sustained manner, goat production systems have been improving over the last 20 years as an alternative for small and medium-size farmers. The introduction of purebred milking goats, the use of high quality forages from trees planted under agroforestry systems, and the intensive confinement of goats led to an important increase in production and productivity per unit area.

With regards to swine production systems, the industry is widespread throughout the country. However, the greatest concentration is found in the central valley which, at the same time, has the highest population density. The most common swine production system is total confinement with the use of complete rations. There is a growing need to identify foodstuffs and unused raw materials to substitute at least partially for the use of concentrates, due to the rising prices of the concentrate components in the international markets. Another area of interest in swine production is the development of new and appropriate ways to use and dispose of pig manure, especially in densely populated areas.

As a consequence of the restructuring of the Ministry of Agriculture, which began in the late 1980s, a National Committee for Research and Transfer Technology (CONITTA) was created in 1987. This independent entity was created to serve as an advisor to the Ministries of Agriculture and Science and Technology and to establish the Inter-institutional Committee to Define Research and Transfer Technology (PITTAS), which in turn will contribute to the definition of the national agricultural program.

Within livestock production systems, there is a need to increase production and productivity per unit area in order to minimize environmental risks, especially in fragile ecological regions, and to develop integrated herd health programs for both goats and beef and milking cattle. Another area of interest is the study and evaluation of the use of crops, pastures and trees in different modalities and sequences and their contribution to the environment. The improvement of forage quantity and quality through the introduction of legumes and improved pastures must be continued, as well as the development of appropriate post-harvest technology in order to ensure a steady supply of animal-source products and improve marketing opportunities.

INTRODUCTION

Costa Rica is a tropical country located in the southern end of Central America. Its total territory amounts to 5,062,000 hectares, of which approximately 50% are pastures for bovine production. More than half of the area dedicated to bovine production are farms of less than 500 has. (SEPSA-CNP, 1988).

The Agricultural Sector during the last decade has contributed up to 20% to the Gross National Product (GNP). Livestock has represented between 20 and 25% of the GNP of the agricultural sector. Beef cattle has been, in the past, the most important and stable component within livestock production in the country. Animal production contributes 35% to the GNP, although its economic input, expressed in colones, has been growing at a lower rate than other agricultural enterprises (Pérez, 1995).

In 1993, the yearly consumption of beef in Costa Rica was 25 kg/ person (Pérez, 1995), similar to developed countries in Europe, Brazil, Denmark and Panama, and double the average in the rest of Central America and the rest of the world (FAO, 1992).

The export of beef has ranged between 20 and 35 thousand cubic tons/year, which represents 5 to 8% of the value of all agricultural exports

and more than 80% of the livestock exports. However, this level of export of beef has been possible mainly because of the import of steers from Nicaragua which are slaughtered and re-exported. Meat exports in Costa Rica generate an annual income of between 40 and 60 million U.S. dollars (SEPSA-CNP, 1988).

Since 1988, milk production has surpassed beef production because of its sustained growth. Costa Rica has been self-sufficient in milk production since 1987, becoming only the second country after Uruguay in Latin America to reach this position without subsidies. The level of milk consumption per capita is 150 lt./year This level is double the consumption in the rest of the Central American countries, which averages close to 80 lt./year (FAO, 1992); above the United States by 50%; and at the same level as such developed countries as Switzerland, Holland, Denmark and Sweden (Planeación Colanta, 1994). Costa Rica is generating nowadays a small but growing surplus of milk for export to neighboring countries.

Regardless of this optimistic situation, livestock production, and specifically dairy cattle production, in Costa Rica has low production and productivity indexes; and the cattle population has been steadily decreasing, from 2.1 million animals in 1988 to an estimated 1.6 million in 1994, in contrast to a rapidly increasing human population growth rate of 2.5%/year (for instance, in 1988, there were 2.7 million inhabitants; in 1994, there were 3.1 million) (Pérez, 1995).

BEEF PRODUCTION SYSTEMS

Beef production systems are represented in Costa Rica by farmers who rear and produce their own animals, which is basic to all systems of production. This activity is supported by forage production through natural pastures, which developed in acidic soils of low fertility as a consequence of recent deforestation where wood was sold and short cycle crops introduced after the land had been cleared. The resulting pastures of low quality and productivity sustain only extensive beef production systems, which cannot be expected to produce high yields.

It has become more and more frequent to find farmers milking their cows on a temporary or permanent basis under extensive or semi-extensive systems of cattle production. Sale of milk or by-products processed within the farm provide a continuous cash flow. Income comes

from the sale of the weaned calves for fattening under pasture or feedlot systems. This generally occurs in a different region. Fattening of bull calves is done under semi-intensive or intensive pastoral systems in areas where soils are of good fertility with good infrastructure and access by road. Stabulated and semi-stabulated production systems for rearing and fattening bulls and steers are located in soils of excellent fertility and close to potential markets.

Limiting Factors For Beef Production in Costa Rica

Low production and productivity indexes observed in most beef production farms in Costa Rica, and the lack of suitable integral technical assistance and marketing and economic information, have limited the strategic planning capacity of small and medium-size farmers. This has reduced the financial competitiveness of the beef production systems, which is reflected in a small but gradual decrease of this activity. To satisfy a growing internal demand and to meet export quotas, live animals are being imported to be slaughtered (Pérez, 1995).

Specific Beef Production Factors in Costa Rica

- Beef production is carried out under extensive systems.
- There is low reproductive efficiency under this system.
- There is a high incidence of diseases and pests.
- Marketing difficulties are associated with the sale of beef products.
- Beef production systems have a low level of revenue.

Close to 66% of the area covered by pastures is of poor nutritional value, with low potential for the improvement of production levels per animal. Only 24% of the pastureland consists of improved forage species (SEPSA-CNP, 1988). In 1988, the number of animals/hectare was 0.94 (Pérez, 1995). In 1995, without considering the reduction in the land destined to be pastures, but taking into account the reduction in the total cattle population, the number of cattle/ha was 0.66, equivalent to approximately 0.5 animals/ha, which is very similar to that found by Rivas (1991) in the Latin American tropical areas. The primary reason for this low number of animals/ha has mainly to do with the low annual productivity and quality of dry matter available for the animals to graze. In the Pacific area, a prolonged dry season affects forage production; while in the Atlantic basin (humid tropics), the intensity and the amount of rainfall limits forage consumption by the animals.

In conclusion, Costa Rica has excess land dedicated to beef production, with a very low ratio of animals per unit area and low production/animal/ha (Pérez, 1995).

One of the most important limiting factors is the poor reproductive performance of the national herd, which has a strong genetic base on the Bos Indicus breeds. The annual parturition rate is 50%, which is equivalent to calving intervals of 24 months. These variables agree with those found by Rivas (1991) in other Latin American countries.

The main reasons for the low fertility of the national beef herd are attributed to nutritional, genetic and sanitary problems. It is difficult to identify the least productive animals on each farm due to the absence of reliable production information and adequate identification that would contribute to the design of strategic programs to correct nutritional, sanitary or management drawbacks (Pérez, 1995).

There is a need to introduce well-planned and validated crossbreeding programs in order to take advantage of the improved productive and reproductive traits of crossbred animals well-adapted to a tropical environment.

Apart from routine vaccination of animals to diseases such as septicemia, blackleg, malignant edema, and the routine parasitic control in Costa Rica, there are a number of other diseases which are not well known by farmers and that affect reproductive efficiency, such as Brucella abortus, IBR-IPC, bovine viral diarrhea and some of the venereal diseases such as campilobacter, tricomoniasis, leptospira, etc. Programs for the control and eradication of these disease should be jointly developed by government agencies and producers' associations (Pérez, 1995).

The middleman, and those who retail meat, have been the great winners in the marketing chain. They have entered at all levels of the marketing, from the purchase of live animals at the farm level to the slaughter and purchase of meat directly from the slaughterhouse (Pérez, 1995).

The excess of slaughter facilities properly installed for the slaughter and processing of meat has placed the industry in a position where they can recover only 30% of their investment (Pérez, 1995). One can also add the fact that most producers have little or no interest in getting

involved in marketing the meat they produce. This has opened an important space for the retailers who have obtained the major benefits through the direct sale of meat to the consumer.

By law, the price paid to the producer is regulated through supply and demand and the following are the most common ways in which cattle are sold:

- Purchase directly at the farm, where animals are paid for on the basis of an agreed price (small and medium-size farmers); or purchase on the price per kg for those farmers who can weigh their animals.
- Purchase at regional cattle auctions which have become a popular alternative; price is paid on the basis of weight.
- Purchase at the slaughterhouse, where price is paid based on the weight of the animal after slaughter.
- Purchase in the processing plants, where price is based on the yield of kilograms of choice cuts.

The high cost of land, the investment in animals, the high costs of labor and inputs required for beef production and the low prices producers get in return, combined with the low biological indexes obtained under the actual production systems, make this activity economically unprofitable when compared with the rates of return obtained with the same amount of capital investment in the financial market.

MILK PRODUCTION SYSTEMS

From 1970 to 1988 the national herd responsible for milk production has increased 4.9 times in what we call specialized milk production systems and 2.4 times for dual purpose production systems (Table 1).

Table 1: Total cattle population and number of females under specialized and dual purpose production systems (thousands of head)

YEAR	CATTLE POPULATION TOTAL	NUMBER OF FEMALE CATTLE	
		Specialized	Dual-Purpose
1970	1481.0	56.0	150.0
1982	2276.0	255.0	222.3
1988	2190.0	277.0	369.2

Source: GAFICA y SEPSA, adapted from CATIE, 1990.

Table 2: Total number female cattle in Costa Rica distributed according to geopolitical region and production system (thousands of head)

REGION	PRODUCTION SYSTEMS		
	BEEF	SPECIALIZED MILK PRODUCTION	DUAL-PURPOSE
CHOROTEGA	328.4	8.0	122.2
CENTRAL	160.0	160.3	112.6
BRUNCA	110.0	16.6	23.8
HUETAR ATLANTICA	118.3	30.3	38.0
HUETAR NORTE	129.1	61.9	72.6
TOTAL	845.9	277.0	369.3

Between 1984 and 1991, the specialized milk production herd has grown 17%, while the dual purpose herd grew 37% (CNPL, 1995). This is attributed to the adoption of production systems which exhibit more flexibility and can more easily absorb the changes in the price of meat by incorporating beef cows into the dual purpose production systems.

According to the data available from the national survey carried out in 1988, the distribution of the female cattle population group by geopolitical region and production systems (Table 2), 24.7% belong to the dual purpose production system and 18.6% to the specialized milk production system. These animals are distributed amongst 35,000 farms, of which 86% have less than 50 hectares. Of the total number of farms, 57% are dedicated to a dual purpose production system and 43% to specialized milk production.

Between 1979 and 1983 a total of 54 farms were analyzed to characterize specialized and dual purpose production systems in Costa Rica (CATIE-BID Project, 1990). It was found that livestock production is complemented by other agricultural activities in order to minimize economic risks. It was also found that specialized milk production used more inputs in the way of herbicides, pasture fertilizers and nutritional concentrates (Table 3). However, milk production/hectare/year was low, with averages ranging between 1,647 kg in farms which used specialized milk production systems, to 558 kg in farms under dual purpose production systems. In both cases, the parturition rates were under 63%.

Milk production is third in importance with regards to the GNP within the agricultural sector, with a total production of 519,000 metric tons of milk in 1994; and an increase of 65% between 1983 and 1995, along with an annual growth of 3.8%, which is higher than any of the other agricultural products (CNPL, 1995).

Table 3: Characterization of specialized and dual-purpose milk production systems in Costa Rica (static diagnose)

CHARACTERISTICS	MILK PRODUCTION SYSTEM	
	SPECIALIZED	DUAL-PURPOSE
Percentage of pastures on the farm	78	30
Percentage of farms with only cattle	59	13
Rotation of pastures (%)	94	50
Pasture fertilization (%)	88	11
Use of mineral supplements (%)	100	89
Use of nutritional concentrates (%)	76	0
Use of agricultural by-products (%)	18	22
Vaccination of animals (%)	94	72
External parasite baths (%)	100	78
Internal parasite control (%)	76	67

The amount of milk produced by province and geopolitical region is shown in Table 4. The Central, Chorotega and Huetar Norte regions are the main contributors to milk production, since 82% of the national milk herd is concentrated in these regions. It is also important to point out that in 1989 of the total amount of milk processed in Costa Rica came from farms located in the low tropical areas in the Caribbean and Pacific basins.

Of the total milk production in the country, half is commercially processed in large-scale plants and the other half is used for small-scale commercial processing and to produce home-made fresh cheese at the individual farm level (Figure 1).

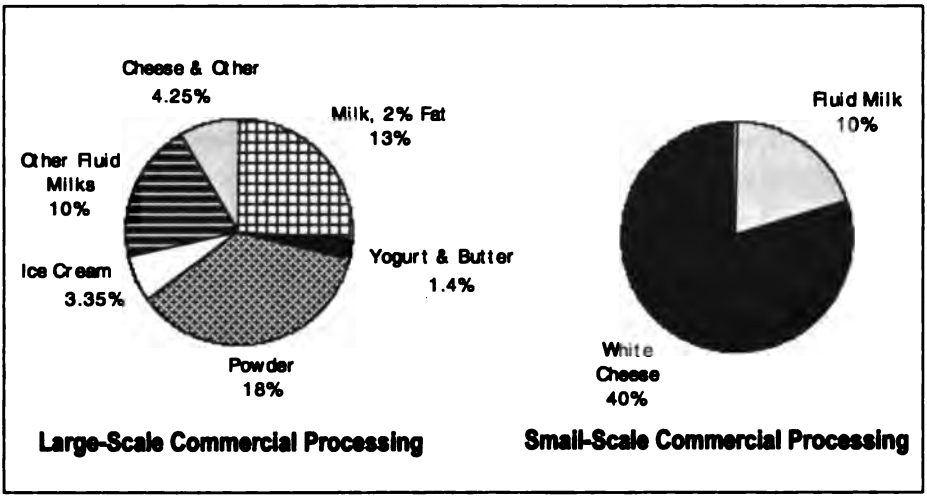
Since 1987, Costa Rica has been self-sufficient with regards to milk production, and a small but growing export market has opened. In 1994, 7% of the national production was exported as fluid milk (UHT), and

Table 4: Percentage of milk produced by province and geopolitical region in Costa Rica

PROVINCE	GEOPOLITICAL REGION	AMOUNT OF MILK (%)
ALAJUELA	H. Norte y Central	59.28
CARTAGO	Central	17.03
SAN JOSE	Central	7.41
GUANACASTE	Chorotega	6.89
HEREDIA	H. Norte, H. Atlántico y Central	4.67
OTRAS		4.72

Source: CNPL, (1995)

Figure 1: Commercial processing of milk in Costa Rica in 1995



imports of milk derivatives in the form of condensed and evaporated milk and processed cheese amounted to 4%.

The growth of small farmers in the humid tropics (farms of 10 hectares) and their participation in the free market will not be possible unless subsidized credit is obtained from the public sector.

Farmers in the humid tropical areas of Costa Rica are destroying the already-depleted natural resources in an effort to increase pastures and other agricultural activities. Improved pastures have been invaded by species of lower nutritional value, and this has prompted farmers to increase the size of their herds and to rent additional pasturelands in neighboring farms, as well as to supplement their animals' diets with concentrates. These efforts have not increased the production and efficiency levels of milk production/unit area and lactation (Holmann et al., 1995).

Taking into account the different ecological life zones in Costa Rica, it is important to consider soil, drainage, topographical and climatic characteristics of each zone in order to maximize animal and forage yields within the context of integrated farming systems, and with special attention to the protection of natural resources and the environment.

In order to develop an efficient milk production systems it is necessary to:

- Use cattle breeds adapted to the climate conditions of the different

life zones, with special emphasis on the use of commercially important naturalized species.

- Use forage species adapted to the soil and climate conditions and develop strategies for their use, conservation and improvement under the different production systems.

- Integrate the use of crops, pastures and trees.

- Direct efforts to increase yields per animal/ha and reduce the rate of growth of the dairy herd, specially in the life zones with higher ecological risk.

SMALL RUMINANTS

With regards to small ruminant production systems in Costa Rica, one could safely say that goats are the main species exploited within the country.

In contrast to other Latin American and Caribbean countries, goat production in Costa Rica since colonial days has been oriented towards milk production. Consumption of goat meat is minimal. A Spanish conquistador by the name of Diego de Artiaga brought 500 goats from Granada, Nicaragua to Costa Rica during the early 1600s.

During the first three decades of the 20th century, through private enterprise, Tuggenburg and Saanen goats were imported from Europe. In the 1960's, the Rockefeller Foundation donated to small farmers animals from the Nubia, Tuggenburg and Saanen breeds. However, the real takeoff of the goat production systems as we know them today began with the Heiffer International Program during the 1970's. This program was regional and included not only the donation of purebred animals from Tuggenburg, Nubia, Alpine, Saanen and Alpine breeds, but also had a well-conceived training program directed towards technical staff and small farmers, and was carried out as a collaborative effort in conjunction with the ministries of agriculture, NGOs and the newly-formed National Association of Goat Farmers. These actions created a significant change with regards to the role of goats within the context of animal production systems. Goats started to be considered highly productive animals per unit area, especially when kept under intensive

Table 5: Biological and economic variables of goat production systems in Costa Rica, 1975 - 1994

BIOLOGICAL VARIABLES	1975	1982	1988	1991	1994
Milk Prod./Goat/Day (kg)	0.50	1.30	1.65	1.80	2.00
Milk Prod./Lactation (kg)	90.0	305.0	417.0	460.0	528.0
Milk Prod./Has. (kg)	2700.0	7026.0	12106.0	12512.0	18000.0
Days Lactation/Year (kg)	180	235	253	256	264
Number of Goats/ Has	15	25	29	32	34
Average Weight/ Adult Goat (kg.)	32.0	36.0	42.0	45.0	50.0
ECONOMIC VARIABLES					
Number of Adult Goats	2000	6000	9500	12000	20000
Milk Prod./Year (Thousands of kg)	180.0	1833.0	3961.5	5520.0	6000.0
Absolute Price of Milk/Kg (Colones)	10.0	30.0	60.0	130.0	160.0
Total Income (Millions of Colones)	1.80	54.99	237.69	717.60	960.0

Sources: Castro, A. 1975 (MAG); Navarro, H. 1982 (MSc. Dissertation, CATIE); Vallejos, M. 1988 (Graduation Work, Lic. UCR); Marin, C. 1991 (Graduation Work, Lic. UCR); Castro, A. 1994 (MAG).

confinement production systems in which the basic feeding strategies were based on agroforestry schemes. Under this approach, conservation of natural resources and recycling play a major role.

According to the Costa Rican Association of Goat Production, there were 30,000 goats in Costa Rica in 1993. An overview of the last 20 years of the main biological indicators within this production system is presented in Table 5. With regard to the absolute price of goat milk in 1975, 1 liter of milk was 10 colones; in 1994 the price was 160 colones. However, this does not take into consideration inflation and devaluation of the colon over this 19-year period

The following are the strengths of the goat production system used in Costa Rica:

- The eixistence of an efficient national inter-institutional program, where government, research institutions, NGOs and small farmers interact.

- The development of sustainable agroforestry systems in association with goat production, which has generated encouraging results over the last 10 years.

- The development of low-cost, intensive goat production under total confinement.

- Active participation of family members (women and children) in operating the goat enterprises.

- The use of leguminous forage provides excellent nutritional value, and at the same time, contributes to soil conservation and improvement.

- The production of value-added products of excellent nutritional value.

- The use of goat manure as an organic fertilizer and a natural nematode control.

Areas for future research within the context of current goat research in Costa Rica:

- More research is needed in order to further develop and validate the use of agroforestry systems, with special emphasis on the contribution of trees to forage quality and soil conservation.

- Development of appropriate farm technology which could increase the value of goat milk through the production of yogurt, cheese and sweets.

- Development of technology and marketing strategies which will enable producers to compete with similar imported products.

- Further research in management of reproduction and breeding strategies with purebred goats in tropical environments.

- Development of preventive veterinary medicine programs suitable to the different environmental conditions in Costa Rica.

SWINE PRODUCTION

The swine industry in Costa Rica is widely spread across the national territory, with a great concentration within the Central Valley, 60 minutes from San José, the capital. The annual consumption of pork in Costa Rica has been established by the Hog Association to be 7 kilograms per capita.

The most common production system used in Costa Rica by the pork industry is total confinement and the use of complete rations. The land use is minimal and most of the hog farms are located close to rivers or creeks. Swine production is cyclical. Until the new legislation of January 1994, it was relatively easy for any farmer, or any person, to start a small production unit. This practice had caused cycles of overproduction in the past, forcing farmers out of business due to drops in the market price of pork.

According to the legislation of January 1994, the government role in regulating the swine industry is limited. It mainly controls the ocation of new facilities and the management of manure. The price of pork at the slaughter house and paid to the producer is dictated by supply and demand. The amount of pork imported or exported has been relatively low. The government has participated in regulating both activities due to pressures from pork producers or the slaughterhouses. The government is dedicating its efforts to the coordination of swine research. It has reduced the personnel dedicated to swine extension and is switching its support to the Hog Producers' Association in its efforts to help the producers.

Table 6: Number of pigs and number of farms per province

Province	Number of Animals	%	Number of Farms	%
San José	44.193	19.99	619	8.79
Alajuela	69.441	31.41	1.462	20.77
Cartago	25.270	11.43	257	3.65
Heredia	13.096	5.92	105	1.49
Puntarenas	30.781	13.93	1.042	14.80
Guanacaste	19.342	8.75	2.768	39.32
Limón	18.924	8.56	786	11.17
TOTAL	221.047	100	7.039	100

Source: Dpto. Salud Animal, MAG; Cámara Nacional de Porcicultores.

There are three major areas where the industry needs help:

1. Due to the industry dependency on the use of concentrates and the rising prices of foodstuffs on the international market, it is a priority to search for appropriate local foodstuffs and to develop new processing systems for currently unused raw materials.

2. Development of new and appropriate ways to use and manage the manure.

3. Research on different ways to market pork and to improve the efficiency of the marketing channels by the producers.

LIVESTOCK AND THE ENVIRONMENT

Cattle production in Costa Rica has traditionally been operated as an extensive production system. Between 1973 and 1984, the increase in land use for cattle operations grew more than 300%. This rate of expansion has decreased in the last two decades, and more land has been left abandoned as a result of declining beef prices and increasing interest rates which reduce the profitability of the business. Recent indicators tend to confirm that the area under pasture in the country is relatively stable around 2.5 million hectares. However, the national herd has been decreasing steadily for the last decade.

There are now over 500,000 hectares of abandoned pasturelands, which are both a challenge and a problem for policymakers since some of the areas are suitable for cattle production, agriculture and/or forest lands. It is possible to incorporate silvipastoral systems into these areas with rather little effort. The problem would be convincing cattle producers to increase investment at this time.

The effects of cattle and small ruminants effects are rather conspicuous in highland areas with little vegetation cover. The southern and west-central areas of the country, as well as some areas in Guanacaste province, have been severely eroded during the last decades. However, now that the intensity of cattle grazing has diminished, there is a chance that these areas will partially recuperate.

Some promising technologies may become widespread in the search for more intensive cattle production systems. Semi-confinement and

confinement could be explored as options to extensive cattle operations. There are mixed results in terms of the economic and financial viability of these options. But there is also a great deal of research and collaboration to take place before the possibility of a more intensive cattle production system in the tropics is ruled out.

Using alternative forages which are available and well-adapted to tropical climates would be desirable, and there are good examples that could be used as starting points for a detailed and productive agenda. The search for a high protein forage is of the utmost importance. This would lower costs and allow for a better and more productive diet for small ruminants, while decreasing the industry's dependence on imported foodstuffs and decreasing the pressure on the natural resources.

Another area of increasing importance is waste management of excreta and by-products of intensive cattle operations such as dairy farms, stables and goat production systems. The increasing population pressure has forced many operators to abandon areas near the central part of the country, which transfers pollution problems to rural areas with little incentive to improve conditions in the near future. It is increasingly important to develop alternative, low-cost and efficient management systems which would generate income and wealth for cattle operators, including processors and value-added industries.

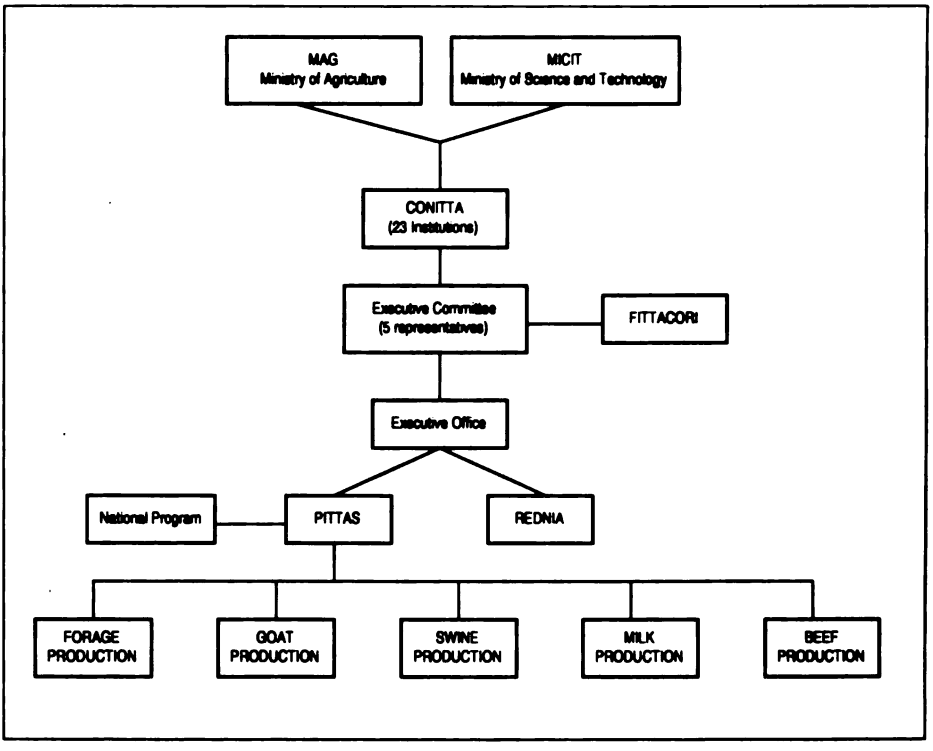
STRUCTURE AND INTERACTION BETWEEN INSTITUTIONAL COMPONENTS

Restructuring of governmental institutions, which started during the late 1980's, has significantly reduced the services offered by official institutions, which in the past were in charge of defining research and extension programs and policies.

In 1987, a government decision created the National Committee for Research and Technology Transfer in the Agricultural Sector (CONITTA) (Figure 2). The main functions of this committee are:

- To act as technical advisor to the Ministries of Agriculture and Science and Technology Transfer in the areas of research and technology transfer.

Figure 2: Policy, research and extension bodies in the livestock sector in Costa Rica



- To establish inter-institutional ommittees that will define and execute research and technology transfer programs at a national level (PITTAS).

- To establish databases with all the necessary information regarding research and technology transfer facilities and capacities within national institutions (REDNIA).

A total of 17 inter-institutional ommittees (PITTAS), five of which belong to the livestock sector (Figure 2), have been working together for the past two years.

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Animal Production in Mexico: Constraints, Problems and Researchable Topics

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ABSTRACT

Animal agriculture is an important activity in Mexico. It uses more than half the land, represents a third of the agricultural GNP and generates 12% of the employment in the sector.

Mexico is among the 10 largest producers in the world of beef, poultry, eggs and honey, and among the top 20 countries in the production of milk, pork and goat meat. It is also one of the largest exports of live cattle (more than 1.3 million/year).

Very modern producers and production systems coexist with traditional small producers, so there is a wide spectrum of technology in use, with a variety of products, systems and ecological conditions in which production occurs.

In an analysis of current research attention on different production systems, in which experts' opinion regarding the systems' future importance and their dependence on the national research systems were contrasted, it was determined that there is a need to give more research support to goats, beef, poultry, and home-yard diversified systems. The national use of grasslands in both tropical and arid zones, and in the systems promoting income and food availability and better use of labor in small producers' households, were also defined as being important.

The country has about 150 P.Ds and more than 320 MSCs actively involved in animal production and health research in different institutions, particularly INIFAP and universities. There is a reasonable network of producers and other NGOs that can participate in technological innovation for production, sustainability of resources and improving the quality of life for small farmers and peasants.

The priorities for research are the following:

- Development of technology to predict performance of production systems and technological components within them
- Prevention and improved diagnosis of important infectious diseases, particularly those that affect international trade
- Integrated control of parasites—internal, blood, and external
- Increased production and higher quality products of dual purpose cattle systems in the topics
- Genetic management of beef productivity and disease defense
- Development of new production lines and the use of non-traditional species

INTRODUCTION

Animal production in Mexico is a highly relevant activity in the country that uses most of the land for grazing purposes, either temporarily or permanently.

Out of 196.7 mil. ha. of territory, grazing occurs on around 124.7 mil. ha. Of those, 86 mil. ha. are grasslands and shrublands in arid and semiarid zones; 10 mil. ha. are of cultivated forages; and 28 mil. ha. are secondary vegetation after bushland clearings. There are about 700,000 ha. of forage crops, irrigated or rain-fed, in good rainfall areas.

In addition to the grazing lands, animal production systems utilize as feed sources more than 40 mil. tons of corn stover, straws and other crop residues; 2 mil. tons of poultry litter; 600,000 tons of blackstrap molasses; and about 16 mil. tons of feed concentrates. We have estimated cereal grains consumption for farm animals to be about 11.8 mil. tons per year, of which 16.5% go for dairy, 31.7% for pork, 19.9% for eggs, 24.5% for poultry meat, and 7.4% for beef. Negligible amounts are used for sheep and goats.

The estimated inventories of animals for 1994 were: Bovine 35.4 mil., Swine 17 mil., Goats 9.3 mil., Sheep 5.9 mil., Hens and Broilers 310.2 mil., and Beehives 2.5 mil.

The production obtained in 1994 and the relative place in the world were as follows, respectively: Beef carcass wt. 1.364 mil. ton., 8th place; Swine carcass wt. 873.000 ton., 18th place; Sheep carcass wt. 30.200

Table 1: Relative Value of Animal Products in Mexico, %

PRODUCT	AVERAGE 1980-1985	AVERAGE 1986-1993	1994
Beef	26.5	30.0	29.2
Pork	28.9	17.8	16.0
Sheep meat	0.8	0.9	0.9
Goats meat	1.1	1.3	1.2
Poultry meat	9.5	15.5	19.6
Milk (cow)	25.0	23.4	22.8
Milk (goat)	1.1	0.5	0.5
Eggs	6.0	9.2	9.1
Honey	1.1	1.2	0.9

Source. Programa de producción de leche y de sustitucion de importaciones, p.2. SAGAR México, 1996.

ton., 34th place; Goat carcass wt. 38.600 ton., 13th place; Poultry carcass wt. 1.246 mil. ton., 9th place; Cow milk 7.32 bil. lt., 16th place; Goat milk 141 mil. lt.; Eggs 1.126 mil. ton., 8th place; and Honey 62.000 ton., 4th place. Preliminary figures for 1995 show an increase in beef (1.422 mil. ton.), pork (0.9 mil. ton.), poultry (1.336 mil. ton.), eggs (1.222 mil. ton.) and cow's milk (7.676 bill. lt.); and a slight reduction in sheep and goat meat and goat milk. A major reduction in bee honey is reported (47,200 ton.).

As far as the participation of the different products in the economic value of animal production, Table 1 shows that bovine products are the most important (beef and milk) with a little more than 50% of the total value of animal production. Notice that pork lost ground in the last decade, while poultry meat and eggs have steadily increased their participation.

The agricultural sector contributes 7.06% (1994) to the Gross National Product (GNP), while the rural population is 27%, and the rural labor force 24%, of the country's total.

Animal production participates with around one-third of the Agricultural GNP. In 1994, it was 31.6%. The average annual rate of growth of the animal GNP has been 0.2% between 1982-1992, which is below the average of human population growth and parallels the economic crisis of the 1980's suffered by Mexico and Latin America.

Animal agriculture provides 12% of the agricultural employment and pays about 47% of the average wages of the whole economy per person employed; it represents, however, 287% of what the crop sector pays as an average.

Agriculture and animal agriculture have therefore been losing importance in relative economic terms, showing decapitalization. A lag in productivity in the rural areas shows that the decapitalization process in concentrated in the poorest areas, mostly represented by underpaid or unemployed landless peasants, and producers with so little revenues that they can not make the investments required to modernize their farming systems to make them more competitive and productive.

Side by side with this sector of small producers are large producers and integrated consortiums which are very dynamic, taking a larger share of the total rural output of animal agriculture (more than 60% of the total value), basically through intensive systems. This last sector has different problems compared to the small producers and is more affected by government economic policies and the international markets of their main inputs and products, particularly those of the USA

Since the social revolution at the beginning of the century, land tenure for animal grazing was restricted to that required to carry a maximum of 500 Animal Units per person (Animal Unit equals a 450 kg. cow and its calf or its equivalent), in the original carrying capacity condition of the land. You could have more animals when your effort and investment increased the carrying capacity of the land. However, the land had to be classified as grazing land; and if you devoted part of it to crops, fruit crops or any other activity, chances were that the classification could change and the peasants could ask for rights on the surplus land according to the new classification.

Reforms to the Constitution in 1993 defined that you could give any use to the land without change in classification, allowed the sale of land given to peasants (made them owners), and promoted the establishment of rural production enterprises, including land of several private owners under a single administration and even renting, or including in those enterprises land of the so-called social sector or peasants that received rights to the land from the government as "ejidos" or communal lands.

PRODUCTION SYSTEMS

Dairy and Dual Purpose cattle:

The **per capita** consumption of milk or equivalent of milk products in Mexico is around 330g daily. From 1992 to 1994, about 35% of this has been from imports. The estimated consumption of milk for the year

2000 is about 13.8 bill. kg., about 88% more than production in 1994.

The trend of production in the last 30 years is quadratic when analyzed by regression on years (R2=0.9273), showing a better correlation than with a lineal model (R2=0.8182). Anyway, in that long period, what can be observed is that production has been steadily growing and that the relative annual changes are decreasing. In that period, different production areas and systems have evolved differently as far as their contribution to the total production of the country. The more tropical states, where dual purpose is the main system, have dropped in their contribution from about 39% of the total in the mid-sixties, to 30% in the mid-seventies and then have shown a rather steady contribution of about 25% from the eighties to date. A larger group of states from the central part of the country, where most systems are semi-intensive and some intensive, with a large proportion of small family operations, under a mixture of rain-fed conditions and irrigation, have moved their relative contribution from 48% to about 52%. The last region is in the northern states, which has more intensive production systems under irrigation, which has changed their relative participation in the total production from around 13% to close to 25%.

In the last 10 years, a sharp decrease in production was observed from 1985 to 1989 (from 7.1 to 5.5 bill. kg/year) with a recovery of an estimated 7.7 bil. kg. in 1995. The capability of response is higher in irrigated intensive systems, followed by semi-intensive family systems and then tropical dual purpose systems. Table 2 shows the distribution of dairy and dual purpose farms and animals in relation to herd size, according to the 1991 Census.

Table 2: Distribution of herds and inventories of dairy and dual purpose cattle in Mexico

	Accumulative %			
Herd Size, No. head	Dual Purpose Herds	Dairy Herds	Dual Purpose Cows	Dairy Animals
< 5	32.8	56.3	7.7	13.8
6-10	56.1	77.0	18.0	27.7
11-20	76.3	89.6	33.3	43.9
21-50	92.3	97.2	57.5	64.4
51-100	97.3	99.9	73.0	74.9
101-500	99.8	99.8	92.4	90.6
501-1000	99.9	99.9	96.0	94.9
>1000	100.0	100.0	100.0	100.0

Source: Calculated from 1991 Census (rounded figures).

More than 75% of the farms have 20 cows or less and around 60% of the animals are in herds of 50 or less cows. So, in the country, the great majority of the producers who require technology adapted to their means and capabilities, manage herds of 50 cows or less. Larger producers with more intensive systems can profit easier from knowledge developed anywhere in the world.

Specialized intensive systems have typical productions between 5000-6000 kg. of milk/cow/year, with highest registered-average-productions in a herd of 11,606 kg./cow/year (1071 cows 3x), and the top registered production in an adult cow adjusted at 305 d lactation was 16,600 kg. in 1995.

Production levels in semi-intensive family systems, which use a wide range of local feed resources, usually stay around 3000 kg/cow/year, with well managed herds averaging above 5000 kg/cow/year.

Tropical dual purpose systems average around 600 kg/cow/lactation plus the milk suckled by the calf.

So, there is an obvious great variation in the technology used and the resources involved in milk production by different groups in the country. Almost any modern techniques available in the world are used by someone; but there are large numbers of producers, and most of the inventories, that do require technology specifically designed for their conditions. About 18% of the cows milked produce close to 60% of the milk. Seven states produce more than 55% of the milk and, within those, milk is primarily produced in well defined areas.

Beef Cattle:

Two distinct main activities can be considered: cow-calf and growing and/or finishing operations.

Cow-calf operations are most often carried out under extensive conditions in the arid and semiarid regions (A-S.A.) and under tropical conditions (TC). Almost all the male calves produced in the A-S.A. regions are exported to the USA at weaning and are the main source of revenue of those producers. In the last few years, calf exports have amounted to between 1.3 to 1.5 million animals; more than 90% of those come from the northern states, even though the central and southern states are increasing their participation fairly rapidly.

The distribution of beef cattle according to herd size shows that about 50% of the total inventories are located in herds of 100 or less animals, and only 10% are in herds larger than 500 animals (Table 3).

In general, reproduction efficiency can be considered low: about 55% calf crop in A-S.A. and 50% in TC. There is a lot of room to improve herd productivity and the sustainability in the use of the natural resources involved in this system.

Table 3: Distribution of beef cattle according to herd size. Mexico, 1991

Herd Size No. Head	Cumulative % of the inventories
< 5	7.8
6-10	15.7
11-20	24.8
21-50	38.4
51-100	49.5
101-500	79.1
501-1000	90.1
>1000	100.0

Source: Calculated from 1991 Census (rounded figures)

Growing-finishing operations are common in TC with extensive to semi-intensive systems on pastures that deliver 3-yr-old animals with approximately 450 kg. live weight. More intensive systems on pasture plus concentrates are becoming more frequent, and shorten the growing finishing periods by more than a year under rain-fed TC and even more grazing in irrigated areas with intensive forage production and utilization.

Feedlot finishing is a highly variable activity, depending a lot on markets that mostly depend on the buying capacity of the households. As can be expected from the feed grain consumption for this purpose, the feedlot systems use a lot of by-products and are not as intensive as those of the USA. Carcass grading systems are in place in some of the northern states, but fat content or marbling of the carcasses are not highly demanded.

The large markets for beef are for lean, trimmed, boneless cuts. In the last 15 years, beef production in the country has fluctuated from 0.9 to 1.4 million tons, and demand estimations for the year 2005 are between 1.6 and 1.8 million tons

Sheep:

Sheep production has been rather static. Mexico imports more than 90% of the wool it requires. Sheep meat consumption is very low when compared to other meats. However, sheep are very important because they are a source of food, cash income, fiber for art crafts and fertilizer

for very small rural producers. Sheep are usually part of a small farming system typical of a lot of the Indian populations. According to the 1991 Census, there are 420,827 production units that have sheep; of those, 48% are in holdings of 2 ha. or less, usually in small towns or in landless backyard operations.

Most systems are pastoral with very little use of feed inputs from outside the production unit. Children, women or old people herd the small flocks during the morning and early afternoon and return to the household for the night. There is a lot of use of crop residues. In tropical areas, Pelibuey has become very popular and is extending all over the country.

Commercial operations do exist. Some of them are very efficient, particularly in central and northern Mexico, but there are only a few.

Markets for slaughter animals have been traditionally affected by unfair competition of culled ewes from the USA, which have very little value given subsidies for wool production, which rendered culled ewes as a surplus. The recent reduction in those subsidies are having a favorable effect on internal markets.

One aspect of particular importance about sheep production in Mexico, is the fact that most of the meat consumed is in the form of "barbacoa," a typical spicy dish which is deeply cooked underground, so the age of the animal or the degree of finishing makes little difference.

Goats:

As in the case of sheep, goats are socially a very important system. Mexico has the second largest population of goats on the continent (after Brazil) and, goat's milk is much appreciated for candies and typical desserts. Meat of adult animals is usually marketed for local dishes, which do not require high quality standards of age and fat infiltration at finish. However, in the case of goat products, there is an important peculiarity, which is the consumption of baby goats (suckling), which is the most important source of revenue for the producers. Baby goat is a rather expensive dish in urban centers.

The 1991 Census registered 493,384 production units with goats; 70% of them had most of the inventories and were of 5 or less ha., or located in the back yards.

Some of the pastoral systems share the same characteristics as those of sheep. But there are important differences, such as the fact that goat systems use a lot of the shrublands, mainly in arid and semiarid regions, and they graze on the crop residues of intensive managed irrigated areas, particularly of cotton.

In many areas of the country, goats are blamed for the destruction of grasslands, a situation that has its roots in the overstocking of these animals in poor rural areas where goats are the savings of the families. That is one of the reasons for the heavy utilization and degradation of range areas around small towns. True nomadic systems are practically non-existent with sheep and goats, even when in the northeast of the country some flocks move up to 20 km daily during the season when forage is scarce.

Intensive milk production with goats is increasing in northern and central Mexico, and in irrigated lands and mixed irrigation-dry land operations, basically for milk processing purposes to produce high value products such as cheese and other delicatessen items. This is an interesting trend that will bring more participation from commercial producers in goat production and will modify technological demands.

Swine:

This is one of the domestic animals with wide distribution in the country (1.37 million production units). Pork products are in high demanded when the buying capacity of the families is high.

Production grew rapidly between 1972 and 1983 (more than 250%) and, in fact, pork surpassed beef production in the early 1980's. From 1984 to 1994, there was a dramatic drop in production (around 40%) due to economic policies—such as reduction and suspension of subsidies for grains, reduction of commercial protection, opening to international markets—and an economic crisis that reduced family incomes.

The integration of Mexico into global markets, and particularly into NAFTA, has had a drastic effect on pork production. Between 1992 and 1994, around 20% of pork products consumed in Mexico were imported, and for commercial producers the rising costs of grains and interest rates are detrimental for unintegrated producers, who cannot even pay their debts. Producers now say that the only way out is productivity. The country

Table 4: Distribution of swine and swine production units according to herd size. Mexico, 1991.

Herd Size No. Head	Accumulative Percentages Farms	Animals
<5	79.93	25.4
6-10	93.28	40.7
11-20	98.32	51.3
21-50	99.55	56.7
51-100	99.77	59.0
101-500	99.92	63.7
500-1000	99.95	66.9
>1000	100.0	100.0

Source: Calculated from 1991 Census

was the 6th largest pork producer in the world in 1983, but was around 18th place in 1994.

Even when most of the production comes from modern intensive systems, more than 50% of the swine population and 98% of the production units have only 20 or less pigs (Table 4). Fewer than 1200 farms have more than 500 pigs.

Small, backyard units are important as a source of income and savings for rural and suburban families, who use complicated mixtures of traditional and modern technology. Marketing constraints and ecological and sanitary regulations are reducing the presence of backyard and small operations as significant contributors to pork production.

As mentioned for milk production systems, in swine one can find any modern technology being used, as well as swine units and integrated consortiums as productive and efficient as anywhere in the world. On the other hand, there are producers with swine roaming free in extractive systems, where the animals are a real sanitary hazard both to humans and to other swine.

Poultry:

As in the case of swine, in poultry production systems there is a bipolar situation with large enterprises on one hand, and a multitude of backyard poultry owners on the other hand.

There are only around 1600 farms with 5000 or more birds (out of more than 3.4 million production units with poultry). Mexico is the largest producer of eggs in Latin America and the second largest producer of broilers.

The technology used in commercial farms is similar to that in other parts of the world. So are the problems producers have to face, with the peculiarity that Mexico imports most of the feedstuffs and the seedstock it uses for poultry production.

One area of importance is the Criollo swine and poultry populations that have evolved under little selection pressure and can be a valuable source of genetic variability for these species.

Bees:

Before the Spanish conquerors arrived, Mexican Indians produced and sold honey from bees. Europeans brought more productive European bees, which nowadays make an important rural industry for small producers; Mexico is the third largest exporter of honey. It is estimated that the natural resources of the country could easily permit the doubling of current bee production.

Of the more than 2 mil. beehives, only about 6% are old-fashioned; the rest are the modern type, producing an average of 25.6 kg/year. Around 45,000 small producers are involved in apiculture, including pollination activities.

One of the problems faced by the bee producers has been the presence of African bees. So far, the technical measures adopted have avoided a sharp decrease in production. Between 1990 and 1994 there have been 492 human accidents with African bees, involving 3,949 persons, 236 of which died.

Figure 1 depicts the author's opinion on the current situation and tendencies of the most important animal production systems.

Figure 1: Current situation and tendencies of the animal production systems in México

Product/system	Type of Operation		
	Large Integrated	Medium Integrated	Small Integrated
Eggs			
Poultry meat	⧫ XXXXX	→ XX	
Pork	→ XXX	⧫ XX	X
Dairy (Intensive)	→ XXX	XXX	X
Dual Purpose (Tropical)	XX	XX	XXX
Cow-Calf	⧫	→ XXX	XX
Beef (growing-finishing)	→	XXX	
Sheep breeding	XX	⧫ X	XXXX
Goats milk		XX	XXX
Small Ruminants (growing-finishing)		XX	XXX

→ Tendency

⧫ Strong Tendency

INSTITUTIONAL SUPPORT TO ANIMAL PRODUCTION

Federal Government:

The most important agency is the "Secretaria de Agricultura, Ganadería y Desarrollo Rural" (SAGAR). It is in charge of the promotion and support of animal production and health programs. There are four major components: General Director of Animal Production Improvement and General Director of Animal Health, who report to the Undersecretary of Crops and Animal Agriculture; the National Research Institute (INIFAP), which has an Animal Production and Health Division, and reports to the Undersecretary of Rural Development and to the Director General for Statistics, who reports to the Planning Undersecretary. All of these are central units for planning and define the uniform methods and rules. Operations are carried out in the different states under the coordination of a representative of SAGAR and the state's Department of Agriculture.

Federal actions deal with sanitary campaigns, inspection services, registration of products to be used in animals, regulation of producers' organizations, interstate mobilization of animals and animal products, development of policies to support a given animal production activity and organization of events of interaction between producers, government, processors (packing and so on) and retail distributors of animal products.

Research is carried out in three national centers (by discipline) and eight regional centers (by production system). Extension service has gone through a series of adjustments and is oriented to share and coordinate efforts with private technical assistance.

State Governments:

Every state government has a specialized unit that deals with animal agriculture matters. They coordinate with federal programs. But some of them develop and operate their own programs, usually dealing with land and infrastructure improvement for production, storage or distribution of products and inputs for production.

One important activity of state government agencies is the registration and control of irons and brands of the individual ranchers and farmers.

Some states have programs of technical assistance in pasture improvement, animal nutrition, reproduction and health management, and contribute to the implementation of the animal health national campaigns.

Non Government Organizations (NGOs):

Nationally, there are two major organizations with national mandates: National Council for Animal Health (CONASA) and the National Commission for Animal Genetic Improvement and Reproduction (CONAMEGRA). The first one is an advisory group of experts organized into 26 committees; the second is a joint effort of the government (SAGAR) with the National Confederation of Animal Producers (CNG). CONAMEGRA processes semen of outstanding animals and distributes it all over the country, hires or contracts outstanding animals of private producers for their intensive multiplication, and promotes or conducts training events on animal genetic improvement and reproduction.

There is a third organization which is under formation—the National Council for Animal Production—which will have a lot of similarities with CONASA.

One important NGO is the Mexican Association for Rural Development, which conducts specific activities at the farm level with the support of private and some government funds from Mexico or other countries.

In every state there is a formal committee called "Comite de Fomento y Protección Pecuaria," with the joint participation of government agencies, producers' and professional organizations, and, in some cases, the local universities, to coordinate programs for the development of animal agriculture. These are the most important people involved in animal genetics, health and pasture improvement programs. The president of these state committees is usually the president of the state animal producers' union.

There has been a recent promotion for the establishment of a Foundation for Research and Technology Transfer for agriculture in every state. This will eventually support and administer INIFAP and other SAGAR programs in a given state. In this foundation there will be representatives of NGOs, producers and governments.

RESEARCH SUPPORT

INIFAP has the largest group of researchers, with the widest range of fields (45 Ph.D.'s; 173 MSc.'s and more than 30 Ph.D.'s in formation) in animal production and health. In addition, there are 14 graduate programs in different universities which are recognized by the National Science and Technology Council (CONACYT) and are doing some research.

Around 150 Ph.D. and more than 320 MSc. trained professionals are involved in research, either at INIFAP or at one of the universities.

The largest and more solid groups are in: Animal Feeding and Nutrition, Animal Health, Forages and Range Management; Reproductive Physiology and Management and Animal Breeding and Genetics. Smaller groups are oriented to socioeconomic studies and other general aspects of production.

There is a National Scientific Researchers System (SNI) that provides fellowships to recognized productive scientists. By 1994, only 168 were in the areas of Animal Production and Health. Of those, 92 were from INIFAP, followed by UNAM (23), CP (9), U.A. Chapingo y U.A. de N. León (4), and several others with 3 or less recognized researchers.

Besides INIFAP, the institutions with more staff members with Ph.D. or MSc. levels devoted to animal production and health are: National University (UNAM) in two schools (around 60); University of Yucatán (28); University of Chihuahua (29); Post-Graduate College (22); University of Tamaulipas (15); University of Chapingo (9); and Agrarian University Antonio Narro (around 10). Emerging programs are the universities of the states of Mexico, Baja California and Colima, with this last state joining efforts with 3 other universities to offer graduate degrees.

RESEARCH NEEDS

Defining research needs and priorities for animal production and health is a complicated task, since there are a lot of things to take into consideration, among them: priority of the species involved; specific regions and systems; type of producers; potential impact of the results at different levels (from individual farms to a whole industry); urgency of the results (attention to emergencies or circumstantial conditions) and so

Table 5. Relative importance (%) of the animal production systems in relation to their dependence on national research. Mexico, 1994.

Species/System	Regions		
	Tropical	Arid and Semiarid	Temperate
Cattle:			
Cow-Calf	19.8	24.6	-----
Dual Purpose	21.3	-----	4.0
Intensive Dairy	-----	6.1	6.0
Semi-intensive Dairy	-----	10.5	15.0
Finishing on Pasture	14.7	3.5	7.0
Finishing in Feedlot		2.6	6.0
Sheep:			
Meat	10.3	-----	-----
Goats:			
Meat	-----	7.9	5.0
Milk (DP)	-----	20.2	3.0
Pigs:			
Intensive	-----	5.3	11.0
Poultry:			
Broilers	2.9	3.5	7.0
Eggs	2.2	3.5	10.0
Other:			
Apiculture	11.8	3.5	12.0
Diversified Back yard Systems	13.2	4.4	14.0
Game-Ranching	3.7	4.4	-----

Source: División de Investigación Pecuaria. INIFAP, México, 1994.

on. Consideration must also be given to an assessment of real capabilities to tackle the defined subject of research adequately enough to have success, and to deliver efficacious information and technology on materials for the problem, need or opportunity addressed.

Taking into account those complications and the limits of this paper, I shall define some areas which have been identified as important.

In the second semester of 1994, a series of workshops (8) were carried out in different regions of Mexico to consult with policymakers of every state (federal and state government) about the regional animal production systems that should be addressed in the research projects and to prioritize them. It was made clear that the priorities referred to required national research and adequate support for those systems to develop within the next fifteen years. Importance was subjectively defined by each participant for social, economic or other reasons for a given region. A summary of the results of those workshops is shown in Table 5.

As far as specific topics, for ruminants in general, there is a need to develop the required basic information and the models to simulate different options of production systems, to take advantage of emerging markets and the recent changes in land tenure legislation.

Associated with the last point, development of sustainable agroforestry pastoral systems at different scales, from large commercial operations to small family units, is a demanded topic, particularly since the new legislation places no restrictions to multiple uses of the land. This point is particularly relevant for the tropical areas.

For the arid and semiarid zones, the development of regional prediction models for the severity and impact on pastoral systems and range lands, and for drought and other climatic events, is an important subject.

Of the animal health problems, there are four particular aspects more relevant for ruminants: An efficient vaccine against tuberculosis that does not interfere with diagnosis; development of efficient vaccines against anaplasmosis and piroplasmosis which can be handled in refrigeration with a long shelf life; prevention and control of the development of resistance or tolerance to pesticides of ticks, flies and other insects; and biological and integrated control schemes against internal parasites.

Other important general aspects of animal health are epidemiological monitoring of animal populations and reduction of reproductive losses and prenatal mortality.

For semi-intensive dairy and dual purpose systems, the aim is the relevant reduction of the large seasonal fluctuation in production. This includes systematic research to regionally define forage production conservation and utilization schemes, as well as strategic use of other feeds and herd management tools.

For beef production associated with dual purpose systems, it is important to define carcass qualities and yields of the different genotypes subjected to different methods and degrees of finishing. Yields and qualities should be referred to the traditional (more common) Spanish cutting system.

For dual purpose systems in tropical areas, there is need for a more

complete evaluation of genotypes and the development and establishment of affordable sire and cow evaluation methods.

Identification, characterization, evaluation, conservation and management of local and rare (usually Criollo) biotypes of domestic animals is a global priority. F.A.O. and IICA are promoting the establishment of an inter-American system for this purpose.

Specific topics for swine and poultry that need local (national) attention are: swine paramyxovirus or Blue Eye Syndrome, respiratory complexes, farm waste management and disposal, and the development of production systems less dependent on imported cereal grains, particularly based on high sugar or starchy crops that can be locally produced at low cost.

In bees, the priorities are in the area of the genetic basis of defense and their association with other productive traits, and biological or integrated control of parasitic diseases such as varroasis.

Development of new production lines or use of non-traditional species has been little explored and deserves more attention. For instance, sheep milk production could be important for small farming systems in poor areas and there is no experience, technology or animals to attempt any preliminary study. This is true for many species and systems that exist in other parts of the world.

Guatemala: Situacion General de la Produccion Animal, Algunos Problemas y Limitantes

By Sergio Ruano
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ABSTRACT

Guatemala is a country of great variety, both in social and ecological terms. It is a small country—108,889 square kilometers in size—with altitudes above sea level ranging from zero to more than 4,300 meters. Rainfall quantity ranges from about 600 millimeters to more than 6,000 millimeters. It has 9 of the 14 ecosystems recognized worldwide.

There are 23 different cultures totaling more than 10 million people, half of whom are native Indians. Socio-economic conditions are also highly varied, with 80% of the people considered poor. Around 55% of the population is rural and 85% depend on agriculture as their main economic activity.

Most of the population depends on corn and beans as the main staples, and do not consume either meat or milk on a regular basis. The per capita consumption per year is 50 liters of milk and 20 kg of meat (beef, pork, chicken).

The most important livestock production systems are cattle, swine, poultry, small ruminants, bees (honey), and shrimp. Cattle are the most important in terms of the country's economy; between 60-70% of farmers who own land are raising cattle. Nationally, the cattle population is estimated to be 2.2 million head. Most small farms (which are the majority of the farms) have only 2-3 animals; cattle are raised primarily on medium and large farms (more than 45 head). Around 55% of the cattle are in the Pacific Coast area. They are 65% dual purpose, 20-25% beef, and the remainder dairy. Most are under extensive management, regardless of the size of the enterprise or the quantity and quality of their resources.

Milk production is around 815,000 liters per day, and 85% of it comes from dual purpose cattle. Guatemala imports 26-30% of the milk consumed. Beef production in 1995 was estimated at 53,000 metric tons, about 20% of which was exported.

Currently, many farmers from the southern coast are moving their herds to the agricultural frontier in the norther part of the country (Paten), using the same extensive management system. Unfortunately, this move has resulted in a great negative impact, at an accelerated pace, on the area's natural resources.

Among the main problems and constraints in Guatemala are: a) extensive management in general, and animal feeding during the dry season in particular (regardless of the size of the enterprise), b) lack of producers' organizations, c) lack of credit and technical assistance, d) international economic policy (structural adjustment), dumping, and the elimination of subsidies at the insistence of developed countries (without these countries reciprocating), e) environmental problems due to the current extensive management practices, f) lack of access to animal-source foodstuffs (meat, milk, cheese, etc.) for most of the population, and g) lack of resources for research as a result of international economic policy.

Guatemala raises 60% of the goats and 90% of the sheep in Central America, the great majority coming from small and subsistence holdings in the highlands. The goat population is estimated to be 150,000 head, and sheep 600,000 head. About 30,000 and 35,000 rural families are involved in goat and sheep production, respectively.

Small ruminants are raised in coordination with other production systems of small-scale farming in the highlands. In this area, animals and animal by-products (wool, manure, milk, etc.) form the people's capital savings and are the basis of their existence.

More than 95% of the pigs are also being raised on small-scale farms in the highlands, with more than 70% of rural families having a few pigs as scavengers. While pigs are not economically important, at the rural level, they are socially important.

Traditional and very primitive management with very low productivity, along with widespread diseases, are some of the main general problems and constraints.

INTRODUCCION

Debido a que el objetivo principal del taller en el cual será presentado este documento, es el de desarrollar una propuesta de agenda de investigación para Latinoamérica, el carácter de lo que a continuación se presenta es muy general. De acuerdo a lo interpretado por el autor se persigue plantear, discutir, analizar y priorizar la problemática, las limitaciones existentes y las necesidades principales de investigación, así como acciones de política y otras como parte de la búsqueda de soluciones. Todo esto para un contexto multinacional, como una posible gran región de trabajo en un nuevo ciclo del SR-CRSP. La información a continuación puntualiza solamente algunos pocos aspectos considerados prioritarios, varios de ellos estimados de relevancia mas allá del ámbito Guatemalteco, por lo menos con validés dentro de la región Centroamericana, mismos que se espera contribuyan como insumos para cumplir con el objetivo perseguido.

El documento se divide en tres partes principales: Una visión general de la situación del país, con información geográfico-política, demográfica, socioeconómica y cultural. Luego una descripción de los principales subsistemas de producción animal y su contexto fisico-biológico y socioeconómico. Por último los aspectos institucionales incluyendo los recursos humanos alrededor de la investigación y la extensión pecuaria.

EL PAIS Y SUS CONDICIONES

Tal como el resto de los paises de Centroamérica, Guatemala es un pais pequeño que se localiza al sur de México y al oeste de Belice, Honduras y El Salvador. Posee costas tanto en el océano Atlántico como en el océano Pacífico. A pesar de su tamaño, su variabilidad es enorme, tanto en aspectos fisico-biológicos, como en aspectos socioeconómicos y culturales. Durante la época de la colonia (1524-1821) fué el centro político y económico de las que en ese entonces conformaron las provincias de la "Capitanía General de Centroamérica".

Geografia y Ambiente

Tiene un área de 108,889 kilómetros cuadrados, es decir mayor que Belice, El Salvador, Costa Rica y Panamá, y ligeramente menor que Nicaragua y Honduras. Su localización es tropical, entre los 14 y 18

grados al norte del Ecuador; con alturas sobre el nivel del mar que van desde 0 hasta arriba de 4,300 metros, estas últimas en las tierras volcánicas altas.

Existen dos cadenas montañosas que atraviezan el país de oeste a este, con alrededor de 40 volcanes, tres de ellos en actividad. Por esa razón, buena parte de sus suelos son volcánicos, encontrándose los mejores en la zona sur, suelos aluviales que cubren la costa del pacífico.

Su ubicación geográfica es muy peculiar (puente entre norte y sur américa) y posee una gran variabilidad de alturas y de climas, cuenta con temperaturas desde menos de 0 grados centígrados en las zonas altas, hasta mayores de 30 grados en las zonas bajas, con precipitaciones que van desde alrededor de 600 hasta mas de 6,000 milímetros por año. Por lo anterior, existe también enorme diversidad de ecosistemas (cuenta con 9 de los 14 clasificados mundialmente), junto con el sur de México (Chiapas), se considera uno de los centros de biodiversidad del continente americano y del mundo.

La precipitación pluvial es bimodal, con picos en Junio y Septiembre. El período de lluvias y el período seco dentro del año son bién definidos. Las lluvias van desde Mayo-Junio hasta finales del año.

Poblacíon

Se estima en mas de 10 millones, con un 25 % viviendo en ciudad Guatemala, la capital. Al igual que su ecologia, su población es muy diversa. Existen 23 culturas diferenciadas, cada una con su propia lengua madre (no dialecto), 21 de ellas indígenas (la mayoria descendientes de los Mayas y que son 45 % del total), una cultura caribeña (de influencia Africana) en la costa atlántica y la cultura llamada "ladina", constituida por todos aquellos no indígenas con patrones occidentales (Aquí se incluyen Europeos, Asiáticos y Mestizos). Estos últimos constituyen alrededor del 49 % del total.

La mayoría de la población (55 %) es rural y alrededor del 85 % de la misma tiene a las actividades agropecuarias como su principal actividad económica.

Economía

El sector agropecuario es la principal fuente de empleo, comercio, e ingreso de divisas. Los principales productos alimenticios son: maiz, frijol, trigo, arroz, papa, hortalizas diversas, sorgo, leche, carne, huevos y aves. Los principales rubros de exportación son: café, azucar, cardamomo, banano, carne, hortalizas, ornamentales y madera.

Este sector contribuye con mas del 25 % del PIB, emplea alrededor del 50 % de la población económicamente activa y genera la mayoria de las exportaciones (mas del 80 %).

Aunque cuenta con la mayor diversidad y cantidad de recursos naturales de Centroamérica, en términos generales es un país pobre, con un 80 % de su población dentro de este calificativo. En este aspecto muy similar al resto de los paises centroamericanos a exepción de Costa Rica, que cuenta solamente con un 20 % dentro de esta categoría. Existen grandes contrastes socioeconómicos, debido a un agudo desbalance en la distribución de la riqueza y del bienestar.

Cerca del 90 % de las familias rurales viven en predios menores de 7 ha con acceso a solamente un 20 % de la tierra en uso agropecuario.

En términos de seguridad alimentaria, el pais es relativamente autosuficiente (entre un 96 y un 100 %); sin embargo, especialmente a nivel rural se depende mayormente del maiz y el frijol, los que aportan mas del 60 % de las calorias diarias por persona. Esta situación determina que principalmente a nivel infantil, exista un porcentaje alto de desnutrición.

PRINCIPALES SUBSISTEMAS DE PRODUCCION ANIMAL Y SU CONTEXTO

Aunque existen otros mas, los mas importantes (bajo diferentes criterios) giran alrededor de las especies siguientes: bovinos, cerdos, aves, ovejas, cabras, avejas (miel) y camarón. A continuación la situación general de los principales, ciertas interacciones, problemas y limitantes y la relación de todo esto con los escenarios socioeconómicos en que se desarrollan.

BOVINOS

En términos de generación de divisas y de contribución al PIB, es el mas importante. La mayoria de las familias de agricultores (60-70 %) que poseen tierra del pais, también poseen bovinos, aunque muchas de las fincas manejan solamente 1-2 cabezas, epecialmente en los altiplanos central y occidental. Así mismo, la mayoría de las fincas con bovinos son sistemas mixtos de producción (cultivos + animales) con fuertes interacciones.

Se estima que el hato nacional es de alrededor de 2.2 millones de cabezas. En contraste con el parrafo anterior, la mayoria del mismo se produce en fincas medianas y grandes (mayores de 45 ha). bajo sistemas solos o con poca interacción con otros subsistemas, esto último ocurre principalmente en las fincas grandes.

Aproximadamente un 55 % del hato nacional se produce en la costa del pacífico, en fincas medianas y grandes. Otro porcentaje considerable (alrdedor de 30 %) se produce en el nor-oriente y norte (Izabal y Petén), zonas de trópico bajo y humedo y de frontera agrícola, en su mayoría con suelos superficiales y frágiles. El resto se produce en la zona oriental y en el altiplano central y occidental, con mayor volúmen en la primera.

En la actualidad se está dando un traslado de muchas ganaderías de la costa del pacífico a la región nor-oriental y norte del país, Izabal y Petén, debido a que la buena calidad de los suelos en la zona pacífica representan un mayor costo de oportunidad en otras actividades de exportación, tales como caña de azucar.

En términos generales se estima que el 80-85 % de los productores manejan fincas menores de 45 ha, pero producen solamente entre el 15 y el 20 % de las cabezas del país.

Respecto al tipo de ganadería, alrededor del 65 % es doble propósisto, con orientación a leche, un 20-25 % es de carne, y el restante 10-15 % es especializada a leche. El doble propósito se desarrolla mayormente en la costa pacífica y en el oriente del país, la especializada a leche en la zona central cercana a la capital y en el altiplano occidental, mientras que la orientación a carne es en la región de Izabal y Petén.

La mayoría de la población del pais no consume leche regularmente, se estima que un 45 % de la misma ingiere menos de 15 litros per-cápita

por año. En el otro extremo, solo un 15 % de la población consume arriba de 100 litros per-cápita por año, estando el consumo promedio per-cápita unos 30 litros por año.

La causa principal del bajo o no consumo de leche es la pobreza de la población, ya que la elasticidad del ingreso de este producto es bastante alta.

Mucha de la población campesina y urbana pobre, luego del destete ya no consume leche (aunque la produzcan para venta), llegándose al extremo de que su sistema digestivo pierda la capacidad enzimática necesaria (lactasa) para digerir la lactosa. Cuando a través de ayudas a comunides rurales o a barrios urbanos marginales, se provee de leche donada a esta población y se consume abruptamente y en grandes cantidades, se han provocado problemas de diarreas.

Actualmente la producción de leche diaria es de alrededor de 815,000 litros. Aproximadamente un 85 % de esta producción proviene de ganado de doble propósito y el resto de especializado. Esta producción nacional es deficitaria en un 26-30 % compensandose con importaciones y donaciones. En 1995 las importaciones alcanzaron las 16,000 toneladas.

Respecto a la producción de carne, esta se estimó para 1995 en cerca de 53,000 toneladas métricas en canal, de las cuales alrededor de un 20 % se exportó.

Al igual que con la leche, la mayoría de la población no consume carne de res regularmente, estimándose un consumo per-cápita al año de 5 kg.

La producción se da bajo diferentes sistemas de manejo y circunstancias socioeconómicas. De manera simple podemos categorizar su producción dentro de dos grandes mundos, con sus consabidos traslapes: 1. El comercial; y 2. El de subsistencia.

EL MUNDO COMERCIAL

Constituido por productores orientados parcial o totalmente al mercado. Fincas grandes y parte de las medianas son dedicadas total o casi totalmente a este propósito. Parte de las fincas medianas y algunas pequeñas (menores de 10 ha) que disponen de capital e infraestructura

adecuada, también son orientadas al mercado, aunque en muchos casos, parte de su producción es para el consumo familiar.

Son la minoria de los productores, pero manejan la mayoría de la tierra en producción. Normalmente las unidades productivas, se localizan en zonas favorables de clima, suelo, e infraestructura fisica y de mercado, cuenta con cierto nivel de capital (alto a medio) y con acceso a servicios de insumos y de asistencia técnica. Este es el caso de los productores de la costa del pacífico y de los cercanos a la capital.

Muchos de los propietarios de las fincas grandes normalemente no radican en ellas y la producción ganadera es solamente una de varias de sus empresas.

A pesar de las condiciones favorables, la mayoria de los sistemas son extensivos o semi-intensivos, particularmente en los aspectos de producción. El componente de salud animal ha tenido mayor atención en cuanto al uso de la tecnología moderna (mercadeo de las empresas comerciales especializadas), en comparación con los aspectos de producción. Debido a lo anterior, los índices productivos y reproductivos promedio son bastante bajos y factibles de mejorar significativamente.

Problemas y Limitantes de Tipo General

Produccion. El problema principal radica en los aspectos de nutrición, particularmente en la época seca (noviembre-diciembre a Junio). Este problema afecta a todo tipo de productor, independientemente del nivel y calidad de sus recursos y de la orientación de su producción. En síntesis el problema es la poca disponibilidad o falta de alimento adecuado en esa época. Aunque ya existen algunas tecnologías para ayudar a solventar este problema, la difusión de las mismas es una seria limitante.

Otros problemas importantes y generalizados en orden descendente son: el poco manejo o manejo inadecuado de las pasturas; manejo inadecuado del hato, incluyendo aspectos de genética; y el manejo sanitario del hato y del producto (particularmente leche y derivados).

Institucionales. El estado ya no tiene la capacidad de atender a este sector y por lo mismo una limitante importante es la falta de programas de investigación y de asistencia técnica de manera institucionalizada, para este grupo de productores. Aunque tienen la capacidad económica

de invertir en investigación y en asistencia técnica privada, todavia no lo realizan. La asistencia técnica la reciben de casas comerciales o individualmente y los productores de mas recursos la pagan, pero no existe ningún programa gremial, con definición de estratégias, políticas, metodologías y programas específicos.

A diferencia de otros productos como la caña de azucar y el café, históricamente la organización gremial para este rubro no ha existido, lo que ha limitado fuertemente la colaboración y el esfuerzo combinado, en función de sus intereses. Sin embargo, de poco tiempo a esta parte, ha surgido un moviento privado, con el apoyo estatal de cooperación gremial, tales como el grupo subsectorial de carne y el grupo subsectorial de leche.

De Politica. Aunque ha mejorado últimamente, hasta 1992 las políticas de gobierno desestimularon la producción bovina, principalmente la leche. Por ejemplo los precios tope y aspectos arancelarios, como favorecer importaciones (que todavía existen en cierta medida) frenaron la inyersión en este sistema de producción. A la fecha los efectos de esas políticas todavía mantienen secuelas que tomarán tiempo para superarlas, si el gobierno afina y hace eficiente la operativización de las incipientes políticas de estimulación.

Actualmente un problema serio radica en las políticas macro-económicas mundiales, que en opinión del autor viéndolas en el papel presentan un gran paradigma y un absurdo contrasentido. Claro que se sabe y entiende que quienes dominan dichas políticas van a velar por sus intereses aun a costa de nuestros países. Por ejemplo, por un lado obligan a paises probres como los Centroamericanos a eliminar subsidios y eliminar o disminuir servicios estatales de cualquier tipo; sin embargo, por el otro lado le continuan subsidiando a los productores de sus paises, varios de sus productos agropecuarios, a niveles hasta de un 70 % de los costos.

Otro problema serio afectado por la política, se describe a continuación, por sus efectos en los recursos naturales.

Ambientales. Estos involucran y afectan tanto a productores comerciales como de subsistencia. Las zonas frágiles ecológicamente de frontera agrícola, como en la región del Petén (en donde se encuentra la mayor reserva de Centroamérica, la Reserva de la Biósfera Maya), están siendo colonizadas aceleradamente y de forma desordenada. A la fecha

no existen políticas de gobierno implementadas para frenar esta situación.

No existe un ordenamiento de la colonización, ni programas agresivos de legalización y planificación del uso de la tierra.

Por un lado ganaderos grandes de la costa sur están trasladando sus ganaderías a estas zonas de frontera agrícola; y por el otro campesinos sin tierra están colonizando las mismas. Ambos grupos con tecnologias no sostenibles para la producción agropecuaria en general y para la producción bovina en particular. Debido a esta situación, en la región del Petén se queman anualmente alrededor de 60,000 ha de bosque, con fines de preparación de tierras para la agricultura (principalmente maiz) y para la ganadería bovina.

Organizaciones y personas ambientalistas culpan principalmente a la ganadería bovina de esta problemática. Organizaciones de desarrollo sostenible, abogan por el desarrollo de tecnologias sostenibles, para la producción bovina en estos ecosistemas. Esto bajo una estrategia de intensificación y de alimentación con base en árboles forrajeros, con el desarrollo de sistemas silvopastoriles.

EL MUNDO DE SUBSISTENCIA

Son la mayoría de los productores con la menor cantidad de tierra y de unidades animal bajo producción. Como en muchos otros países, las fincas se encuentran en zonas desfavorables y muchas veces aisladas, con poca o sin infraestructura y sin o con deficientes servicios.

La orientación de la producción está ligada fuertemente a consumo familiar o a la venta o el trueque local (leche y derivados), a la disponibilidad de estiercol para fertilizar sus cultivos, y a la disponibilidad de un activo realizable que pueda suplir cualquier necesidad en cualquier momento.

El interés de este grupo por los bovinos es muy alto, ya que es una forma de acumular capital, bajo circunstancias en donde otras formas convencionales como la banca, no son posibles. Cada unidad de producción maneja pocas cabezas, bajo sistemas mixtos con fuerte interacción entre los mismos y que incluyen cultivos anuales, cultivos permanentes, árboles y otras especies animales.

Problemas y Limitantes de Tipo General

Produccion. Es similar a los productores comerciales, en cuanto a la falta o limitación de alimento en la época seca, aunque bajo circunstancias aún mas extremas, tales como menos acceso a información, suelos pobres y en ladera, con menor disponibilidad de agua y erosionables. Nutrición en época seca en particular y nutrición en general son problemas serios. Otros problemas son el desconocimiento de un manejo mas adecuado de los pastos, del hato y de la sanidad. Para la mayoría de las casas comerciales, no son clientes de interés y por lo tanto no reciben asistencia técnica en salud animal, tampoco hay disponibilidad de crédito.

A la fecha existen algunas tecnologías, para aliviar esta problemática, aunque no las suficientes, pero no existe un mecanismo eficiente de difusión.

Estructurales. Por la mala distribución de la riqueza y de los recursos en el país, tierra y capital son dos limitantes serios para el desarrollo de la producción bajo estas circustancias. Tampoco existen medios, servicios, ni tecnologias accesibles para desarrollar una intensificacion.

Institucionales. El organismo nacional de investigación, El Instituto de Ciencia y Tecnología Agrícolas (ICTA), el cual es descentrlizado, trabaja desde hace 15 años en producción animal bajo una unidad técnico-científica especifica, aplicando el enfoque de sistemas y en parte para este tipo de productores (enfocado a medianos y pequeños). Aunque cuenta con un programa bién estructurado a corto, mediano y largo plazo y tiene un equipo de trabajo de alta calidad, este es muy pequeño y su cobertura es muy baja en comparación con las necesidades. Este equipo ya ha generado y validado tecnología apropiada a condiciones específicas, principalmente para fincas medianas de la costa del pacífico (parcelamientos agrarios), cuyos propietarios eran campesinos sin recursos antes de obtener estas tierras. También ha trabajado en parte de la zona oriental, igualmente con productores medianos.

El ICTA ha contado con la colaboración de otras organizaciones como el CATIE, el CIID, el CIAT, el IICA, RISPAL, la Universidad de San Carlos y otros. A pesar de su buén trabajo, debido a su extrema limitación de recursos (agudizado por las medidas de reajuste estructural) y como consecuencia su poca cobertura, así como por carecer del apoyo de un sistema de extensión, su alcance e impacto es todavia muy bajo, menor aún a nivel del productor de subsistencia.

El pais también cuenta con un organizmo centralizado de extensión pecuaria, La Dirección General de Servicios Pecuarios (DIGESEPE). El enfoque del mismo ha sido hacia salud animal y muy poco o nada ha extendido el trabajo realizado por el ICTA. Debido a las políticas de globalización económica y de reajuste estructural, esta organización se encuentra ahora casi congelada, en cuanto al cumplimiento de sus funciones de asistencia técnica. Se ha complicado la situación con la fuerte resistencia de su organización sindical, la cual no permite reducción de personal, por lo tanto los fuertes recortes presupuestarios han sido en los demás rubros, no contándose con recursos para trabajar.

La incipiente organización campesina, tal como las cooperativas, todavía tienen serias limitantes de organización y de apoyo, por lo tanto no han potencializado muchas de las posibles soluciones que por medio de este tipo de cooperación se puedan obtener.

De Politica. Los recursos del estado para investigación y extensión han ido desapareciendo paulatinamente, por las razones apuntadas arriba, bajo el supuesto de que se está favoreciendo las organizaciones privadas y que esto facilitará la autogestión a nivel de este tipo de productor. Sin embargo, habrá un considerable grupo de la población rural, que por diferentes circunstancias no se podrán organizar eficientemente para atacar la problemática de todo el sistema de producción y consumo. Por ejemplo, es muy difícil, si no imposible, que ellos pudieran financiar un sistema de investigación.

Ambientales. Aparte de lo anotado arriba, para las áreas de frontera agrícola, buena parte de los sitemas de producción se desarrollan en áreas quebradas. Se estima que el 61 % de la tierra en ganadería bovina está en laderas, de la cual también la mayoría carece de prácticas sostenibles de manejo, con el consecuente deterioro del suelo y de otros recursos naturales.

En zonas de bosque tropical humedo como en el Petén, que cuenta con cerca de 3.6 millones de ha, todavía existe alrededor de un 65 % de cobertura boscosa. Sin embargo, la tasa de deforestación es muy acelerada, en buena parte por los sistemas tradicionales muy extensivos de producción bovina. Con la debilidad (por tamaño) y seria limitación de recursos económicos del ICTA y de otras organizaciones privadas como el Centro Maya (que trabaja en Petén) y la no existencia de un sistema funcional de extensión, se preveen serios problemas de deterioro de los

recursos naturales en esa región, con las concebidas consecuencias negativas para la población y al ambiente del pais y al ambiente del mundo.

RUMIANTES MENORES

Guatemala posee mas del 60 % de las cabras y mas del 90 % de las ovejas de Centroamérica, la mayoría manejadas en fincas pequeñas por campesinos indígenas de los altiplanos central y occidental.

Se estima una población de 150,000 cabras, de las cuales el 85 % se encuentra en los altiplanos y el resto en el oriente y sur-oriente del país. Para ovinos la población estimada es de 600,000 unidades de las cuales el 98 % están en los altiplanos.

También se estima que son unas 30,000 familias las involucradas en la producción de cabras y 35,000 en la de ovejas.

Son sistemas de producción prácticamente exclusivos de pequeños productores semi-comerciales y mayormente de productores de subsistencia. Primordialmente no tienen una orientación hacia el mercado, sino que principalmente como productores de estiercol y luego como productores de satisfactores del hogar como leche en el caso de las cabras y de lana y carne en el caso de las ovejas. También cumplen la función de activo realizable, en caso de una necesidad familiar inmediata.

Ambas especies mantienen una fuerte interacción con los otros componentes del sistema de producción, que son mixtos. Se asume y se ha comprobado a pequeña escala, que un cambio positivo en estos sistemas, también afecta positivamente el resto del sistema, por la alta interdependencia entre dichos componentes.

Las cabras predominan en zonas quebradas con bosque, mientras que las ovejas en las mesetas de los altiplanos, en donde ya no existe o hay muy poco bosque.

Problemas y Limitantes de Tipo General

Ambos sistemas se han desarrollado aislados, a través de la experiencia y el conocimiento local. Padecen serias limitantes de salud, por ejemplo la mortalidad es muy alta debido a diferentes enfermedades.

Hay serios problemas nutricionales debido a los sistemas de alimentación y de manejo en general, que a su vez determinan muy bajas tasas productivas, para cualquiera de los productos o subproductos. Debido al stress alimenticio histórico, el potencial genético también es muy bajo.

Salvo los esfuerzos recientes del ICTA, que de nuevo son insuficientes, no ha existido investigación formal para dar solución a los problemas y limitantes de estos sistemas, en la búsqueda de mejorar su eficiencia.

Al igual que en bovinos, cierta tecnología ya disponible, principalmente para cabras, no se puede difundir efectivamente, debido a la carencia de un sistema de extensión.

Los sistemas tradicionales de manejo, también tienen efecto negativo sobre los recursos naturales. Estos son de libre pastoreo, con serios efectos negativos sobre otros recursos como cultivos, arbustos y erosión del suelo.

PORCINOS

Arriba del 95 % de su producción está en manos de pequeños productores semi-comerciales o en manos de productores de subsistencia. El propósito de su producción es básicamente de contar con un activo realizable, que se puede vender, dar en trueque o como prenda para un préstamo, ante una necesidad urgente.

Los precios de mercado determinan que no sea una actividad rentable (desde el punto de vista capitalista), salvo el caso de los sistemas que tienen todo el proceso vertical integrado (que son los que producen el 5 % restante). A pesar de ello mas de un 70 % de los productores de escasos recursos del país se dedican a esta actividad.

A nivel rural son producidos en forma libre y para su nutrición consumen los desechos de la alimentación de la familia y lo que pueden conseguir bajo el libre pastoreo. Debido a ello los aspectos sanitarios son un problema primordial, tanto para el cerdo, como para el consumidor.

La tecnología de manejo es muy simple, salvo vacunaciones eventuales y castraciones de algunos de los machos que se dedican al engorde. La raza prevaleciente es el cerdo criollo, mezcla de otras muchas razas y la cual presenta bajos niveles de productividad (conversion

alimento-carne), pero muy altos niveles de resistencia al ambiente desfavorable.

La comercialización es por medio de compradores ambulantes, quienes compran al ojo y luego los llevan a rastros municipales, en los que existe poca vigilancia respecto a los aspectos sanitarios. Sarna, tenia y como consecuencia cisticercosis que afectan al humano son, entre otros un problema derivado de todo ello.

En resumen no es una actividad de importancia económica desde la perspectiva global del país, pero tiene una tremenda importancia socioeconómica a nivel campesino, que como sabemos no necesariamente opera económicamente bajo una racionalidad capitalista.

El 5 % señalado arriba, es producido por la industria, con altos niveles de tecnología y altos niveles de productividad, con razas especializadas, todo bajo la responsabilidad de la inciativa privada con disponibilidad de recursos económicos.

AVES

Arriba del 90 % de las familias rurales las producen, pero con un manejo casi silvestre, salvo el uso de algunas vacunas. El propósito es múltiple: carne eventual, huevos (mayormente para la venta local) y activo realizable cuando hay necesidad.

A nivel rural los índices productivos son sumamente bajos, alrededor de solamente un 10-15 % de la productividad que tienen los sistemas intensivos.

Casi la totalidad de la población urbana y sub-urbana que consume carne de pollo, tiene como fuente el sistema intensivo de producción industrial, la cual está sumamente tecnificada y desarrollada y que cuenta con una historia de mas de 30 años de evolución.

La producción industrial es responsable del 85 % de la producción nacional de carne y huevos. Esta produce alrededor de 4 millones de huevos diarios, para facilitar un consumo per-capita promedio de 143 unidades por año. La productividad de las aves bajo este sistema es de unos 270 huevos por ave por año. En contraste la productividad de una ave bajo el sistema tradicional es de alrededor de 30 huevos por año.

La producción de carne industrial es de alrededor de 230 millones de libras por año, permitiendo un consumo promedio per-capita por año de 23 libras.

ASPECTOS INSTITUCIONALES EN LA INVESTIGACION Y EXTENSION

Ya se han mencionado algunos puntos claves, como complemento se puede añadir que el sistema nacional de investigación tiene dos organizmos importantes: el ICTA y la Universidad de San Carlos.

El ICTA es la organización oficial para el efecto, la cual es descentralizada, es decir que aunque es del estado es manejada por una junta directiva con participación pública y privada (con dominio de la pública). Le cabe el privilegio de haber sido la primera institución oficial del mundo que adoptó y desarrolló el enfoque de sistemas de producción (Farming Systems Approach), inicialmente restringido a cultivos alimenticios.

A pesar de la seria limitación de recursos económicos, todavía mantiene un nivel alto de recursos humanos (pese a la masiva deserción de profesionales) y es la única entidad oficial en su ramo que tiene un enfoque, estrategias, metodologías y planes de trabajo bién definidos.

Cuenta con una unidad técnica de producción agrícola y otra unidad técnica de producción animal. La investigación pecuaria está bajo la responsabilidad de la segunda y cuenta con un total de 14 investigadores con formación profesional univeristaria, cuatro de ellos con grado de Maestría.

Por su parte la Universidad de San Carlos cuenta con alrededor de 7 investigadores a tiempo parcial, cinco de ellos con grado de Maestria. El proyecto Centro Maya cuenta con tres investigadores, uno con grado de Maestria.

Obviamente para las necesidades del pais, son recursos humanos inmensamente escasos, pero esa es la realidad económica existente. A diferencia de la Universidad, el ICTA ha desarrollado planes y programas a corto, mediano y largo plazo, de los cuales los siguientes son los prioritarios para la producción animal:

1. Evaluación de germoplasma de gramíneas y leguminosas forrajeras.

2. Diseño y evaluación de sistemas agroforestales con rumiantes. Bovinos de doble propósito, caprinos y ovinos.

3. Utilización de subproductos agropecuarios e industriales para la alimentación de rumiantes. Bovinos doble propósito, caprinos y ovinos.

4. Mejoramiento de la salud y manejo reproductivo de rumiantes. Bovinos doble propósito, caprinos y ovinos.

5. Mejoramiento de los sistemas de producción porcina en pequeñas fincas.

Es importante señalar que para todas las especies el enfoque se basa en el desarrollo de sistemas silvopastoriles, tomando seriamente los aspectos de sostenibilidad de los recursos naturales.

A la fecha, tanto para doble propósito, como para cabras y ovejas, ya existen módulos intensivos de producción que han sido validados exitósamente a nivel de productor. Como ya se mencionó, actualmente en la práctica no existe un sistema de extensión, ya que esa misión la debería cumplir DIGESEPE, el cual prácticamente a nivel operativo ya no tiene recursos para funcionar.

Por mucho tiempo se ha intentado que la función oficial de transferencia de tecnología, también estuviera dentro del ICTA. Falta de apoyo político en el pasado, por no entendimiento del sistema, no ha permitido esa intención. Cuando ha existido ese entendimiento y apoyo político para hacerlo, tal como con la administración del ministerio de agricultura del gobierno anterior, que finalizó el pasado enero, la organización gremial de las instituciones de extensión lamentablemente lo impidieron.

Respecto a la Universidad de San Carlos, esta realiza investigación a través de la escuela de zootecnia, principalmente con tesistas, supervisados por profesionales docentes. En muchas ocaciones dichas investigaciones se realizan en coordinación con el ICTA.

En esta institución no existen en si un programa de investigación que cuente con planes definidos a mediano y largo plazo. La misma normalmente se raliza de acuerdo a las necesidades, intereses y posibilidades inmediatas.

Con el desarrollo de las organizaciones no gubernamentales ONG, se comienza a desarrollar investigación por parte de estas. Por ejemplo en la zona del Petén, el CATIE y el Centro Maya, hacen esfuerzos en este sentido.

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Reality, Limitations and Research Needs of the Peruvian Livestock Sector

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ABSTRACT

The majority of the cattle, sheep and camels in Peru are between 2,200 to 4,500 meters above sea level (masl) and they are in the hands of peasant communities. Domestic livestock are mostly "Criollos," indigenous animals with low levels of genetic improvement and feeding which results in low productivity. There are more than 5,000 communities that represent approximately 69% of the rural families and 30% of the total number of families in the country. Communities are autonomous organizational systems originated during the reordering of the population demanded by Virrey Toledo in the XVI century with the purpose of increasing manpower and tribute collection. Communities which are over 4,000 masl are almost exclusively pastoralist, while the others combine agriculture with livestock raising. Individual owners maintain patterns of agricultural and livestock production that are similar to those of families belonging to communities.

Mountain rangelands constitute the main feeding resource for livestock in Peru. It is estimated that at least 60% of grazing lands are in poor condition due to mismanagement and overstocking. Land degradation of the rangeland ecosystem is linked in some way to the model of organization within communities, land tenure systems and government policy. The worst ecological conditions correspond with the lowest levels of organization and subsistence economies. There is no government legislation to regulate the use and conservation of rangelands. The state directly controls less than 10% of the national rangelands. Communities have the authority to determine animal number and use practices of rangelands.

The institutional framework of the Peruvian livestock sector is composed of a group of decentralized organizations of the Ministry of Agriculture, universities and nongovernment organizations. The Ministry of Agriculture monitors, regulates and promotes the improvement of the livestock sector. Universities provide human resources and generate technology, NGOs promote peasant training, enterprise organization and

access to bank loan services, emphasizing these services for peasant communities. The main limitations on livestock production systems in Peru are the scarcity of financial resources to strengthen institutional capabilities, the absence of national scientific and technological projects, and the lack of a national extension system.

INTRODUCTION

The majority of the cattle, sheep and camels in Peru are between 2,200 to 4,500 meters above sea level and they are in the hands of peasant communities. The ruminant population in Peru consists of approximately 4.5 million cattle, 12 million sheep, 2 million goats, 2.5 million alpacas, 1.3 million llamas and 66,000 vicunas. The majority of the domestic cattle are "Criollos," indigenous animals with low levels of genetic improvement and feeding which results in low productivity.

Highland soils with potential for agriculture represent 3.5% of the Peruvian Sierra. The existence of hard frosts, hailstorms, and snowfall makes agriculture production a highly risky activity. Consequently, peasant economies are primarily dependent on livestock production. Peruvian rangelands cover 14,300,000 hectares, equivalent to 32% of the highlands (Table 1). The grazing lands of the communities are 12,000,000 hectares, with the remaining 2,300,000 hectares in the hands of small and medium producers.

There are more than 5,000 communities in Peru, the majority of which (approximately 4 million people) live in extreme poverty. These peasant families represent approximately 69% of the rural families and 30% of the total of the families in the country. Communities are autonomous organizational systems that were originated during the reordering of the population demanded by Virrey Toledo in the XVI century, with the

Table 1: Ecological condition of Peruvian rangelands

Range Condition	Communal Enterprise		Community Family	
	%	HAS	%	HAS
Excellent	1.00	12,000	---	-----
Good	28.00	336,000	9.50	1,026,000
Fair	50.00	600,000	28.50	3,078,000
Poor	21.00	252,000	62.00	6,696,000
Total	100.00	1,200,000	100.00	10,800,000

purpose of increasing manpower and tribute collection. Inside the communities there are different land tenure systems, organization levels and production systems which interact to influence the actual ecological status of the natural resources.

Evidence of this type of interaction can be seen in the community of "Villa de Junin" which is located in the central highlands. The community has 17,000 hectares of rangelands. This community of 1,723 families has created a livestock enterprise on 6,000 hectares of grazing lands in which 1,080 community members are copartners. The rest of the land has been assigned in General Assembly to individual families for their support. Rangelands of the livestock enterprise are in better condition than those which the community uses. Their high level of organization enabled them to install a system of irrigation in 40 hectares for the introduction of perennial white clover and rye grass for the commercial production of Brown Swiss x Criollo dairy cattle.

Experience suggests that it is easier to transfer technology and improve living conditions of community members when there is a high level of organization. In the past, national and international institutions gave priority to those communities that had adopted some kind of enterprise organization. Community farms, community enterprises, cooperatives, rural enterprises of social interest, livestock departments and multicommunes are enterprise models adopted on their own initiative or from the governments. These organizations that in the 80's represented more than 400 enterprises, and comprised about 35% of the Andean highland territory, today represent less than 10%. A significant number of these enterprises have ceased activity or have changed their enterprise model due to internal and external factors. Today's rangelands are in the hands of the communities and are poorly managed. Thus efforts to generate and transfer improved technology must be emphasized more in those communities that have not been able to develop an adequate organizational model to manage their livestock and natural resources.

STATUS OF NATURAL RESOURCES

Different vegetation types named pajonales, cesped de puna, bofedales, arbustales y canllares, juncales y totorales, in this order of importance, dominate the high mountain ecosystem of the Andes from Cajamarca in the north to Puno in the south.

It is estimated that at least 60% of the native vegetation is in poor condition and only 9.5% is in good condition, because of mismanagement and overstocking. Overgrazing is a common and significant phenomenon in the Andes. Present use almost duplicates its potential livestock carrying capacity. The degradation of the Andean ecosystem represents a complex problem which is linked in some way to the model of organization within communities, land tenure and government policy. The worst ecological conditions correspond to the lowest level of organization and subsistence economies (Table 1).

Overgrazing, inadequate management practices, overexploitation of the resources and lack of protectionist practices are among the main causes of land degradation in Andean rangelands. The National Institute of Natural Resources (INRENA) reports that 3,724,711 hectares of preserved areas that should be given over to the protection of hydrological basins and refuges for wild animals, are being used to increase grazing lands.

At the end of the 60s and after the Agrarian Reform, 40% of the grazing lands which were private property were expropriated by the government for the benefit of the communities. The government gave them the land to use, provided it was handled under an enterprise system—communal farm, cooperative or multicommunal enterprise—while they paid for the cost of the land. By the end of the 70s the government pardoned the agrarian debt, and in that way the land passed into the hands of the communities.

Debt cancellation left the government without a powerful mechanism to exert strict control over the number of animals and management practices on the range. The government directly controls only 10% of the national territory. Areas under government control are called Conservation Units and can adopt different models. Seven National Parks, eight National Reserves, seven National Sanctuaries, three Historical Sanctuaries, six Protected Forests, one Communal Reserve, two Landmark Boundaries for Hunting, eight Reserve Zones, and four National Forests make up the Conservational System of Peru. Conservation units in the highlands represent a limited proportion of land compared to the coast and the tropical region (Fig. 1).

Peru lacks legislation to regulate the use and conservation of rangelands. Most of the land is under community control. Law No 24656

Figure 1: Mapa Agrostologico

named "General Law for the Communities" enacted by the Congress in April 1987 gave them autonomy to determine animal number and use practices of rangelands in communal enterprise, family or individual form. The family plots of land should be worked directly by qualified community members, in extensions that are no larger than the ones fixed by the Community General Assembly. The law also allows the communities to create specialized committees as consultant organizations or advisory councils for the execution and control of activities related to

management and improvement of rangelands. This means that government agencies, universities and nongovernment organizations have to promote committee formation when it is necessary to develop and implement a rangeland conservation program.

LIVESTOCK PRODUCTION SYSTEMS

Livestock production systems are related to community organization level, land tenure systems and elevation above sea level. Communities which are over 4,000 masl are almost exclusively pastoralist, while the others combine agriculture with livestock raising. Individual owners maintain patterns of agricultural and livestock production that are similar to those of the community families. However, the social and economic context in which they develop are different.

Enterprise community system

This system is found mainly in those regions over 3,800 masl. This zone is covered by native grasslands dominated by tussock plants. The most important animal species in these systems are sheep, cattle, and domestic and wild camels. This enterprise system raises improved breeds of higher productivity than Criollos (Table 2). Sheep are mainly Corriedale, Junin, Criollo and Merino. Cattle are Brown Swiss, Simenthal or breeding crosses with Criollos. The majority of camels are white alpaca of the Huacaya or Suri varieties. These enterprises are able to incorporate advanced technology. Labor forces are highly specialized. They produce milk in natural and cultivated pastures, besides meat and fiber for the market using both intensive and extensive forms of farming.

Table 2: Productive indexes of improved breeds and Criollo livestock

	Improved Breeds				Criollo			
	Alpaca	Goats	Sheep	Cattle	Alpaca	Goats	Sheep	Cattle
Natality (%)	65	190	80	70	50	174	70	50
Birth Weight (Kg)	8	3	4	30	6	2	3	22
Weaning Weight (Kg)	25	16	20	100	20	11	15	80
Adult Weight (Kg)								
Females	60	50	47	500	40	30	27	195
Males	65	70	90	900	55	40	35	300
Carcass Yield	34	45	43	52	52	39	40	48
Total Mortality	7	7	12	4	22	20	50	10
Milk Production (Kg)	—	200	—	1200	—	80	—	350
Wool Prod. (lb./animal)	4	—	6	—	3	—	3	—
Clean Wool Yield (%)	88	—	70	—	84	—	58	—
Fitness	24	—	27	—	26	—	27	—

To this same system belong more than 800 communities that by their own initiative or by the initiative of the government have created some type of enterprise: livestock departments, community farmers, community enterprises, cooperatives and multicommunity enterprises. These enterprises vary in their objectives, size and management capacity. For example, in the community farms the surplus is used for social programs such as building schools, medical posts and roads, whereas the community enterprise surplus is distributed among the members for whatever purposes they consider beneficial. These enterprise community systems are a fertile ground for research, model validation and transfer of technology.

Non-enterprise communal system

To this system belong the families that the General Community Assembly has assigned a portion of grazing land and the "parcialidades," which are a group of peasant families who are not members of the community but who own grazing land. They group together for specific common goals. Their geographical location and environment is similar to the enterprise community system. It is an extensive system. The herds are a mixture of sheep, cattle, camels and horses whose proportion varies depending on the region. In the central highlands, mixed herds of sheep, cattle and horses are predominant. In the southern highlands, mixed herds of alpacas and llamas are predominant. For example, in the area of Arequipa, province of Caylloma, Corococha sector, a family has an average of 82 alpacas and 26 llamas.

This system uses the family as a source of labor; women supply at least 40% of the labor force and the children supply 27%. Cattle are mostly "Criollo," a sort of breed perfectly adapted to the altitude and nutritional stress (Table 2). The community families and the families of the "parcialidades" are distinguished because they have a primary activity of supplying themselves with commercial surplus placed on the market through formal and nontraditional channels, such as bartering of meat, fiber and hides to satisfy their basic needs. The main problem for these producers is their low level of training and organization.

Non-communal family system

This system is composed of individual families and producers who possess pieces of land called "minifundios" that are too small to carry

out commercial activities. At least one million occupants of inter-Andean valleys and those who are mainly settled between 2,800 and 4,200 masl belong to this system.

In the lower areas, there is a mixture of agriculture and livestock (cattle, sheep and horses). The main species are sheep, dual purpose cattle and dairy cattle. The number of animals per family is small. Cattle feeding is based on agricultural by-products of wheat, barley, corn and grazing on rangelands during the crop growing season. This system, like the former ones, has a subsistence economy where women and children take care of the animals. Men participate mainly in the sanitation campaigns and marketing decisions. In the highest areas (depending on the weather conditions and water availability) they use associated legumes and grasses, rye grass and clover for the commercial production of milk. Cultivated annual grasses, such as fresh oats and barley, or silage are also used to supplement feeding.

INSTITUTIONAL FRAMEWORK FOR LIVESTOCK AND NATURAL RESOURCES

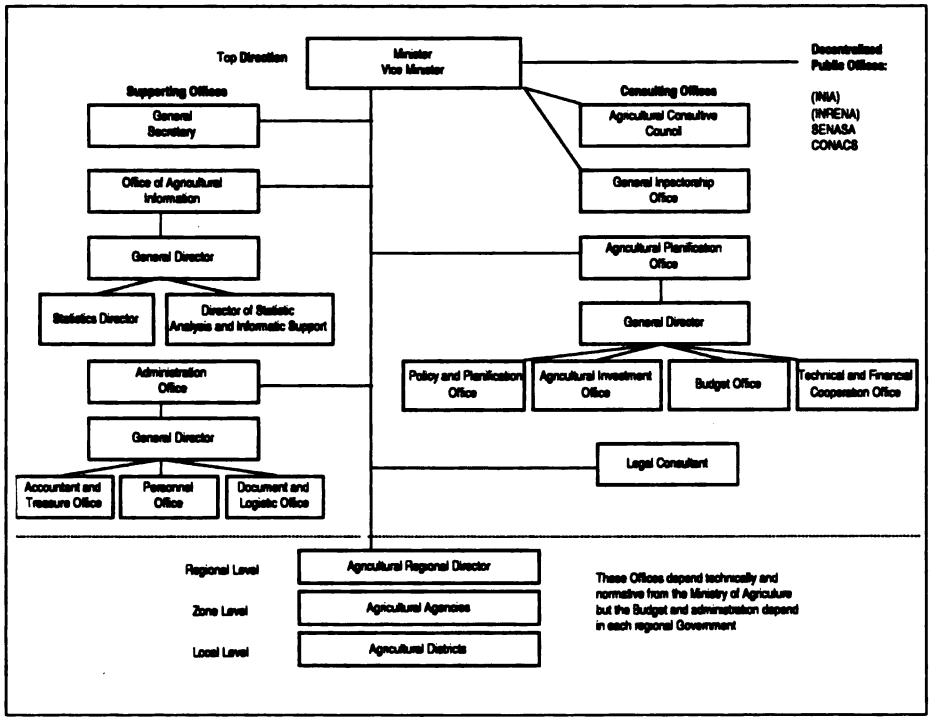
The institutional framework of the Peruvian livestock sector is composed of a set of decentralized institutions of the Ministry of Agriculture, universities and non-government organizations. MINAGRI monitors, regulates and promotes the improvement of the livestock sector. Universities provide education and training and generate technology. NGOs promote peasants' training, enterprise organization and credit, emphasizing these services for the communities. Because the level of coordination among these institutions is limited, it is necessary to improve the degree of interaction among them.

Ministry of Agriculture

MINAGRI carries its actions through Instituto Nacional de Investigacion Agraria (INIA), Instituto Nacional de Recursos Naturales (INRENA), Consejo Nacional de Camelidos Sudamericanos (CONACS), Fondo Nacional de Fomento Ganadero (FONAFOG), and Servicio Nacional de Sanidad Agraria (SENASA). These organizations have technical, administrative, economic and financial autonomy (Fig. 2).

The administrative structure of these organizations is very similar. All of them have a Board of Directors Committee composed of

Figure 2: Organization of the Ministry of Agriculture



representatives of MINAGRI, producers and universities, where the Executive Director is appointed by the Ministry of Agriculture. Their actions are primarily concerned with the highlands and the jungle, where the highest poverty indexes can be found.

INIA activities are centered in research and transfer of technology, with the latter having priority. This organization has a limited number of experimental stations, mainly located in the highlands. This is because the government has transferred the majority of the experimental stations to the private sector and universities. The funds and people for research are scarce. Most of the resources come from the "Ministerio de la Presidencia" whose priority is the social support of the poor communities located in the Andean trapezoid (Apurimac, Ayacucho, Huancavelica, Cuzco and Puno). The most important extension programs concern alpaca, sheep and forage production of associated cultivars of perennial ryegrass and clover. Their strategy consists of developing projects with the cooperation of the communities. The way they help the communities is by giving them credits in materials and capital goods called "Rotating Funds." Under this scheme, the communities repay with animals or seeds the loans they receive as capital goods. INIA coordinates and monitors

the projects. The projects are carried out by specialized staff under a contract for the time the project lasts. The communities contribute land and manpower to the projects.

INRENA evaluates, monitors and promotes the prudent use and preservation of the natural resources, with the participation of the private sector. This organization has the necessary funds and people in the areas of water, soils, forests, wild animals and national parks. Its present action is centered in the regional evaluation of the natural resources, with the help of international organizations. However, the institutional capacity to deal with the degradation of the rangelands is limited and should be reinforced.

CONACS is in charge of the promotion, advice, evaluation, development, preservation, management, genetic improvement and exploitation of all the species of American camels and their corresponding hybrids. Their actions are centered on the vicuna because of the potential of this species to improve the peasants' economic position. CONACS has promoted the organization of vicuna committees under its supervision in more than 100 communities for the protection, capture, shearing and processing of vicuna fiber in the international markets. Vicuna fiber is extremely fine and its prices are high, as much as 250 dollars per pound. In contrast, knowledge about its habitat and management is very scarce, restricting optimum exploitation.

FONAFOG is exclusively in charge of supporting and promoting the supply of improved breeds and pasture seeds to the communities and small breeders. More than 85% of the population of the camelids is in the south, in spite of the fact that the southern and northern highlands have similar raising capacity. The highlands have the potential to grow cultivated pasture and dairy production under dry and irrigated systems of approximately 500,000 hectares, but less than 5,000 ha of the community's land is being used for this purpose. Infant malnutrition in the Sierra has been estimated to be 40%. FONAFOG directs its programs mainly to restore the population of alpaca and the growing of cultivated pasture for milk production in the highlands.

SENASA has recently been created and it is in charge of the development, promotion and execution of plans and prevention programs to control and eradicate pests and diseases. The actions of this organization are oriented towards agricultural products with the potential to be exported.

Universities

The universities are experiencing serious problems due to the scarcity of funds for training and research programs. One of the serious efforts to train university professors and researchers was the Small Ruminant Collaborative Research Support Project (SR-CRSP) during the beginning of the 80s. This project financed the training of specialists in fundamental areas for the scientific and technological development of the livestock sector: genetics, reproduction, animal nutrition, forages, ecology, rangeland management and agricultural economy. The majority of these researchers are working now in state universities.

Non-government Organizations

These organizations work alone or in collaboration to analyze, coordinate or implement actions that will help the poor producers. Their strategy consists in organizing, training and facilitating credit for individual producers and members of the communities. NGOs have installed training and extension centers in the central and southern highlands (CETAS). In these centers they give technical training in administration, livestock management, agriculture, management and conservation of natural resources and manufacture of livestock products. The majority of the participants are adults selected by their communities who attend short training programs of no more than three months. The Director of the Center is a member of the NGO appointed by the Board of Directors. CETAS almost always have a consultive body where the producers and universities are represented.

RESEARCH LIMITATIONS AND NEEDS

The principal limitations on livestock production systems in Peru are the scarcity of financial resources for the agricultural sector, the absence of scientific and technological development projects, and the lack of a national extension system.

Genetics and Animal Breeding

The genetic characteristics of commercially important sheep and cattle are well known; however, this is not the case with alpacas. Genetic improvement programs emphasize the study of improved breeds of Corriedale and Junin. There is a need to implement a genetic improvement

program in sheep, camels and cattle that considers the selection of valuable animals, organization of breeding stocks and progeny tests. The main difficulty in carrying out these selection programs is the lack of organization, training and economic scale that the families in the community and individual owners have.

Animal Reproduction

The reproduction projects have emphasized the measurement of the influence that altitude and nutrition have on the reproductive rate of improved breeds, in spite of the fact that fertility and stress resistance of the "criollos" is better than that of the improved breeds. Alpacas have low fertility rates and high embryo losses, which makes them less profitable than sheep. Studies should be done in alternative management practices to improve sheep reproductive performance and continue the efforts to identify the restraints of low reproduction of American camels. The main difficulty in solving these problems is the scarcity of qualified people, laboratory equipment and resources to do basic research.

Animal Nutrition and Forages

The previous studies of nutrition have determined the composition of the diet, pasture consumption and nutritional status of grazing sheep and alpaca. It is necessary to widen this information to the other camel species, goats and cattle. In relation to the farming and management of exotic pastures of ryegrass and clover, it is necessary to know the growing rates and the factors that affect longevity and response to the management system. The main limitation to increasing the area of cultivated pastures in the highlands is the lack of forage specialists and the absence of precise information about the location and potential areas for sowing cultivated pastures.

Management and Preservation of Rangelands

Past efforts have been oriented toward establishing standards of range condition and the stocking rate of the different types of vegetation. It is important to establish the response of native vegetation to fire, weed control, water management, revegetation and grazing systems. The main limitation in making these practices optimum is the lack of basic knowledge about the ecophysiology of native rangeland plants.

Animal Health

Work has been done to determine the causes and prevalence of the main diseases that constrain the production of sheep and camels: Lung adenomatosis, toxoplasmosis, leptospirosis, brucellosis and epididymitis in sheep; itch, sarcocystiosis, fever and newborn enteritis in American camels. The main limitation to implement health programs is the absence of an adequate national system of prevention and control of diseases.

Economy and Sociology

There have been advances in the determination of the sociological and cultural relations of livestock production in the communities. It is necessary to point out the remaining systems. The main limitations are in the absence of basic research, lack of an agricultural information system and human resources. The majority of highly trained economists and sociologists are working for the private sector.

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Significant Characteristics of Agriculture and Livestock Production in Ecuador

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BACKGROUND

Development in Latin American since the end of the Second World War meant, essentially, the transfer of the lifestyle of industrialized countries into the region. Thus, the upper and middle classes adopted the consumption patterns, the way of life, the values, the culture, and, finally, the production patterns, of industrialized societies. As a result of this process, an extremely heterogeneous social and economic structure came into being, characterized by complex interrelations among its various parts.

The State assumed a profoundly different role, undertaking activities with a broad and powerful influence on various aspects of the economy. Protectionist policies were designed to aid in industrial expansion; initially in heavy industry to produce basic industrial inputs. Later, at the beginning of the 60s and in association with the arrival of transnational capital, the focus shifted to the production of goods closely tied to the development pattern of industrial societies: cars, household appliances and electronic goods, paper and cellulose, energy, petroleum-based chemicals, and so on. The same phenomenon was apparent in the fields of transport, construction, fishing, and other sectors of the economy.

Historically, the basis for accumulation in rural areas was an agricultural system known as the hacienda, which later gave way to the latifundio-minifundio complex, a combination of a small number of very large holdings side by side with numerous small parcels. This system was characterized by the exploitation of an abundant, highly fertile natural resource base and the extensive exploitation of land by large landowners—the latifundistas—together with the excessive exploitation of peasant labor.

Beginning in the 60s in rural Latin America, a widespread process of agrarian modernization was instituted. This process involved, in large part, a traditional agrarian system which preserved some of its characteristics while experiencing major transformations in terms of

economic organization, integration into the market and social relations. At the same time, the process gave rise to new, modern types of exploitation in areas near large urban centers, in the most highly developed regions and also in zones located along the new agricultural frontier.

The industrial revolution gradually led to profound changes in agricultural and livestock production systems throughout the world. This occurred with the massive introduction of technologies, including modern mechanization, specialization in the production of a single crop or animal species, the use of chemicals in agriculture and the onset of genetic engineering.

We might summarize the above by indicating that the modernization of agriculture and rural areas in Latin America has taken an unequal course, sharpening structural differences between the modern, capitalist agrarian sector with ties to international markets and the vast majority of rural peasant producers and farm workers who live in poverty.

We need to emphasize this point, as it is impossible to truly understand the patterns of development followed in Latin America without taking into account the central role played by rural areas and the way these are connected to the societies' areas of political and economic power. An understanding of the principles guiding development in Latin America can be better achieved from a holistic perspective—that is, in terms of multiple and complex relationships among sectors as well as in terms of the specific ways these relationships overlap with those developed with centers of power in the more developed countries.

INTRODUCTION

Transformations undergone by Ecuadorian society during the last three decades have led to profound changes in the characteristics of the country's rural communities. These communities have developed a number of productive strategies (socio-economic and cultural) that have facilitated a response, based on the cultural reality of said communities, to challenges originating in the society at large within the framework of the process of capitalist modernization.

The agrarian reform that took place in Ecuador during the 60s and 70s resulted in the disappearance of the hacienda, especially in the Sierra,

and was accompanied by significant changes in the traditional power structure in rural areas[1] (Larrea F.).

Since the end of the 70s, and particularly beginning with the 80s, rural communities have had to deal with new pressures, including the challenge of development, economic and technological changes, and new forms of capital dependence.

Within the context created by the application of neoliberal economic policies and a new agrarian modernization proposal in which the agro-business sector is the central actor, organizations in the rural sector have had to come up with effective economic responses to the deterioration in living conditions. Given the economic limitations of small farmers at the national level, we need to analyze the real possibilities open to members of this sector in order to carry out local and/or regional development processes.

GEOGRAPHIC CONDITIONS

Ecuador is located in northwest South America. The equator runs through the country, which is situated between 75 11'59" and 89 01'11" west longitude and from 1 26'34" north latitude to 5 00'41" south latitude. In the north, Ecuador shares a border with Colombia, and to the south and east with Peru; the Pacific Ocean constitutes the western border. The total surface area of the country is 281,332 km^2.

Ecuador has marked ecological divisions, with four clearly defined macro-regions: Coast, Sierra, Amazon and the Galapagos Islands located approximately 1,000 km from the coast.

The ***Coastal region*** (70,378 km^2) is comprised of lowlands situated between the Pacific Ocean and the western range of the Andes, with altitudes ranging from 1000 meters above sea level (masl) to sea level. The average annual temperature is 25° C; annual precipitation is irregular with a maximum of 4,000 mm and a minimum of 300 mm; rainfall is greatest from January to April, and the dry period occurs between June and November.

Export crops are the major products grown in this region; these include banana, coffee and cacao, as well as rice, cotton, corn, soy, hemp, African

palm, sugar cane and tropical fruits. Livestock activities in this region have always been based on the production of beef; however, in recent years there has been an increase in dual purpose livestock production.

The ***Sierra region*** (72,923 km^2) is framed to the east and west by two Andean ranges. The region is one of tremendous geographical contrast and a diversity of micro-climates, from perpetually snow-covered areas at 4500 masl to low inter-Andean zones beginning at 1500 masl.

Dairy production in the country is concentrated in the inter-Andean valleys, located from 2000 to 3000 masl, with temperatures fluctuating between 11 and 16 C. As for agriculture, the Sierra region provides the domestic market with corn, potatoes, cereals, and temperate climate vegetables and fruits.

The ***Amazon region*** (130,025 km^2) stretches from the eastern range of the Andes to the Amazon basin, and accounts for almost half of the nation's surface area. Altitudes in this region fluctuate from 500 to 1000 masl. Average annual temperature is 25°C, with maximum precipitation reaching 5600 mm and minimum levels at 2000 mm; rainfall occurs throughout the year. Uncontrolled colonization in this region has led to the dramatic deterioration of its fragile ecosystem.

DEMOGRAPHIC CHANGES

According to information from the fifth national population census taken in 1990, Ecuador has 9,648,189 inhabitants. Of these, 4,302,331 (44.59%) currently live in rural areas; of the total rural population, 49.9% live in the Sierra region. These statistics demonstrate the fact that, in spite of increases in urban population during the past four decades, Ecuador continues to have a large rural population.

In 1985, as noted by Chiriboga, 33.5% of landholdings consisted of units smaller than 20 hec; 30% were holdings between 20 and 100 hec; and 36% were units greater than 100 hec. (Chiriboga, 1988). Though the redistributive effect of the agrarian reform process—added to the dynamics of the land market—has been significant, we need to keep in mind that the majority of the rural population can be classified as minifundistas, i.e., small landholders with parcels comprising less than 5 hec (Larrea, 1992). In addition, a large portion of lands held by peasants are located on steep slopes with poor soils affected by erosion.

Table 1: Production systems by farm strata

SIZE OF HOLDING	NO. OF APUs (%)	CATTLE HOLDINGS (%)	DAIRY PRODUCTION (%)
Small	81.2	36.4	30.8
Medium	14.4	24.0	23.2
Large	4.4	39.6	45.9

Source: Estadísticas pecuarias PROFOGAN. 1950-1987.

Economic adjustment policies applied since 1982[2] by successive administrations have had negative effects on peasant economies. These policies marked the collapse of the import substitution industrialization model applied in Ecuador during the 60s and 70s.

AGRARIAN STRUCTURE

Unfortunately, there has been no agriculture and livestock census taken in Ecuador since 1974, and thus we have no reliable figures on the evolution of agriculture and livestock production units (APU) in recent years. Thus, we have to rely on 1974 census data to demonstrate the significance of small and medium livestock production units.

On the basis of data in Table 1, we can deduce that more than half of all cattle production takes place on small and medium-sized farms, where 54% of the milk consumed in the country is produced.

As for the agrarian structure, it is clear that while vast haciendas do not exist in Ecuador as they do in other South American countries, there is, nevertheless, a marked difference in landholdings. On the basis of Table 2, it is evident that small and medium production units represent 97.3% of all APUs, but account for only 52.3% of all lands under production.

Table 2: Agrarian structure according to size of APU and region (percentages)[3]

SIZE APU	SIERRA		COAST		AMAZON		NATION	
	UPA No. &	Surface %	UPA No. %	Surface %	UPA No. %	Surface %	UPA No. %	Surface %
small	86.9	18.1	91.6	34.1	61.0	25.3	87.2	26.7
medium	10.1	21.5	7.o	25.6	31.7	40.8	10.1	26.1
large	3.o	60.4	1.4	40.3	7.3	33.9	2.7	47.2
TOTAL	100	100	100	100	100	100	100	100

Source: Estadísticas pecuarias PROFOGAN. 1950-1987.

The same census indicates the distribution of cattle among small, medium and large holdings. The small APUs account for 36.5% of all cattle, with an average of 4.5 animals per unit. The medium holdings have 24.1%, with an average of 16.9% animals, and the large account for 39.4% of all animals, with an average of 93.2 head of cattle per unit.

Uncertainty exists due to changes in production and productivity parameters, number of head, economic output, etc. among small, medium and large holdings, but the hypotheses listed below, in terms of changes in recent years, have been put forth by PROFOGAN (1990):

- Migration and industrialization have changed the structure of labor use and have encouraged production for sale.

- Modest advances in productivity have taken place, especially on large and medium holdings.

- Benefits related to credit and subsidies were enjoyed, for the most part, by the strongest APU strata.

- Advanced and adapted technology is not available, to any significant degree, to small landholders.

- Small producers have little access to modern inputs due to lack of disposable income and the fact that they have been unable to capitalize production.

- Small landholders have little power in market transactions and their ability to generate income suffers as a result.

EVOLUTION OF LAND USE IN LIVESTOCK PRODUCTION

The statistics available from various sources (INEC, SEAN, MAG, the Central Bank) are not consistent in terms of land use, but it is evident that surface area for pastures has tripled from 1965 to 1989, with the increase particularly marked since 1974. The causes for this phenomenon include:

- Spread of the agriculture frontier toward the east and northwest. The most rapid increase in pasture lands took place on the Coast,

which has undergone a more intense colonization process than has the Amazon region due to greater market access.

- In the Sierra region, the increase in pasture lands is due, above all, to a drop in the cultivation of legumes and grain (wheat, barley) for human consumption. Many agricultural lands previously abandoned are used today as extensive grazing lands for cattle, which takes poor advantage of the land. Between 1974 and 1987, the ratio of natural to artificial pastures has not changed, with artificial grazing lands accounting for 70% of the total.

In general, small producers do not have access to the best lands. This situation, linked to the reduced surface area of holdings, obligates farmers to minimize the risks of a poor harvest by planting a variety of crops and raising livestock. Productive systems relying exclusively on livestock are characteristic of large APUs.

Table 3: Number of animals per hectare of pasture in the different regions in 1954, 1974 and 1987 (in adult bovine units, ABU per hec.)

REGION	1954	1974	1987
SIERRA	0.59	0.69	0.83
COAST	0.52	0.72	0.63
AMAZON	-	0.53	0.35
NATION	0.56	0.61	0.65

Source: PROFOGAN. 1990.

Total land surface dedicated to pastures (1989, without taking into account paramo, or extreme highland, areas) has been estimated at 4,885 million hec. These are distributed among the nation's regions as follows: Coast, 2,188,800 hec = 44.8%; Sierra, 1,831,900 hec = 37.5%; and Amazon, 864,400 hec = 17.7%.

According to statistical sources, the number of animals per hectare increased between 1954 and 1987 (see Table 3), a growing trend in the Sierra, varied on the Coast and diminishing in the Amazon. Though this is a growing trend at the national level, the growth is low, reflecting the very low productivity of pastures. But it is believed that an improvement in pastures would encourage a more marked increase in productivity levels of Ecuadorian livestock; appropriate feed is one of the major limiting factors in this activity.

LIVESTOCK PRODUCTION

Cattle

In 1987, Ecuador had a bovine population of 3.88 million head (for 1993, it has been estimated at 4.802); of these, 48% are found in the Sierra, 43% on the Coast and 9% in the Amazon. It is estimated that 54% of this population is destined for beef production, especially on the Coast and in the Amazon, and 46% is destined for dairy production, especially in the Sierra. These figures include an inexact number of dual purpose cattle. This livestock is scattered throughout the nation, but a majority is found in the lower areas of the province of Pichincha.

The cattle population increased by 3.5% between 1954 and 1974, and by 3.2% between 1974 to 1986; this difference is due to the prolonged droughts occurring in 1978 and 1979, and to the floods of 1982—periods during which animals were indiscriminately slaughtered.

In 1974, 743 million liters of milk were produced, and in 1987, 1,130 million liters—an increase of 52% during this period. In spite of this increase, per capita consumption has remained virtually static; in 1974, consumption was 76.3 liters, and in 1987, 79.8 liters, a deficiency of 33% in terms of minimal nutritional requirements. For 1993, consumption is estimated at 96.52 liters, a deficiency of 23.48%.

Greatest milk production takes place in the Sierra, with 72.1% of the total; the Coast accounts for 21% and the Amazon region for 6.9%.

Yield in milk production in 1987 was 4.6 liters/cow/day in the Sierra, 2.5 liters/cow/day on the Coast and 3.3 liters/cow/day in the Amazon. These are extremely low levels of production when compared with those of other Andean countries. This situation is a clear indication that the increase in milk production is directly linked to an increase in herd size, since per animal productivity has not increased significantly in recent years.

Beef production increased by 69% between 1974 and 1987, from 54,500 to 92,400 tons. This increase is due, primarily, to a significant increase in the number of animals slaughtered, from 346,700 head in 1974 to 563,500 head in 1987, for an annual increase of 3.8%. Consequently, the increase in beef production can be attributed more to

an increase in the number of animals than to an increase in dressed weight, as the latter rose by a mere 15 kg.

Small and medium producers prefer dual-purpose livestock as it offers daily income through the sale of milk and/or cheese as well as occasional income due to the sale of animals for slaughter or the sale of young.

Large livestock

While cattle raised on small farms is almost always sold, it has been noted that a high percentage of small animals are consumed by the farmer's family. A large percentage of pigs and sheep are sold, but this is not the case for fowl, guinea pigs and rabbits. Most commercial production of these species takes place on large holdings.

In 1987, hog production was estimated at 1.6 million head (for 1993, 2,461 million head). An extraction rate of 28% has been reported, a very low figure which presumably reflects only those animals slaughtered in official slaughterhouses, and does not take into account the high rate of clandestine slaughter or consumption on the farm.

Sheep production has increased between 1974 and 1987, reaching 1.3 million head (1,630 million head in 1993). During the twenty years preceding this period, the number of sheep gradually decreased.

In 1993, the goat population was estimated at 350,000 head. This livestock species has not spread through the country to any great degree; most goats are distributed in the Sierra and on the Coast.

The greatest increase in population has taken place in fowl production. Approximately 58,452 million were raised in 1993. This increase is due to the industrialization of production in order to meet the growing urban demand.

MACRO-ECONOMIC SITUATION, POLICIES AND THEIR INFLUENCE ON THE LIVESTOCK SECTOR

Zamosc maintains that while the average growth rate in the agricultural and livestock GNP exceeded average annual growth rates for the national GNP (4.9% versus 2.4%, respectively), the agro-export

Table 4: Agriculture-livestock gross national product (GNP) 1983-1988. Percentages (at 1975 prices)

BRANCH	1983	1984	1985	1986	1987	1988
Banana, coffee, cacao.	1.8	1.9	2.4	2.4	2.2	2.2
Other agricultural products.	3.6	4.3	4.3	5.4	5.5	5.5
Animal production.	5.3	5.3	5.3	5.3	5.8	5.6
Timber.	1.1	1.1	1.1	1.1	1.2	1.0
Fishing and hunting.	1.3	1.4	1.7	1.9	2.5	2.5
Sector total:	13.1	14.0	14.7	15.8	17.2	16.8

Source: Central Bank. Boletín Anuario No. 12 1989-1990.

sector and agro-industrial producers were the primary beneficiaries of this growth. Meanwhile, peasants and small producers tied to the domestic market were affected by diminished demand and a relative decrease in the prices of their products, an increase in the cost of inputs, an increase in interest rates and a reduction in credit availability, and higher prices for basic consumer items as well as a general drop in State support and services (Zamosc, 1993).

The agricultural and livestock sector has increasingly contributed to the gross national product since the 1983 recession, with the livestock subsector playing a stable role.

Within the agriculture-livestock GNP, to which 4 subsectors contribute (Table 4), animal production accounts for the greatest share, varying between 33.3% (1988) and 40% (1983).

From the figures cited, it is clear that in times of crisis (1983), animal production has maintained its significance within the sector, but has required time to reach higher levels. This is due to the makeup of the livestock subsector in which bovine production accounts for the largest share, with a contribution of 55% (1986) to the livestock GNP.

Unlike agricultural production and the production of short cycle animals, which depend on a high percentage of balanced feed, bovine production is not subject to fluctuations from year to year. This stabilizing effect is also due to the behavior of small producers who view their animals as a type of "savings account" to be sold when family emergencies arise; this does not affect supply at the national level, but does affect the productivity of the bovine herd.

In recent years, the evolution of prices for livestock products at the

Table 5: Price increases

	Cattle kg	Sheep kg	Hogs kg	Chicken kg	Milk lt.
1993 price	2.773	2.770	2.919	3.075	494
% Increase	881.9	1.113,8	740.8	400.1	625.6
No. of years	13	13	13	13	13

Source: Compendio Estadístico Agropecuario. MAG. 1994.

producer level has remained below the average fluctuation rate, with a small relative difference in milk prices and a larger difference in meat prices (see Tables 5 and 6). This, together with heavy increases in the prices of inputs, has led to a drop in investment and the use of inputs necessary to increase production levels.

One of the most pressing problems for the agricultural and livestock sector in recent years has been the growing inability of the public sector to provide technical assistance, research and technology transfer to the producer. While public spending on the agricultural and livestock sector rose slightly in absolute terms, in real terms, there was no increase in funds available (IDEA, 1990).

Public spending on the agricultural and livestock sector in Ecuador is among the lowest in South America. The financial situation of INIAP (National Institute for Agriculture and Livestock Research) has taken a sharp turn for the worse, thus severely limiting the ability of this institution to respond to the urgent demands of the sector for technologies needed for development and adaptable to the multiple ecosystems of the country.

Thus, a vicious circle has been created—one which discourages development and the transfer of technology while keeping productivity at very low levels. Such levels, in turn, affect the use of land and leads to soil erosion. International technical assistance, which might help to improve the situation of the small and medium producer, has slowed significantly because personnel and financing from state counterpart institutions depends on public spending.

Table 6: % margin of sales

	Cattle	Sheep	Hog	Chicken	Milk
Producer/wholesaler	62.48	50.56	46.34	22.83	70.50
Producer/consumer	137.04	-	80.03	42.32	87.27

Source: Compendio Estadístico Agropecuario. MAG. 1994.

The challenge of the next few years should be a review of policies affecting research and development in the agricultural and livestock sector. Such a review could help in the distribution of financial and technical assistance according to the economic and demographic significance of the sector. This will require a reorientation of forces and the use of international assistance with the experience developed by local NGOs in order to contribute on a broad scale to the implementation of activities and actions that will lead to a harmonious improvement in the livestock sector.

How is this to be achieved? By joining forces and relying on a methodology of constant participation in which the end beneficiary—the producer—acts, and is regarded as, the be-all and end-all of actions to be undertaken; by providing responses to "their" problems, within the reigning system, which will be beneficial to the natural environment and will utilize inputs and sub-products from the area in which the project is undertaken, without causing damage to the surroundings; by intervening in an inter-disciplinary, inter-institutional fashion, and with planning based on objectives agreed upon by producers, scientists and technicians, while including training and participatory research in which both local and foreign universities have an opportunity to learn and teach, to train their personnel, create a group of technicians and scientists with a focus in terms of production which will lead to the creation of long-lasting processes as the different actors involved "assume ownership" of the processes so that the model becomes dynamic rather than dependent.

FOOTNOTES

[1] Local power in rural parishes was controlled in hierarchical fashion by the classic triad consisting of the large landowner, the priest and the political deputy.

[2] Between 1982 and 1990, the EAP grew at a rate of 4.3% per year, almost double that of the overall annual growth rate in the population; increases in the female labor force participation rate was 7.7% per year. Within the context of the economic crisis, the increase in rates of labor force participation indicates a deterioration in the quality of sources of new employment (Larrea, 1992: 320-321).

[3] Different surfaces were taken for the regions indicated to determine the APU classification, i.e., a small APU in the Sierra has between 0 and 10 hec.; whereas on the coast, a small holding is between 0 and 50 hec.

Assessment of Livestock Production Systems in Bolivia

By Luis Iñiguez
RERUMEN

ABSTRACT

Livestock production systems play an important role in Bolivia, as they contribute to family's income. Livestock production systems described throughout three different agraecological conditions: high altitude (albiplauo), the non-technical intraudean valleys and tropical savannas. Constraints to production in relevant production systems at each agraecological regions are discussed. In general-technical constrains are reflected by law productivity, due to poor understanding of environmental influences, lack of technologies for a rationed utilization of environment and natural resources, lack of appropriate management technologies, insupioul critical mass of scientists and law production incenting. A summary of suggestion for a regional research approach are also presented.

INTRODUCTION

Bolivia is a mosaic of ecosystems distributed throughout a range of elevations, from the high Andes with arctic climates to the tropical lands of the Amazon and Rio de la Plata basins. About 6 million people inhabit the country, having one of the largest rural populations of Latin America (INE, 1987).

With the exception of tropical lands, in particular those devoted to highly mechanized agriculture and beef cattle ranching, small landholdings owned by poor farmers dominate the whole agricultural sector. Smallholdings reflect the social and economic consequences of limited land tenure, which are aggravated by minimal production infrastructure, lack of credit and poor technical assistance. Furthermore, they usually occupy fragile ecosystems subject to environmental degradation and erosion of critical resources.

Livestock production in the highlands includes pastoral and agropastoral systems. Although the animal component is not necessarily

Table 1: Consumption of energy by the productive rural sector of Bolivia, according to sources of energy and different agroecological regions (values are expressed as percent)

Region	Sources of Energy			
	Inanimate	Human	Animal	Total
Highlands				
Altiplano	8	58	34	36
Valleys	10	37	53	37
Tropical lowlands	22	78		27
Total	13	55	32	100

Source: Terán and Villarroeal (1990).

the main source of family income, which is composed of different components (e.g., cultivation of the land, outfarming employment, commerce and others), its role in the household economy is crucial. It has been found that under extreme environmental fluctuations, the animal component is more stable relative to agriculture (Laguna, 1995). Most small farmers live in conditions of extreme poverty (UDAPSO, 1995).

Livestock contribute to family income, as a source of savings and, more importantly, as a source of energy. Draft animal power in the highlands, mainly that of cattle, accounts for more than 80% of the energy consumed in rural areas (Table 1).

In contrast, agriculture and livestock production in the tropics are more market-oriented and each could represent the only or more significant source of family income. The comparative role of animals as a source of energy is minimal in these regions (Table 1).

Major livestock populations in Bolivia are identified in Table 2. Data concerning poultry (about 35 million), from industrialized production that benefits only a small part of the rural sector, and that of donkeys (≈0.5 million) and horses (≈0.1 million) (Iñiguez *et al.*, 1995a), were not included in Table 2.

Table 2: Estimated population of large domestic animals in different agroecological regions of Bolivia

Species	Altiplano	Valleys	Tropics	Total
Llamas[1]	2,022,000			2,022,000
Alpacas[1]	324,300			324,300
Sheep[1]	5,200,000	3,380,000	50,000	8,580,000
Goats[2]		1,200,000	197,900	1,447,900
Cattle[2]	384,000	918,000	4,477,300	5,779,300
Pigs[2]	311,000	712,000	1,202,000	2,225,000

[1]Data from Rodriguez and Cardozo (1989)
[2]Data from CID (1993)
Note: An exceptional small population of goats (about 20,000) can be found in Souther Altiplano

This paper describes the main characteristics of major livestock production systems in Bolivia. It also discusses opportunities to stimulate sustainable agricultural growth to improve family income, with more focused and regionally integrated research programs involving an interdisciplinary approach of biological, environmental, social and economic disciplines.

ANIMAL PRODUCTION SYSTEMS

Three large agroecological regions, differentiated by altitude, can be identified in Bolivia. These are: the high altitude environments, 3,200 m above sea level (masl), generically known as Altiplano; the temperate valleys between 2,300 and 3,200 masl; and the tropical lowlands below 2,300 masl.

The Altiplano (>3,200 masl)

Two general systems can be identified in this region.

System I: Pastoral Production at High Altitude. These systems occupy areas where crops do not prosper and are severely limited by low rainfall (<300 mm a year), extended drought, strong winds that cause higher rates of evapotranspiration and high incidence of frosts. Such severe weather conditions last for 150 or more days per year. Altitude ranges from 3,600 to 4,600 masl.

The marginal areas are not densely populated and production is based on extensive utilization of range. Feed resources come from the range which is not adequately managed and is generally overgrazed, except in the South. The quality and quantity of the forage is affected by seasonality and reflected in low extraction rates. Land in pastoral communities belongs to the community and is used according to long-standing customs and traditions. The North and Central Altiplano are showing signs of overpopulation, overgrazing and land division.

Main production species are llama, alpaca and sheep. Alpaca thrives better in humid niches, while llama are found in the most marginal and dry environments. With few exceptions, llama and alpaca production systems do not overlap, but both can include Criollo sheep.

Fertility rates and yields of alpaca and llama are low. It was estimated in South Altiplano that llama fertility ranges from 16 to 42% under range conditions (Iñiguez *et al.*, 1995b). Most flocks manage males and females together throughout the year and exhibit signs of inbreeding. Management is still traditional and does not take into account the physiological characteristics of camelids. Moreover, more needs to be known and researched to determine adequate production management technologies.

Llamas in the South produce heavier fleece with finer fibers than in Central and North Altiplano (Iñiguez, 1995b). In addition, these ecotypes are heavier and larger (Loayza and Iñiguez, 1995). Nevertheless, farmers shear their animals only occasionally because of unattractive market prices. In contrast, alpacas are shorn more frequently because of better prices.

Small swamps (vegas) are important during warmer and rainy months (September to April) and in critical periods of lambing and breeding in the South. Efficient and balanced utilization of vegas requires research on interactions between soil, water, plants, and animals.

An epidemiological research approach is needed in order to develop management procedures to minimize health problems, in particular scabies and sarcocystis in camelids, that affect production and marketing.

Yields and improvement production targets are provided in Table 3.

In recent years, market opportunities for llama and alpaca products such as fibers, skins and meat have remarkably improved, as reflected in

Table 3: Average yield per animal and improvement production targets that could be achieved by research, technology transfer and attractive market prices, in areas with potential for improvement

Traits	Sheep	Cattle	Llamas	Alpacas
Wool/fiber (kg)	0.5 (0.7)		0.7 (1.5)	1.5 (2.0)
Milk (kg/day)	0.2 (0.7)	6 (12)		
Live weight (kg)	22 (40)		60 (80)	
Carcass weight (kg)	11 (20)		30 (40)	
Fertility (%)	80	60 (80)	40 (80)	40 (80)
Draft (% utilization/yr)		30 (50)		

In parenthesis: Improvement targets; Underlined: In areas of valleys and Altiplano with access to water for irrigation.

Table 4, which broadly summarizes market opportunities for animal products obtained in Bolivia. However, there is a need to develop/ strengthen farmers' organizations and marketing schemes to take full advantage of existing production incentives.

Industrial dehairing offers new comparative advantages for llama fiber and possibilities to improve family income. Technical assistance and research to improve fiber production through breeding, and to establish appropriate shearing technologies should then be considered.

FIDA (1994) has recently launched an effort to market llama meat, which is profitably priced, particularly as charqui (dried and salted). Meat production will require sound research on reproduction aspects in order to secure extraction rates that are compatible with reproduction rates.

Sheep are more often consumed in the household, because it is easier to slaughter a smaller animal than a larger llama or alpaca. Sheep fertility is remarkable; it has been estimated that about 20% of the females reproduce twice a year and very likely 3 lambs in 2 years. However, lamb mortality is high due to forage fluctuations and management. Wool is coarse and of carpet quality.

Table 4: Market opportunities for animal products produced in Bolivia

Species/Products	Internal Market	External Market
Camelids		
Meat	high	NYE
Llama fiber	low	promising
Alpaca fiber	medium	high
Sheep and Goats		
Meat	high	WPP
Wool (Sheep)	low	Unknown[1]
Cheese	high	WPP
Cattle		
Meat	high	WPP
Cheese	high	WPP

WPP: With no present possibilities due to animal health restrictions.

[1] If markets for coarse carpet wool appear and prices prompt farmers to shear and sell, prospects could be excellent.

The main constraints to production in these systems are:

Macro-policy

- Extreme market fluctuations.
- Accessibility problems (in particular during the rains).
- Weak farmers' production and marketing organizations.
- Lack of technical assistance and credit.

Research and Technology Transfer

- Environmental: Poor understanding of the physiology of production in high altitude environments and the effects of altitude on production.
- Lack of sustainable management of natural resources, in particular, water, soil and forages. (A well designed model to utilize vegas, allowing for maximum production with no erosion is urgently needed.)
- Lack of sustainable and improved production on the basis of improved feeding/grazing strategies, improved reproduction, appropriate breeding strategies and animal health programs.
- Lack of technologies for transformation of animal products to increase aggregate value and occupy family labor.
- Lack of a critical mass of well trained scientists.
- Poor understanding of social, cultural and economic issues.

Markets and farmers' marketing organizations deserve major concern. It has been shown that production improvement will take place if prices are attractive. For instance, shearing of llamas and sheep will not occur, nor will all associated technologies to improve wool/fiber production be adopted, unless market prices change and provide a significant contribution to family income.

Many international organizations have funded a number of projects and programs to support production. However, most of them have not been successful. Very few have included a research component; moreover, they were conceived with the premise that research was unnecessary.

North and South Lipez, in South Altiplano, are regions with potential for significant impact. A small and well designed program funded by the European Union is presently contributing to develop basic infrastructure and farmers' organizations. This should be ideally complemented by a research program concerning animal production. In addition, inherent problems in these particular systems have regional incidence in areas under desertification in the northern and southern (Patagonia) parts of Chile and Argentina, which could also be collaboratively solved by a regional research approach.

System II: Agropastoral Production at High Altitude. In general, these are better suited for crop production, with rainfall ranging from 350 to 600 mm, and better water resources and less extreme conditions. Farming involves traditional Andean crops and barley that is cropped as fodder. Alfalfa can be cultivated to produce up to two cuts per year. In most irrigation areas, salinization of soils is under way due to the water's high content of salts. Utilization of halophytes has shown promising prospects in this regard (Yazman, 1995; Tejada and Guzmán, 1993).

Land tenure is more restrictive. In the north, near Lake Titicaca and areas with better rainfall, land division and limited tenure rights are extreme and are a serious limitation to production with almost no solution. In the central area, land is partially owned by the farmers and partially by the community. Utilization of communal land follows traditional patterns and is now confronting problems due to high population growth rates (Yazman, 1995). In general, poverty is not as pronounced because of more employment alternatives.

Important animal species are sheep and cattle. Donkeys suit the needs for transportation to and from cultivation areas, roads and markets.

Efforts to increase sheep wool and meat production on a seasonal basis started in the 60's. However, production systems are still managed under accelerated nonseasonal lambing, because of the farmers' preference to produce cheese in order to obtain a steady cash flow for extended periods. Wool has low value in the market (Table 4) and presently does not have a direct production incentive. Flock size ranges from 30 to 70 sheep.

Cattle are criollo, except in dairy production areas. Criollo animals are poor milk producers, have slow growth rates and are basically used as oxen (Table 5). The number of cattle per family ranges from 0 to 3.

Table 5: Rural population, number of families and number of oxen by region

Region	Population	Families	Oxen		
			n	%	Per family
Altiplano	1,754,545	350,909	233,938	54	0.67
Valleys	1,075,256	215,051	143,366	33	0.67
Lowlands	583,511	116,742	58,370	13	0.50
Total	3,413,511	682,702	435,674	100	0.64

Source: Terán and Villarroel (1990).

Animals graze the range and are fed with barley, crop residues and concentrates, in the case of dairy operations, during the dry season. Forage quantity and quality in the range is affected by land tenure and seasonality. Overgrazing is evident in many systems.

Yields and extraction rates are low (Table 3); however, the latter tends to be higher in areas close to markets where systems intensify in response to market opportunities (Table 4) and attractive prices. In these, the production of mutton and fattening of cattle have proven to be profitable and were adopted. The high sheep reproduction rates (Table 3) are well suited to accelerated lambing, within a small but highly productive flock.

Milk production has also shown significant increases, especially in areas with potential, that is, with better water resources and proximity to markets. Cattle are relatively more affected by high altitude than other domestic species. This problem was partially solved by grading up (to Holstein) crosses of acclimatized Holstein (or Brown Swiss) x adapted Criollo cattle. Dairy production systems consist of few (1 to 3) cows, kept under semi-confinement.

Further production intensification and improvement is still possible and should be based on better utilization and management of local resources, whenever there is potential to support the involved physiological demands.

Forage production could be enhanced by efficient technologies to transfer production during the rainy season into the dry season. This may require development of micro-silos and also cropping during late winter if water resources are available. Technologies to utilize straws and urea blocks more efficiently are not yet widely spread.

Efficiency of animal transportation could also be improved by increasing annual utilization rates and new technologies to fully facilitate the use of draft animal power.

Transformation of products within small artisan units, such as the making of cheese, could increase the aggregate value and absorb family labor more efficiently.

Main constraints to production in these systems are:

Macro-policy

- Market fluctuations.
- Weak farmers' production and marketing organizations.
- Weak technical assistance and credit policies.

Research and Technology Transfer

- Environmental: Poor understanding of the physiology of production in high altitude environments and the effects of altitude on production.
- Lack of sustainable management of natural resources, in particular, water, soil and forages. (A well designed model to utilize irrigation water, allowing for minimal deposition of salts through the aid of plants that are tolerant to salts, is needed.)
- Lack of sustainable and improved production on the basis of improved feeding/grazing strategies, improved reproduction, appropriate breeding strategies and animal health programs.
- Deficiencies in crop management, land rotation and fallowing.
- Lack of well designed intensive production schemes that consider flock size reduction to diminish land pressure and overgrazing, and intensive cultivation of valuable crops.
- Lack of technologies for transformation of animal products to increase aggregate value and occupy family labor.
- Poor understanding of social, cultural and economic issues.

These systems have benefited, unlike many others, from a considerable number of financial and technical assistance programs. Available research results should be screened and compiled for useful

technology transfer. However, research is still needed to address new trends and needs according to ongoing changes in land tenure and market demands.

The Interandean Valleys (2300 to 3200 masl)

Temperate valleys are widely distributed through the depressions in the Andean range. Valleys have Mediterranean climates with annual rainfall varying from 200 to 600 mm, distributed in only a few months of the year. Higher temperatures and lower incidence of frosts allow cropping and cultivation of a variety of crops, forages, horticultural products and fruits. Where water is available for irrigation, intensive cultivation could lead to more than one crop a year. Intensive land utilization has, in many cases, caused serious degradation and erosion of the land, particularly if cultivation is on slopes (Macias, 1994).

Two general systems can be identified in this region.

System III. Intensive Dairy Production. Limited to valleys near large cities, particularly around Cochabamba, these systems are based largely on Holstein cattle with an average milk production of 2013 kg per year (6.6 kg per day) (Ayala, 1995). There is a range of different production scales; however, small producers are the dominant group. Many small producers, known as piqueros, produce milk on zero land basis by grazing their cows on rented paddocks and along country roads and open areas. Medium and large producers utilize their own land where alfalfa and corn are cropped as fodder. Corn is cultivated for silage and hay. Supplementation with concentrates is a common practice among all dairy producers.

Although production standards among medium and large producers are high, about 4,000 kg per year (13.1 kg per day) (Ayala, 1995), feasible production goals have not yet been reached.

Milk is a substantial source of income for small producers. In fact, it has the potential to generate income faster than any other agricultural activity. Woman have an important role in raising dairy cattle. This is particularly important in the making of quesillo (ricotta). Efforts to improve milk transformation, from collection to actual transformation, are still needed. Transformation into cheese, ice cream and yogurt, has proven to be profitable due to market demand (Table 4) and prices.

While the genetic level of cattle seems to have improved, efficient means for improving feeding systems still need further research.

Land around the cities in the valleys is highly valued for urban development and is now a limiting factor to well-established and sustainable dairy production schemes.

Main constraints to production are:

Macro-policy

- Lack of policies to regulate urban development, protecting agricultural land devoted to dairy production.
- Lack of aggressive marketing to stimulate mass consumption of new dairy products.
- Weak technical assistance and credit policies.

Research and Technology Transfer

- Lack of sustainable and improved production on the basis of improved feeding/grazing strategies, improved reproduction, appropriate breeding strategies and animal health programs.
- Deficiencies in intensive cultivation and conservation of forages.
- Lack of technologies for transformation of animal products to increase aggregate value and occupy family labor.

Dairy production compared to other production systems has not yet received full support. Research efforts in this sector could involve active participation of farmers, the industry and the National University of Cochabamba.

System IV. Agropastoral Production in Valleys. These production systems are generally based on smallholdings that utilize land intensively to obtain at least two crops a year. Crops offer residues that will be utilized by large ruminants and occasionally by small ruminants. Corn is the key crop, which serves many purposes, including fodder. Corn straw is stored dried as hay and fed to animals during the drought, which can last up to 9 months (Caballero, 1994).

A small number of criollo cattle or criollo x Holstein grades (1 to 5) are raised next to the household and for draft purposes (Table 5). The annual utilization rate is only 30%, which could be substantially extended and diversified.

Criollo sheep and goats are an important component and are usually raised together on an extensive basis. During the day animals graze the range, and spend nights in rustic corrals near the households. Sheep relative to goats are more numerous in higher altitudes. Both species provide meat, fibers and skins. Manure is highly valued for cropping, although it is not sufficient for the local demand.

Basic feeding resources come from the range, which consists of a herbaceous stratum of native grasses and legumes, intermixed with legume trees and shrubs that provide forage even during the dry winter when all herbs and grasses disappear. Grazing schemes and patterns in accordance with the availability of forage and plant growth are imperative in these areas. It is also very important to consider the transfer of biomass, produced during the rainy season into the dry season. Association of legumes and cereals have proven to be very valuable in this concern.

A solid epidemiological research approach is needed to develop effective management systems to minimize health problems.

Some areas have the potential to produce milk and cheese from small ruminants (Table 4). Research efforts should focus on alternatives to increase extraction rates while reducing flock size in order to relax land pressure and avoid soil erosion in systems under intensive cropping, especially where cultivation is on slopes. Criollo sheep and goats have good dairy potential and have been proven to respond well to breeding programs (Rigalt *et al.*, 1994; Chumacero, 1995).

Marketing and production organization are very much needed. Transformation of products also deserves special attention to allow for a higher aggregate value and utilization of family labor.

Donkeys and horses are the only species used for transportation (Iñiguez *et al.*, 1995a), which could be substantially improved by incorporating new technologies on draft animal power.

Pigs, poultry and guinea pigs could play a very important role in the

local economy. These species have been largely overlooked and should be considered in efforts to improve the overall output of the systems.

Main constraints to production are:

Macro-policy

- Market fluctuations and lack of aggressive marketing.
- Weak farmers' production and marketing organizations.
- Lack of technical assistance and credit.

Research and Technology Transfer

- Lack of sustainable management of natural resources, in particular, water, soil and forages. (Well designed models to utilize irrigation water and agroforestry are needed.)
- Lack of sustainable and improved production on the basis of improved feeding/grazing strategies, improved reproduction, appropriate breeding strategies and animal health programs.
- Deficiencies in crop management, including crop breeding, land rotation and fallowing.
- Lack of well designed intensive production schemes based on flock size reduction to diminish land pressure and overgrazing, and intensive cultivation of valuable crops.
- Lack of technologies for transformation of animal products to increase aggregate value and occupy family labor.
- Lack of a critical mass of well trained scientists.
- Poor understanding of social, cultural and economic issues.

Interandean valleys extend over many Latin American countries, from Argentina and Chile in the south, to Venezuela in the north. Research issues are thus regional and efforts should capitalize on valuable human resources, experience and facilities in this region.

The Lowlands (<2,000 masl)

Three animal production regions can be recognized in the lowlands. These regions are the tropical savannas, the semi-arid Chaco and the extensive/industrialized cropping area. The first and second correspond to beef cattle production under extensive ranching. The last is a

combination of dairy production, beef production and fattening schemes due to ample availability of feeding resources and crop residues. A particular system involving pig production is limited to only a small region of the country. Only the first two systems will be discussed in this paper.

System V. Extensive Pastoral Production in Tropical Savannas. The largest beef production region is located in the tropical savannas of Beni and Santa Cruz, accounting for 71% of the country's cattle population (*5.7 million head) (CID, 1993). Tropical savannas are rich in pastures and subject to annual cycles of flooding and drought. The rainy season starts in late September and lasts until late April. Rivers carrying waters from the high Andes connect and converge in the lowlands, forming the Great Amazon Basin system. In Beni, at least 2/3 of the land is flooded by December and remains submerged in water until late August. As the waters recede, biomass is produced which will be consumed by cattle raised on extensive landholdings. During the flood, cattle graze in the flooded areas during the day and move onto higher elevations, known as isles (islas), overnight without shepherding. Cattle raising is still traditional and in many cases, management lacks the basic husbandry principles.

Cattle production is based on Nellore and crosses of Nellore x Criollo (Bauer, 1995). Production yields and extraction rates are poor, as fertility rates are estimated to be not higher than 60% and intercalving intervals are greater than 2 years.

Medium production systems ranging from 2,000 to 4,000 ha are the most important. Cattle production and grazing is on private land.

Foot and mouth disease (FMD), tuberculosis and rabies are endemic and cause important economic loses. These diseases are further aggravated by internal and external parasites. Management lacks epidemiological practices; moreover, regional health controls to reduce the incidence of the above diseases are lacking. In the last 2 years a nationwide program to control and eventually eradicate major diseases such as FMD has been launched by the government.

There is an urgent need to develop appropriate technologies to manage the tropical savannas to avoid land degradation, soil erosion and erosion of valuable vegetation.

Management of the native pastures in the savannas will improve production rates. However, feeding strategies involving mineral supplementation also needs to be considered.

Horses and pigs are also raised in tropical savannas. Recent interest in hair sheep has been raised, particularly among ranchers who provide meat for their personnel on a regular basis.

The northern part of the savannas overlap with Amazonia, where exploitation of large tropical forests, rubber and Brazil nuts takes place. Thus, integrated systems with large and small ruminants have a tremendous potential to generate additional income, as is evidenced by the experience achieved in Southeast Asia.

Capybara is a widely distributed rodent in the savannas. In many areas, this species interacts negatively with cattle production, competing for similar types of forage. Thus, integrated management of wildlife should be investigated.

Main constraints to production in these systems are:

Macro-policy

- Market fluctuations.
- Weak regional disease control systems.
- Lack of accessibility during the rainy season.
- Lack of technical assistance and weak credit policies.

Research and Technology Transfer

- Environmental: There is a poor understanding of the dynamics of forage production and vegetation changes in the savannas during cycles of flooding and drought, and slash-and-burn agricultural practices.
- Lack of sustainable management of natural resources, in particular, water, soil and forages. (A well designed model to utilize savannas, allowing for maximum production with no erosion, is urgently needed.)
- Lack of sustainable and improved production on the basis of improved feeding/grazing strategies, improved reproduction, appropriate breeding strategies and animal

health programs.
- Lack of a critical mass of well trained scientists in aspects of livestock production in tropical savannas.
- Poor understanding of social and economic issues.

Ranchers are well organized in local and regional associations. Farmers can actively support efforts to improve production.

Absence of research and development has seriously delayed not only improvements in cattle production, but has also delayed further increases in family income for many small and medium producers.

Tropical savannas possessing similar problems are extended over many South American countries, e.g., Venezuela, Colombia, Peru and Brazil. Research issues are thus regional and efforts should capitalize on the available human resources, experience and facilities.

System VI. Extensive Pastoral Production in Semi-arid Tropics (Chaco). These systems occupy semi-arid and tropical environments with rainfall <300 mm. The Chaco region is extended over Bolivia, Argentina, Paraguay and Brazil.

Cattle are kept in extensive operations. Most cattle are Criollo. Native vegetation, consisting of bushes of thorny legume shrubs, is the only source of feeding. Cattle browse the shrubs and also graze the herbaceous stratum.

Extraction rates are low, as production is strongly affected by seasonal fluctuations and drought. Constraints, to some extent, are similar to those for savannas. However, water is the limiting resource, particularly with feed animals. Farmers need to build large reservoirs, collecting all water that is deposited during the rainy season to be used in the long and hot dry season.

INSTITUTIONAL FRAMEWORK

The organization of Bolivia's government is undergoing structural changes. An important change is being induced through a decentralization process, by which the central government's power will be transferred to each Department (the country's largest internal political/territorial unit).

Figure 1: Diagram of institutional components that play a role in policy development concerning the livestock sector

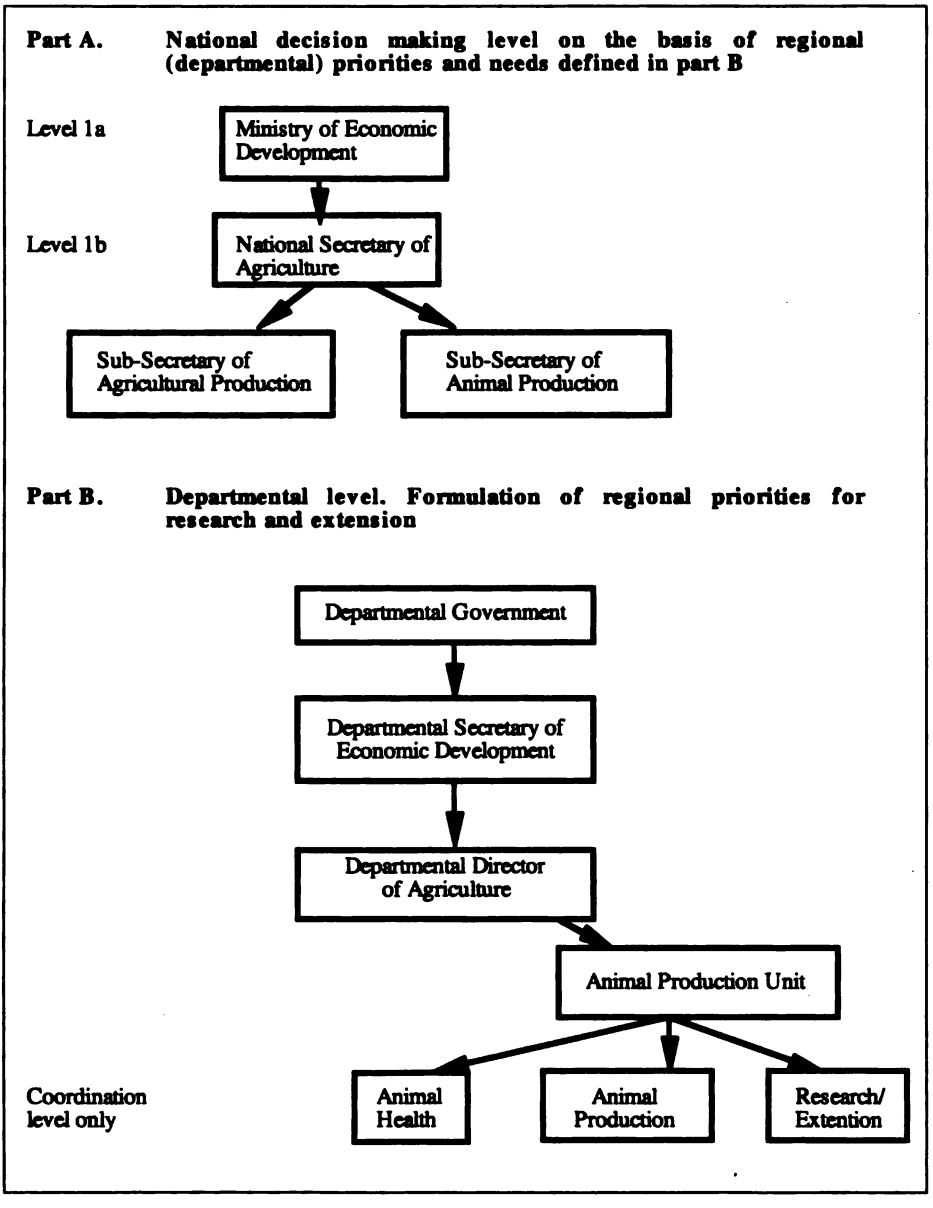

Figure 1 illustrates the organizational structure of the main components that play a role in policy development and information for the livestock sector. In Part A, the higher national decisionmaking levels are shown. Based on inputs and priorities emerging from each of the nine political departments, this level primarily will reconcile them and prepare corresponding norms and policies to be approved by levels 1b or 1a.

Table 6: Institutions and scientists conducting research on livestock matters in Bolivia

Institution[1]	Regional[2] Scope	Total	Scientists (n)			
			B.Sc.	M.Sc.	Ph.D.	English Speakers
IBTA	A + V	9	2	5	2	4
CIAT	T	10	8	2		2
UMSS	V	11	9	2		2
UMSA	A	3		3		2
UMGRM	T	4	3	1		2
UTB	T	2	1	1		1
CMGB	T	2	1	1		1

[1]Major universities: IBTA: Bolivian Institute for Agricultural Technology; CIAT: Research Center for Tropical Agriculture (Santa Cruz); UMSS: San Simón University (Cochabamba); UMGRM: Gabriel René Moreno University (Santa Cruz); UMSA: San Andrés University (La Paz); UTB: Technical University (Beni); CMGB: Cattle Breeding Center (UMGRM, Santa Cruz)
[2]A: Altiplano; V: Valleys; T: Tropics

Part B shows the department decisionmaking levels, where in principle, real needs for improvement and development in a given department will be considered and prioritized. Therefore, defining activities under a given department's jurisdiction and providing a counterpart for agreements (e.g., research agreements), will take place at this level.

At the departmental level (Part B), structures found in Part A are replicated. An Animal Production Unit will coordinate activities only through three major divisions: Animal Health, Production, and Research and Extension. Research and Extension operations will be conducted by organized agencies, the private sector and NGOs in accordance with regional (Departmental) priorities and in response to needs locally identified by farmers, the market and the industry.

RESEARCH INSTITUTIONS

Tables 6 and 7 summarize the institutions and scientists conducting research on livestock matters in the country.

There are two formal research institutions in Bolivia; the Bolivian Institute for Agricultural Technology (IBTA) that focuses on the highlands (Altiplano and valleys), and the Research Center for Tropical Agriculture

Table 7: Distribution of scientists conducting research on livestock matters, per discipline

DISCIPLINE	IBTA	CIAT	UMSS	UMSA	UMGRM	UTB	CMGB
Nutrition	4 (3m, 1p)		1 (b)	1 (m)	1 (m)	1 (b)	
Genetics		1 (m)	2 (1b, 1m)	1 (m)			2 (1b, 1m)
Health	1 (b)	4 (b)			2 (b)		
Forages	3 (2m, 1p)	5 (4b, 1m)	6 (5b, 1m)	1 (m)	1 (b)		
Production	1 (b)		2 (b)			1 (b)	

b: B.Sc. level with training; m: M.Sc. level; p: Ph.D. level

(CIAT) that engages in research and extension in the tropics of Santa Cruz. Major universities involved in research are the National Universities of Cochabamba and Santa Cruz.

In general, research in social and economic issues is not formally conducted by national research institutions, but by a number of NGOs and within the national university system, in particular the Catholic University of Bolivia in La Paz.

CONCLUSIONS

Bolivia is an agricultural country with a large rural population with low family income. Livestock production plays an important role in all regions, through pastoral and agropastoral production systems. With few exceptions, the incomes of most livestock production systems need to be improved. Income improvement may be achieved by increasing yields on an animal and system basis. To this end, important research programs should be developed in order to understand the physiological responses of animals to different agroecological niches within Bolivia and to model/ develop appropriate technologies for producers to apply. In this undertaking, sustainability of the production systems should be considered, as well as the management of natural resources, mainly water, soil, and plant germplasm, to avoid degradation and erosion. Models to manage fragile ecosystems by means of rational livestock production systems could then be proposed and developed.

Experience has shown that production incentives are critical in determining the degree of impact of research and development. In addition, many research efforts have overlooked areas with significant potential for improvement/impact, and have instead focused on very marginal production systems. These systems were where alleviation of constraints to production required more political than technical solutions. To assure success and avoid frustrations, important considerations for

project formulation are: a regional scope to allow for organization of critical referential masses of well trained scientists and more widespread exchange of experience and sharing of facilities; commitment from farmers to participate; interdisciplinary interaction involving biological, environmental and socioeconomic disciplines; and focus on products that will have market advantage and contribute to impact. The tropical savannas, the interandean valleys and regions under desertification in Bolivia, reflect the conditions highlighted above.

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Livestock Production in Honduras

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ABSTRACT

Honduras has a population of 5.7 million inhabitants, of which 60% live in rural areas, and the other 40% in urban areas. The nation's area is 75% forest and the rest is used in agricultural and livestock activities. There are two well-defined seasons in Honduras: winter and summer, each lasting six months. Honduras has zones with precipitation between 400 and 120 mm/year; however, there are also zones that have precipitation higher than 3,000 to 4,000 mm/year.

The livestock sector has an important position within the Honduran economy, not only for its contribution to feeding the population (products of animal origin such as milk, meat and eggs are fundamental to food security programs), but also as a generator of income and employment.

The agricultural sector generates 26% of the Honduran Gross National Product, and the livestock sector contributes 22% of the total. There are about 99,910 livestock farms, of which 83% follow a dual purpose system (milk and meat), 10% specialize in dairy, and 7% in breeding livestock. On dual purpose farms, the use of advanced technology is limited. The per capita consumption of milk is approximately 75 liters/year, which is half the per capita consumption recommended by the FAO.

In the last 10 years, chicken production has had an annual growth rate of more than 12% annually. This has been achieved even with the high dependence on imported genetic material and food inputs such as corn.

Milk and meat production are highly dependent on the availability of pasture, but the supply of pasture varies according to the season. During the rainy season, there is enough pasture to produce plenty of milk in dairy cattle and weight gain in beef cattle. On the other hand, during the summer season, the shortage of pasture results in low production. The production seasonality is a relevant characteristic of the Honduran cattle sector's operating system.

There are other production limitations, such as land tenure. Most of the farmers in Honduras do not have property titles, commonly used as warranties. Therefore, they are not eligible to receive loans. Currently, the Department of Natural Resources is making some changes. The main objective is to bring technical assistance to the most needy farmers or to those who do not have the latest technology. For this reason, they are making a major effort to organize farmers. There are a lot of technical services needed to improve the quality of life in this sector, especially for farmers who raise small ruminants and dual purpose cattle and pigs.

It is necessary to create livestock research programs that focus on pasture species and agricultural products, as well as by-products or agro-industrial residues utilization that can be used to feed farm animals. Honduras has livestock scientists who can develop activities to generate and transfer technology, and institutions that can link themselves to this development process.

INTRODUCTION

Honduras has a population of 5.7 million of inhabitants, 60% of them living in rural areas, and 40% in urban areas. The country has an area of 112,492 km^2, equal to 11.25 million hectares. The nation's area is 75% (8.45 million hectares) forest, with the remaining 25% (2.8 million hectares) dedicated to agricultural and livestock activities

There are three main zones: the highlands and valleys, the lowlands of the Caribbean region and the lowlands of the Pacific Ocean region. These areas present different agroecological conditions that affect crop production and animal species.

The medium annual temperature in Honduras is between 21°C and 32°C; however, some places in the highland zones have temperatures between 12°C and 17°C. There are two well-defined seasons: winter and summer, with a duration of six months each. The winter season starts in May and finishes in October for the highland zones, valleys, and lowlands of the Pacific. In these zones, the rainfall is between 400 and 1,200 mm/ per year; however, for the lowlands of the Caribbean where the rainy season starts in May-June and ends in January-February, the precipitation is in the range of 3,000 to 4,000 mm/per year.

The livestock sector plays an important role in the Honduran economy, not only for its contribution to feeding the population, but also as a generator of income and employment. Products of animal origin such as milk, meat and eggs, are fundamental within the food security programs.

The agriculture sector generates 26% of the Gross National Product and livestock contributes 22% of this total. There are approximately 100,000 livestock farms, 83% of which raise dual purpose (milk and meat) cattle, 10% specialize in dairy cattle and 7% raise breeding livestock. In those farms, the use of technology is limited.

The production of cow's milk reaches significant volumes even though it is insufficient to satisfy the internal demand for milk, particularly during the summer season. In 1992, there was a reported production of 384 million liters of fluid milk. This, added to the equivalent of fluid milk from imports of powdered milk, represented 113.7 million liters (average of the last five years), an estimated consumption of 497.7 million liters of milk per year. Considering a population of approximately 5.7 million, the estimated per capita annual consumption would be 87 liters.

The production of milk in Honduras is 42% lower than the demand for milk, considering that the FAO recommended per capita consumption is 150 liters of milk per year. As a result, the production of milk within the country needs to double.

In the case of meat, between 1985 and 1994, the production of beef increased more than 78%. Beef production represents nearly 25% of the total value of Honduran cattle production, and about 65% of the total meat produced in the country. During 1994, Honduras exported meat products worth 98 million dollars, representing 4.6% of national exports.

During the same period, production of chicken meat increased more than 12% per year, in spite of high dependence on imported genetic material and food inputs such as yellow corn, which come from the United States.

From 1985 to 1994, there was a decrease in the supply of pork, goat and sheep meat, while the supply of chicken meat increased from 21% to 26%.

The production of milk and meat in Honduras is strongly dependent on the availability of pasture. The supply of pastures varies accordingly

to the season. During the rainy season, there are enough pastures to support the dairy industry, which produces a significant amount of milk; there is also rapid weight gain of livestock in general. However, during the summer season, the shortage of pastures results in low production that leaves the cattle industry with a short supply of milk and meat.

THE AGRICULTURAL SECTOR

Council of Agricultural Development, CODA, is an organization providing advice and coordination of the activities undertaken by the public and private agricultural sector.

The agricultural public sector is composed of, in addition to the Natural Resources Secretary and its branches; of the National Agrarian Institute (INA), the Honduran Institute of Agricultural Marketing (IHMA), the National Bank of Agricultural Development (BANADESA), the Honduran Coffee Institute (IHCAFE), and the Honduran Corporation of Forest Development (COHDEFOR). The Secretary of Natural Resources in coordination with the Secretary of Economy and Commerce and the other instituions of the public sector are responsible for promoting the efficient production of food and agricultural raw materials for internal consumption and export.

Unit of Regional Agricultural Planning, UPSA, is a unit of agricultural politics under the Secretary of Natural Resources and has the following functions: First, planning is coordinated among the organizations and institutions that form CODA; second, it creates an adequate infrastructure that allows it to guide and control agricultural and forest activities toward efficient farms through conservation, sustainability and rational use of natural resources, and the protection of the environment in general.

Directorate of Science and Agricultural Technology, DICTA

The Ministry of Natural Resources is charged with the activities and services of the agricultural public sector toward generation and transfer of technology to farmers, with the purpose of achieving agricultural development and food security for the population. DICTA is responsible for the design, direction and execution of research programs and transfer of agricultural technology. It is an organization that is independent

technically, financially and administratively of the Secretary of Natural Resources.

DICTA coordinates the services of generation and transfer of technology, utilizing the cooperation of specialized private institutions that exist in the country, and it also promotes the operation and creation of private enterprises and institutions.

CONAL (National Commission on Milk). It has existed since 1985 and its objectives are to propose new political strategies and to promote the development of production, processing, and consumption of milk products in Honduras.

CONAL is presided over by the Minister of Agriculture and its membership is composed of representatives of the Secretary of Economy and Commerce, the Public Health Secretary, the Technical Secretary of the Superior Council of Economic Planning, the National Federation of Agriculturists and Livestock Farmers, the Milk Industry, the Milk Producers, and the Home-made Cheese Producers.

The milk products with the highest volume of importation into the country are powdered skim milk and powdered whole milk; they have import taxes of 15% and 5%, respectively.

SNITTA (The National System of Research and Transfer of Agricultural and Forest Technology). This system is structured within the Law of Modernization and Development of the Agricultural Sector; its objective is the creation of a systematized register of agencies that perform research and transfer of technology.

SNITTA, besides coordinating the institutional resources, will promote the utilization of technology in the field through the education of producers and technicians.

LAND TENURE

The National Agrarian Institute (INA) is responsible for demanding the restitution of all the rural lands, national or ejidales, that are illegally in the hands of unauthorized farmers. Nevertheless, those farmers who are able to prove to the INA that the land is being used properly and in a

specific manner, or has been in use during a period of no less than three years, will have the right to buy the land, as long as it doesn't exceed 500 acres. However, farmers clearing or plowing areas of forest in order to convert them to agricultural use—contrary to their natural use, conservation and management—are excluded from these benefits.

The land affected is rural agricultural property or privately-owned cattle ranches being converted to agricultural use when such conversion is considered not consistent with accepted principles of environmentally sound usage of land, for example, any of the following cases: when the land remains hidden or not used for more than 18 consecutive months. The term will be extended to 24 months when for lack of financial resources, drought, floods or other reasons beyond the owner's control, the owner has not been able to use the land properly.

The forest areas are excluded from the Agrarian Reform. The national or ejidales lands whose payment is due can not be the object of arrendamiento.

Cooperative, associative enterprises and other forms of organization of the Agrarian Reform Program, can adopt one of the following forms of organization:

- Adjudication of pieces of land in agricultural units for individual use.

- Adjudication of the land to a cooperative, associative enterprise or any other form of organization legally recognized by the state, the one that would be owner and usser of the land. Those forms of organization will be production enterprises whose members associate for common purposes, including production, processing and marketing of their products.

The state will promote and contribute to the execution of the Reconversion Program of the agro-industrial and agricultural enterprises of the Agrarian Reform, with the purpose of consolidating them economically and technically.

PROCESSING OF LIVESTOCK PRODUCTS

All of the activities involved in the processing of livestock products are coordinated by the Secretaries of Natural Resources and Economy and Commerce.

Sub Sector of Milk

In Honduras there are two fundamental types of milk processing for the consumer market: large-scale commercial milk processing plants and small-scale rural cheese-makers.

All milk processors confront serious problems of supply, especially during the dry season; they also have problems with the low quality of available milk, particularly the small-scale processors and those who make cheese at home.

The large-scale processing plants are supervised by the official sector, which controls the quality of the products. This sector is composed of numerous individual parts: producers, collection centers, intermediates and industrial plants. The presence of industrial milk plants has given to the milk production cuencas in influential areas. The milk that arrives at the plants is subject to a minimum of quality control, for example, milk filters and tests regarding percent of gases and level of acidity.

The large-scale milk processing plants have the infrastructure and equipment which permits them to apply diverse technologies. Various milk plants have installed collection centers, which permits them to purchase milk produced in different areas, where it is picked up and transferred to the plants. These units have cooling systems in order to ensure that the product arrives at the central plant in the best condition possible.

Basically, milk is clasified into A, B and C categories, according the standards determined by the enterprises. Both the large and small processing plants have severe problems obtaining a supply of milk, in particular, during the large seasonal fluctuations in the milk supply. These enterprises possess their own distribution net, selling their products directly to the consumer, thus guaranteeing the quality. The principal derived products are for internal consumers, although in actuality they are exporting to countries in the Caribbean Island region and to the United States.

The small-scale producers and producers of home-made products include intermediates, distributors and retailers. The products they produce are—in order of exportation—cheese, clotted sour cream, butter and cream.

Quality control of milk and derived products used by the small-scale and home processors is practically nonexistent, with the exception of some cheese manufacturers who are large enough and have sufficient volume of production to stay subject to sanitarian officials. The equipment of small-scale units, in general, is rudimentary, with wooden molds, and generally low levels of sanitation in their processing practices.

None of the small-scale enterprises pasteurize the milk received, so their products are manufactured with raw milk. Since there is a big demand for dairy products, the cheese makers supply the low-income population; however, because of middlemen, the prices for these foods are as high as for the products of the large-scale milk processing plants. The small-scale producers are not well organized to market their products, making them more vulnerable to the variations of supply and market. There is also an institutional market which includes hotels, restaurants, the military and other organizations, and a market represented by medium and small cities.

Demand and meat consumption

During 1985-1994, 13.4% of the national production of beef was exported. It represented a consumption trend between 15.1 and 18.7 kilograms per person per year. Even though the internal supply of meat increased more than 7%, the internal demand increased only a little more than 2% per year, the result of a shift in demand toward a cheaper product such as the chicken meat.

The steady low level of income resulted in a low increase in the consumption of beef. The competition from chicken and pork contributed to maintain prices steady to the cattle producer. Consumption of chicken meat increased more than consumption of beef.

CREDIT

By law, the National Agricultural Development Bank (BANADESA) is the only government bank permitted to grant credit to agricultural

producers. In the last ten years, however, although the number of loans provided by the bank to the livestock sector has increased, the bank's share in the total credit provided to this sector has decreased because of the rising participation of private commercial banks. Because government banks do not have control over the amount of credit, and because many loans are not for supervised projects, government bankers are unable to confirm whether the amounts lent to the livestock sector have been effectively invested in livestock activities. On the other hand, small and medium-sized livestock farmers note difficulties in repaying loans and point to several reasons, including: the agricultural sector obtains better credit terms than the livestock sector, meat and milk prices are unstable, they do not have adequate collateral since uncertain land tenure is associated with a lack of property titles.

LIVESTOCK RESEARCH PRIORITIES

To develop low-cost production models based on efficient utilization of the production factors within the country.

Beef and Dairy Production

Research on beef and dairy production systems on dual purpose farms, with emphasis on:

- Nourishing during the critical season using different agricultural products and by-products of the area
- Supplementing food with agro-industrial by-products, such as the ones derived from the processing of milk
- Establishing pasture programs, legume and forage conservation
- Semi-intensive calf breeding
- Research on reproduction diseases of beef and dairy cattle
- Techniques of milk and by-products processing and conservation at the small-scale and home level
- Strengthening the competitive and technological capability of the cheese manufacturers

Pork Production

Research on swine production systems in the region

- Research on low-cost food rations for pigs in their different developmental stages, using local products and by-products

- Production of hybrids and commercial breeding on ranches
- Studies of gastrointestinal bacterial diseases
- Studies of respiratory diseases

Poultry Production

Research on poultry production systems at the farm level

- Research on substitution of local raw materials for imported inputs

DAIRY AND BEEF PRODUCTION ENTERPRISES

Specialized Dairy Farms

The dairy farm uses only dairy breeds of cattle, and its sole objective is to produce milk that can be obtained with adequate foodstuffs, herd management and healthy cows.

Cattle uses on dairy farms can be of different types: pure or almost pure breeding stock with both males and females; females are bred and males are sold as bulls. Another possibility is using cross-bred animals that have reached high levels of milk production; in these cases, females are bred and males are eliminated when born due to their lack of dairy breeding qualities. This decision can be made by the dairy farmer if he compares the value of milk (sold as fluid milk) consumed by the calf to a determinate age with the price he could receive for the same calf sold as meat.

Dual Purpose Livestock Enterprises

A large portion of the Honduran livestock sector uses dual purpose cattle, that is, they own a business with daily production of milk, and at the same time, raise beef calves to be sold at weaning or even to fatten on the same farm. This is the livestock activity that has been traditionally used in Honduras, and with few exceptions, it needs to be improved as much in the production as in the utilization of physical, economic and human resources.

Dual purpose farming enterprises are fundamentally based, independent of size, on crossing dairy cattle with beef cattle. This is the

fundamental cause of the low levels of production in both meat and milk, and it takes place on the majority of farms in the country.

Farmers dedicated to using the dual purpose cattle system have the following goals:

- To obtain good production of milk per cow per day
- To obtain good production of milk and meat per hectare per year
- To obtain good weight and development of calves at weaning
- To obtain one calf per cow per year

Breeding Livestock Enterprises

Breeding enterprises are utilized in those situations when the farmer is interested only in obtaining calves suitable for breeding when they are sold at weaning time. In this type of enterprise, the cows are not milked, and the milk calves will generally be crossed with specialized meat breeds.

Livestock Fattening Enterprises

These are enterprises where the farmer dedicates his time and effort to raising and fattening yearling calves, whether they are born on the farm or bought to be sold later for a higher price.

SWINE ENTERPRISES

It was found that 91.1% of these enterprises had less than 10 head; 8.8% had between 10 and 100 head, and 0.1% had more than 100 head. Large amounts of pork products such as ham, pork sausage, and boneless meat are imported from Central America.

There are three types of farms dedicated to swine raising and breeding in the country: 1) the small traditional farms, 2) the semi-technical swine farms, and 3) the technical farms. In the case of foodstuffs, it is known that the quality of commercial concentrates vary frequently in their nutritional analysis. As a result, varying qualities of food affect the weight gain and health of the animals; very few farmers prepare their own food concentrates.

Pigs are sold alive and are slaughtered in processing plants or municipal slaughterhouses; and are destined for internal consumption.

Pork and pork products are available at supermarkets, markets, mini-stores, and wholesale meat markets.

The interest rate for loans to swine producers was 23% at the beginning of 1994; by the end of 1994 the interest rose to 28%.

About 15% of swine enterprises are rented.

SHEEP AND GOAT POPULATIONS

The National Agricultural Census of 1993 reported a goat population of 27,077 head, and a sheep population of 13,145 head.

Livestock Development in Belize: Production Constraints, Potentials and Research Priorities

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ABSTRACT

Belize, a former British colony and the newest country in the region, has a mixed ethnic population of 200,000 in an area of 5.3 million acres. The land is distributed accordingly: 66% broadleaf forest, 3% devoted to annual crops, 2% to shifting cultivation, 4% to sugar cane, citrus and banana cultivation, and 2% to cattle grazing. In 1995, the agriculture sector accounted for 13% of GDP, 16% of total investment, 5.4% of public expenditures, and had an export value of BZ$ 225.2 million. Crop and livestock productivity has increased by 68% and 40%, respectively, during the last decade. However, food imports reached close to $80 million in 1995 and continues to rise.

The major institutions involved in livestock R&D include the Ministry of Agriculture and Fisheries (MAF) with the largest R&D staff, the Belize Livestock Producers Association, and about 5 NGOs, collaborating with several external agencies (e.g., USAID, CARDI, ODA, IICA, FAO, CATIE, IFAD and IDB) and countries (Mexico, Taiwan and the UK).

Four livestock systems are described. The beef cattle system is practiced by some 1,234 farmers, 80% having < 50 head. They use traditional technology, and employ labor at $80-100/week. Some 8,784 animals were slaughtered in 1994. The dairy, semi-intensive system includes about 200 farmers, mostly commercially-driven Mennonites. They use improved technology, and depend mostly on family labor. In 1994, they produced 3 million lbs. of milk. There are about 200 farmers with commercial pig production, ranging from 5-70 sows/unit. They produced about 1.7 million lbs. of meat in 1994. The backyard system may include as many as 2,000 farmers with pigs, chickens, sheep and bees, managed by Mayan and Mestizo farmers for subsistence. There is no information on their productivity. The importation and consumption per capita, respectively, are: 6% and 13.6 lbs. of beef, 8.4% and 25.3 lbs. of milk, and 59.3% and 16.8 lbs. of pork.

To improve its effectiveness, the MAF redefined its mission to

enhance food security, income generation, gainful employment and natural resources, which led to the identification of five major priorities: 1) promotion of the oasis model, a community development, people-driven type of program on production; 2) targeting mission outcomes and impact assessment at the district level; 3) agricultural diversification and sustainability (e.g., crop and meat processing, agroforestry, dual purpose cattle, small ruminants and aquaculture); 4) international competitiveness in product quality and production cost; and 5) a Buy-Belizean campaign to counteract a cultural bias for imported food.

An identification of priorities for policy, research and extension interventions were identified for the beef, dairy and the incipient but attractive sheep production systems. This exercise was done using the vertical integration equation which includes components of natural and productive resources, production, health, processing and marketing. The results are presented and justify a number of upcoming projects with complementary external funding, such as the Toledo pig production project (financed by USAID), agroforestry development with CATIE (USAID), sustainable agriculture development (IFAD), trade promotion and business development (IDB) and agricultural diversification (IDB). These projects will include livestock-related components and opportunities where livestock research, e.g., CRSP, can make a substantial contribution.

BACKGROUND

Belize, formerly known as British Honduras, achieved constitutional independence from the United Kingdom in September, 1981. It is a sovereign, democratic state, with membership in the Commonwealth of Nations, Caribbean Community and the Non-Aligned Movement, and one of the newest members of the United Nations and the Organization of American States. Belize is located in the north-east corner of Central America and bordered on the north by Mexico, on the west and south by Guatemala, and on the east by the Caribbean Sea.

In an area of 23,000 square km, Belize has a population of approximately 200,000. Its composition is multi-ethnic and distributed as follows (CSO, 1991 Census): 43.6% are Mestizo (Spanish-Mayan); 29.8% are Creole (of African descent); 11.1% are pure Mayan (Yucatecan, Mopan, Ketchi); 6.6% are Garifuna (of African-Caribbean descent); 3.1% are German/Dutch (mostly Mennonites); and the remaining 5.8% includes

Table 1: Distribution of land use in the country

	Acres	% Total
Agricultural Land		
Annual Crops-- Mechanized (rice, corn)	99,450	1.84
Annual Crops-- Non-mechanized	48,480	0.90
Shifting Cultivation (cleared only)	91,830	1.72
Banana	5,085	0.09
Sugar cane	158,325	2.95
Tree Crops (citrus, mango, cocoa, etc.)	36,691	0.68
Pasture (unimproved & improved)	88,024	1.64
Shrimp farming	625	0.01
Natural Vegetation		
Broadleaf/open broadleaf forest	3,533,409	65.67
Degenerated broadleaf forest	209,477	3.90
Pine forest/open pine forest	160,324	2.97
Mangroves	77,233	1.43
Saline swamp vegetation	85,152	1.58
Others		
Water bodies	96,818	1.80
Bare land, herbaceous scrub, etc.	668,984	12.44
Urban areas	20,646	0.38
Total	5,380,553	100.00

SOURCE: Anon, 1994.

Europeans, Chinese, Syrian/Lebanese, etc. The age distribution is as follows: 44% are under 14 years of age; 34.3% between 15 and 34 years; 17.5% between 35 and 64 years; and 4.2% above 65 years of age (CSO, 1995). Over the past years, two major forces have affected the demographics of Belize: first, the large migration of Belize Nationals to the USA in search of employment opportunities; and second, the large influx of refugees due to the continuous civil conflicts throughout Central America.

Traditionally the national economy has been based on extractive industries, i.e., logging, gum base (chicle) and fishing; and of late, based on three major perennial export crops, i.e., sugar, banana and citrus. For many years, agriculture for food production has been virtually undeveloped, with most food items being imported from the United Kingdom and North America. It has been established that about 2.2 million acres are suitable for agricultural production (MUCIA, 1988), yet less than a third of this area has been exploited for productive activities (Table 1).

Table 2: Land Tenure in Belize

Tenure type	%	For Private Lands Area	% of Holdings	% of Total
Private	37.0	Holdings > 607.5 ha	2	31.8
Leased	10.0	Holdings < 14.6 ha	85	4.0
Forest reserves	28.0			
National	25.5			

SOURCE: Ag. Census, (1984-85)

There are four basic types of land tenure in Belize, and the overall distribution of land in the private sector is highly skewed toward the large-scale holding, as shown by these figures in Table 2.

STATUS OF THE AGRICULTURAL AND LIVESTOCK SECTORS

In 1994 the gross domestic product (GDP) of Belize was estimated at Bz$ 945 million (Bz$ = USD 0.5), disaggregated into the main economic sectors as follows: trade, restaurants and hotels 18.0%; manufacturing 16.9%; transport and communication 14.0%; agriculture 13.5%; and public administration 8.2%. The other activities in the primary sector—forestry, fishing and mining—contributed with 2.84%, 2.8% and 0.7%, respectively.

On the importance of the agriculture sector, the following indicators provide a fairly clear picture of its significance to the Belizean economy (Table 3). Noteworthy are that while agriculture productivity and exports have increased, its contribution to agriculture has slightly declined, government expenditures on agriculture have decreased (current levels are at their lowest), and food imports continue to expand. Not only is agriculture, by far, the main generator of foreign exchange, but it also makes a hefty plus to the national balance of payments. These trends must be taken into account in order to determine the future agricultural development strategies.

The traditional export crops of sugar, citrus, banana and fisheries generated Bz$95 million, $29 million, $49 million, and $30 million, respectively, during the 1995/96 financial year. According to the Prime Minister's budget speech, the projected 1996/97 combined exports of these four commodities are expected to hit the $250 million mark.

Looking at the productivity trends of the major commodities, one can also appreciate the huge strides Belize has made in the last 12 years

Table 3: National indicators on evolution of the agricultural sector, 1983-95

Indicator	1983	1988	1993	1995
Percent of Total:				
GDP generated by agriculture	17	14	13	NA
Investment in ag.	12	14	16	NA
GOB expenditures in agriculture	11	8.2	7.4	5.4
Productivity in ag.	99	103	146	NA
Rural population	48	NA	51	NA
Value: B$ millions				
Ag. exports	108.7	145.7	167.8	225.2
Food imports	46.2	56.9	72.9	79.3

Source: CSO, 1995. * 1984 As base year. NA = not available.

(Table 4). For example, livestock productivity has increased by about 70%, with notable growth particularly in pigs, milk and poultry, while crop productivity has increased by about 40%, with notable growth not only in the export crops (citrus and banana) but also in food crops (beans, rice and corn).

Along with livestock productivity increases, the importation of food products (especially those of livestock-related products) has increased substantially, totaling close to $80 million annually. For 1994, some of the major items imported include: dairy products and bird eggs, cereal and cereal preparations, animal feeds, and fruits and vegetables (Table 5). The figures for 1995 are expected to be no lower. On the contrary, when one considers the daily informal trade with neighboring countries, these figures grossly underestimate the real food import bill. Most of these products can be produced in Belize, and though some may say that it is cheaper to import rather than produce them, in the long run they are not, especially when one takes into account the lost multiplier effects, that is, the foregone opportunities to create productive investment and employment as well as expertise and sustainability in the

Table 4: Index of agricultural production for major commodities: 1984 as 100%

Commodity	1983	1988	1993
Livestock	97	119	168
Cattle	94	90	134
Pigs	84	155	216
Milk	83	220	245
Poultry	97	166	251
Honey	95	77	19
Crop	100	99	140
Sugar	111	76	112
Citrus	61	192	240
Banana	96	256	377
Rice	74	98	172
Corn	109	143	168
Beans	120	175	282

Source: CSO, Abstracts of Statistics, 1994, p. 81.

Table 5: Distribution of Food Import Bill for 1994 (B$millions)

Dairy products & bird eggs	18.9	Cereal & cereal preparations	11.9
Animal feedstuff	10.1	Fruits & vegetables	7.5
Meat & meat preparations	6.6	Coffee, tea, cocoa, spices, etc.	3.9
Fixed vegetables (oils & fats)	3.9	Fish, crustaceans, & mollusks	1.4
Sugar, sugar prep. & honey	1.1	Oils seeds and fruits	0.7
Live animals	0.2	Misc. products & prep.	13.6
	Total	$79.8 Mil	

Source: MAF data.

agricultural sector. In short, these figures indicate that there is about $36 million which can be captured by producing our own animal feeds, processing our meat products or simply, successfully marketing our fresh meat in the domestic market.

THE INSTITUTIONAL CONTEXT AND EXPERIENCE

The Ministry of Agriculture and Fisheries (MAF) is one of the largest ministries of the government responsible for planning, implementing and evaluating agricultural (including livestock) and fisheries research, development and training policies and programs in the country. The MAF has field programs in each district supported by policy, management and finance units in Belmopan and research and training sections in Central Farm (located 20 miles west of Belmopan, the capital). Nationally, the MAF has the largest staffing for the livestock sector: 2 senior staff members trained in livestock sciences, 8 livestock officers (3 away on training), 6 veterinary doctors (1 on training), 3 livestock technicians and 5 screwworm inspectors. This staff is responsible and/or involved in livestock production, research and extension.

The Belize Livestock Producers Association (BLPA), located near Belmopan, was legally established in 1977 to develop the livestock industry, to control slaughter, export and import of cattle, and to promote all necessary efforts in the best interest of the industry (BLPA 1996). The BLPA is a producer-driven organization active in coordinating, monitoring and informing on livestock production, marketing and training, and collaborating in national research, health and regulatory programs in all

districts of the country. It is managed by a board of directors with broad representation of the industry and government, who entrust the daily management of the Association to an executive secretariat. From 1984 to 1992, USAID financed a national livestock development project which collaborated with BLPA and the MAF. The project had components of a) livestock, pasture and feed management; b) marketing, credit and policy support; and c) staff development (DEVRES 1991). The project strongly supported field programs and raised expectations in the livestock industry which today are not being properly supported and implemented.

At Central Farm, the MAF has its main research facility in the country and the Belize College of Agriculture (BCA), a two-year, college-level institution granting an associate degree. The Minister of the MAF has commissioned a task force to prepare a proposal for integrating Central Farm and BCA into what tentatively has been called the Belize Institute of Agricultural Development (BIAD). The objective is to establish a semi-autonomous land grant model in order to improve research, education and extension cost-effectiveness and institutional impact at the national level. Its recommendations will be ready by May 1996.

Several NGOs—e.g., Belize Enterprise for Sustained Technology (BEST), Help for Progress (HELP), Program for Belize, the Belize Center for Environmental Studies (BCES), National Development Foundation for Belize (NDFB)—are very active in the agriculture and natural resource management sectors, hence having some activities in livestock-related research, development and/or financing issues. However, due to the tight financial situation of international donor agencies, some doubts about credibility and accountability on the part of a few NGOs, and local management and coordination constraints, the NGO community is experiencing serious constraints in maintaining and/or expanding their work programs.

There are several international agencies with an established track record in Belize, e.g., Caribbean Research and Development Institute (CARDI), the Natural Resources Institute (NRI) and the Overseas Development Administration (ODA) of the United Kingdom, the Republic of Taiwan (ROC), International Fund for Agricultural Development (IFAD), and, of course, USAID which unfortunately will be leaving Belize in September 1996. There are others who are in process of getting established, e.g., IICA, FAO, CATIE and OIRSA (Regional Organization for Animal Health). Due to the recent emergence of Belize

on the international scene, there is heightened interest in collaborating with Belize, hence the signing of formal agreements with a relatively large number of international agencies and governments of supporting countries. Recent sectoral studies have been completed by USAID in the mid-80s and more recently by IICA and the World Bank. Their recommendations, together with complementary studies by the MAF, NGOs and funding institutions, are being utilized to formulate new development thrusts and projects.

STRUCTURE AND FUNCTION OF LIVESTOCK PRODUCTION SYSTEMS

Livestock represents a major land-use system, particularly in the north and west of the country. For example, a recent study indicated that livestock contributed about 40% of all gross farm income of Cayo households in the western region, producing an average income of $3,728 per farmer per year (Pulver and Arya, 1993). At the national level, livestock contributed $22.5 million or 17.6% of the GDP of the primary sector in 1993.

There are basically four livestock production systems in Belize: the extensive beef production system, the semi-intensive dairy production system, pig production, poultry production, and the backyard/free ranging livestock system (pigs, chickens and occasionally sheep or cattle). Table 6 provides a brief on the structure and function of the systems of interest to this meeting. First of all, the livestock industry is a relatively small sector, hence there is a great potential for expansion, investment, technology improvement and growth, provided the local and international markets can be organized. Secondly, the small community of Mennonites, who originally arrived in Belize in the early 1960's, are extremely productive in agriculture, and especially in the grain, dairy and poultry industry. There are several reasons for their success:

- By religion and culture, they participate only in agricultural activities, hence investing capital and improving their agricultural systems.
- They were granted a government concession to import agricultural machinery, equipment, and supplies (except fuel) free of import duties and taxes.
- They have large families and their children are fully involved in agriculture from an early age, and hence they do not experience labor problems.

Table 6: Structure and function of livestock production systems in Belize

Beef cattle: extensive	Dairy: semi-intensive	Pig production	Backyard production
FARMERS & RESOURCES Cattle farmers: 1,234 National herd: 65,841 92% farmers < 50 hd with 35% of cattle herd Few above 100 head	About 250 dairy farmers and 1800 dairy cows	About 200 farmers averaging about 5-70 sows	About 2,000 farmers having some 4,000 pigs and 20,000 chickens
HOUSEHOLD PRIORITIES Strong market orient. but limited marketing skills Capitalization objective Mostly traditional knowledge Few progressive ones Hire labor at cost of $80-100/week	Dominated by Mennonites who are highly commercial Highly skilled and committed Use only family labor	Highly commercial Good knowledge, keen on new technology provided it is profitable Hires labor at cost of $80-100/week	Mainly Mayan and Mestizo small farmers, for subsistence Indigenous know-how Role of women and children
FEEDING SYSTEM Grazing on native spp.: Paspalum notatum, P. virginatum Stocking: 0.45 anim/ac. Mostly continuous grazing	69% improved with Cynodon nlemfluem., Panicum max, Hypar. rufa Stocking: 0.8 anim/ac. with some rotation	Use of commercial concentrates, quite advanced when market is attractive	Scavenging represents health hazard for villagers and destroys crops
PRODUCTION: Slaughter 1983 5 820 1991 7 157 1994 8 784 1994 % imports: 6%	'000 lb. 975 2 851 3 019 8.4%	'000 lb. 495 1 012 1 705 59.3	Not known
CONSUMPTION PER CAPITA 13.64 lb.	15.3 lb.	16.8 lb. (69.1 lb. for poultry)	Not known

Source: CSO, Abstracts of Stats, 1995; Gongora 1992, BLPA, MAF data.

- They are highly disciplined and hard working, are quite skilled at adapting and maintaining agricultural machinery, and know how to work cooperatively.
- They have a fairly advanced concept of vertical integration by commodity, with a balanced emphasis on the production, processing and marketing functions.

Due to their great success and contribution to the national economy, the present policy of the government and the MAF is to work with, support and integrate the Mennonite community into the local agricultural planning and development process.

With respect to the livestock industry, some of the recent success stories of the MAF are the following:

- Farmers are now able to increase livestock production, improve product quality and decrease labor and cash inputs, thanks to the tremendous success of the screwworm eradication program. This program was officially launched in August 1989 in Belize as a collaborative effort between the Ministry and the Mexico-US Commission. Belize was declared free of screwworms in 1993 and except for strategic monitoring, the screw-worm problem, which used to cost our farmers an estimated $15 million per annum, is now a relic of the past.

- Many farmers were awed by the effectiveness of the vigorous and well-organized vampire bat education and control program. Vampire bats have caused livestock farmers to lose millions of dollars through loss of blood, morbidity and low productivity. However, through education, farmers have learned of the other species of bats with beneficial contributions to agriculture, e.g., as pollinators, seed broadcasters, and crop pest controllers.

- The MAF supplied superior genetic stock to 111 livestock farmers, facilitated the importation by the Belize Livestock Producers Association (BLPA) of 65 head of breeding cattle and 4,922 lbs. of grass seeds for establishing over 1,000 acres of improved pastures, supplied $135,071 to BLPA for steer fattening, treated more than 2,000 cases of animal health, and recently has been working closely with the main decision makers to set policy and develop programs to revitalize the industry.
  Presently, MAF is pursuing a full range of consultations with farmers, farmers' associations, NGOs and other interested parties, at the national and district levels, to develop an integrated comprehensive agricultural development strategy in which we clearly envisage livestock playing a prominent role.

With respect to a national livestock development objective, the MAF has indicated the importance of aiming for self-sufficiency in all livestock products and meat product preparations, needed and demanded by the Belizean people. Considering the vast potential for livestock production and the small consumer population in Belize, self-sufficiency can be easily achieved, and hence is not a real challenge. The real aim is the external market. But first, Belize must improve the cost effectiveness of the production systems, develop good marketing skills, and train and motivate producers and youth to take full responsibility for decision making and program implementation.

MISSION STATEMENT OF MINISTRY OF AGRICULTURE

The mission of the MAF has been stated as: to enhance food security, income generation and gainful employment, while conserving and improving the natural environment, by catalyzing, supporting and accelerating the sustainable development of the agricultural and fisheries sectors in order to secure a better socio-economic standard and future of the Belizean people (Garcia 1995). To achieve this mission, the MAF is guided by the following principles which determine its program strategy and the methodologies applied:

1. Research, extension and institution building must respond to the priorities and opportunities of farmers, the private sector and government.

2. Production options and technologies must be developed with the aim of sustained adoption, productivity and profitability.

3. Greater entrepreneurship, know-how and self-reliance are essential building blocks for agricultural development.

4. Public and private sector collaboration is necessary to have a viable, competitive and sustainable agricultural sector.

5. The policy framework affecting our trade, research and development environment must be streamlined to realize greater investment and production in the sector.

These are the key determinants of the future success and impact of MAF efforts. Therefore all the staff, from the top to the bottom of the hierarchy, must understand, be convinced and participate in implementing our mission.

With free trade liberalization right at the doorstep, it appears that a concerted, strategic plan must be put in place to make the agriculture sector more profitable, competitive and sustainable. Some key issues to be addressed in this connection are:

1. The need to diversify and focus on production, and in particular, on milk, meat, cereals, fruits and vegetables, oilseeds and livestock feeds, which represent about Bz$ 60 million a year.

2. The need to improve and adapt technologies aiming to reduce production costs (fuel, machinery, commercial inputs) and reduce producer risks (e.g., through irrigation, integrated pest management, agroforestry).

3. Considering our natural resources and ethnic diversity, there is a major opportunity for agriculture to benefit enormously from ecotourism (plant, wildlife diversity, national monuments, natural attractions of waterfalls, reefs, etc.), arts and crafts made of natural products, and commercial use of medicinal plants.

4. Processing must be a high priority, e.g., for slaughtering and meat processing (following USDA standards), food processing and utilization of vegetables, fruits, oilseeds, root crops, and by-products (e.g., sugarcane, rice, fishing).

5. Regulatory services must be improved. This refers to quarantine, product quality and standards (e.g., seeds, exportable commodities, commercial inputs, etc.) and national laboratory facilities (e.g., plants, soils, pests, diseases, chemical residues).

6. A marketing intelligence service, linked to trade and investment promotion, is an absolute must. Our producers need good, reliable markets, and the supporting infrastructure to market their products successfully.

7. Though financing is available, the interest rates and conditions

are not favorable for agriculture. First, the commercial interest rates are high; secondly, transaction costs (administration, traveling, time) are high; and thirdly, producers must bear all the risks. Small farmers in particular have problems using the commercial banking institutions.

8. There is a need to break the vicious circle of dependence among rural communities, which we are partly responsible for through our habitual reinforcement of top-down approaches.

9. Above all, there is a strong bias towards the large-scale producers in Belize. We urgently need creative, multidisciplinary approaches to promote, support and accelerate the development of the farming systems of the small and medium-size farmers.

10. Taking into account the large number of public and private sector agencies and organizations (more than 30) involved in agricultural and rural development and environment, vis-à-vis the small size of the target population (e.g., 12,000 farmers in the country), there is an urgent need to harmonize priorities, coordinate programs and collaborate for the mutual benefit of the organizations and the beneficiaries.

LIVESTOCK INDUSTRY CONSTRAINTS AND PRIORITIES

Technically speaking, the major constraints for cattle production have been well defined (Juan 1996, and others). They are:

- Inadequate slaughterhouse facilities; these must satisfy USDA standards and have processing machinery and equipment to produce final meat products;
- Lack of markets and an absence of grades and standards;
- Inefficient pasture management and lack of low cost local feed options;
- Reduction in research and extension services provided by the MAF;
- High cost of production, due to high cost of fuel, electricity, transport, and imported inputs which are subject to high tariffs, such as basic materials and medication;
- High loan interest rates and risks for producers.

Pig producers are seriously constrained by the high cost of feeds, inadequate infrastructure, and limited replacement stocks of improved breeds. The problems of poultry are related to high feed costs, disease/ pest management, and a very competitive market price.

According to the Development Finance Corporation of Belize, lending for the livestock industry is minimal, accounting for about 9% of the agriculture portfolio of $14 million, and it continues to decline. Yet loans are easily available for beef/cattle improvement and expansion, dairy production, pig improvement and expansion, and poultry (broiler and layer production), and for meat processing facilities. Such loans can be used for infrastructure development, start-up capital and working capital. In addition, there is the fondo ganadero, managed by BLPA, operating in the Orange Walk, Cayo and Belize Districts. The fondo provides, on loan, between 10 and 50 cattle, veterinary and mineral supplies, at an interest rate of 6% per annum and a management fee of USD 1.75/animal/ month to Belizean farmers who qualify in terms of experience (cattle raising, good project), infrastructure (pasture and facilities), age of the farmer (18-65 yrs.) and a willingness to meet the contractual obligations of the fondo. Since 1991 when the Fondo Ganadero Project was launched, the BLPA has been managing a revolving loan fund of $600,000.

To analyze the constraints of the livestock industry and to identify policy, research and extension priorities, in relation to achieving the mission statement of the MAF, it was essential to focus on the production-to-consumption model, i.e., a vertical integration equation which can be specified as:

> Development of livestock industry = f (natural and productive resources, investment, production, health, processing, marketing).

Wherein policy, research and extension interventions (resulting from the actions of the public and private sectors) would have an important role to play in each component.

The results are presented in Tables 7-9 for the extensive beef, semi-intensive dairy, and the sheep production systems, respectively. The specific constraints focused on are: genetics, soils and land preparation, water management, pest and disease vectors, labor, external inputs as well as processing, markets and marketing, credit, natural resources management and livestock policy. Suffice it to state here that addressing

Table 7: Identification of constraints and priorities for beef production

Constraint	Policy priority	Research priority	Extension priority
GENETICS Herd downsized, not enough bulls, breeding disrupted, no knowledge of new grasses and legumes	Provide support for 2 research stations Develop regulations enabling private enterprise to take over breeding stock	Evaluate stock of private producers Check records and certify stock Evaluate forages, requires MSc training	Promote appropriate breeds and train farmers on taking good records
SOILS AND LAND PREP Limited knowledge on profitability of improved grass + fert on marginal land Machinery not available for land preparation	Prioritize different models in terms of profitability Facilitate credit schemes/producers' bank like fondo ganadero	Analyze, computerize and update annually Conduct on-farm trials on pasture and forage consv. Test appropriate technology	Disseminate information on best bet options Organize farmers to share some resources in critical periods
WATER Need ponds and wells for watering	Provide incentives for pond and fish culture	Analyze construction costs and financial viability Adapt/test technology	Identify progressive farmers who may want to try proposed options and help to establish
PESTS &DISEASES Vesicular stomatitis, TB, minimum residue test, brucella & aftosa, meat/plant inspection	Facilitate support from charges for quarantine and regulatory services Update diagnostic labs Train meat inspectors	Conduct essential surveys and diagnostic tests to access export mkts and protect local production	Promote preventive medicine in extension programs
LABOR Workers earn $80-100/ week, cost too high	Special attention to small-farm sector with lower cost labor pools Support for research/ investment in labor-conserving implements/ equipment.	Evaluate and test viability of labor conserving systems	Identify small farmers with innovative options and promote them
INPUTS Very expensive	Explore ways of reducing import costs and wholesale/retail mark-ups	Evaluate options using local inputs, materials and cycling techniques	Provide information on how to use inputs timely and judiciously
PROCESSING Inadequate due to lack of USDA standards Lack of competition among processors.	Provide incentives to construct more processing facilities MAF to increase staff for research & extens.	Develop product standards Assess marketing margins Develop teckpacks for cottage industry	Extend home processing through village group.
MARKET Self-sufficient in fresh meat market Inadequate info for local & international markets	Promote marketing info service, e.g., INTERNET Promote market development through investment & training	Work on improving quality and reducing production cost for competitiveness Assess effects of free trade	Extension agents must relate all advice to market situation
CREDIT Credit available but cost & risk are too high (15-22%) (inflation- rate about 10%)	Assist producers to access resources Explore ways to extend fondo ganadero concept	Assess credit and risk factors to propose better strategies for livestock support	Organize producers to identify local savings and fundraising options
NATURAL RESOURCES Deforestation & biodiversity loss in buffer zones Degradation of old grazing areas	Change tenure law regarding development and ownership Provide incentives for pasture improvement through agroforestry and other such technologies	Develop agroforestry options Assess shrubs/trees for quality fodder and soil fertility	Demonstrate how to improve technologies, i.e., fodder bank, live fencing, trees/pasture Help large-scale enterprises reduce negative effect.
POLICY Lack of comprehensive and cohesive policy for livestock industry	Develop effective mechanism for Min. of Finance, Trade, Agric, Econ Dev to work together and with private sector	Research policy objective to emphasize marketing, processing and environmental/NR impact assessment.	Support and training for extension agents on above areas

these constraints and priorities/opportunities will require a closer working relationship between the producers, the business sector, the MAF, the BLPA and the NGOs. The MAF is fully committed to such collaboration, as clearly demonstrated by recent interactions.

Table 8: Identification of constraints and priorities for dairy production

Constraint	Policy priority	Research priority	Extension priority
GENETICS Demand for dairy heifers far exceeds supply Need to know more about grasses and legumes	Continue to produce improved heifers and maintain AI as source of improving genetics or privatize the service Provide support for 2 research stations	Evaluate stock of private producers Check records and certify stock Evaluate forages Training needed as in case of beef	Promote appropriate breeds Train farmers on taking good records and evaluating cows
SOILS AND LAND PREP Need to intensify use of improved pastures on fertile soils Machinery never available for pasture	Prioritize different models in terms of profitability and in liaison with credit agencies	Analyze, computerize and update annually Conduct on-farm trials on pasture and forage conservation	Disseminate information on best bet options
WATER Need ponds and wells for watering	Provide incentives for pond and fish culture	Analyze construction costs and financial viability Adaptitest technology for cost-effectiveness	Identify progressive farmers who may want to try proposed options and help with appropriate info
PESTS & DISEASES Vesicular stomatitis, mastitis, a significant problem Milk quality control for public health Risk of entry of devastating diseases	Update diagnostic and quality control labs Training for product quality control and plant inspection Work with private sector to ensure sustainable service	Conduct essential surveys and diagnostic tests	Promote preventive medicine in extension programs
LABOR Labor demand high Adoption of machine milking without proper hygiene	Support for research/ investment in labor-conserving implements/ equipment. Support for optimal size and scale of operation	Evaluate and test viability of labor conserving systems and different scales of operations with dairy farmers	Identify small farmers with innovative options and promote them Use Mennonite technology to train other Belizeans
INPUTS Very expensive Supplementation with grains	Provide cheaper rates for electricity and fuel costs	Evaluate options using other sources of energy and quality feeds	Provide information on how to conserve these resources and on alternative models, e.g., St Stanislaus from Guyana
PROCESSING Local milk market limited Need to diversify: e.g., cream cheeses, ice cream etc. (imports)	Provide incentives to construct more processing facilities MAF to increase staff for processing technology & extension	Resource person to evaluate processing technologies, product quality and cost competitiveness	Same person to extend info to farmers/ processors
MARKET Self-sufficient in fresh meat market Inadequate info for local & international markets	Promote market development through investment and training	Assess effects of free trade	Extension agents must relate advice to market situation
CREDIT Credit available but cost & risk are too high (15-22%)	Assist cooperatives and industry to access resources	Assess credit and risk factors to propose better strategies for dairy support Analyze info on milk market trends etc. due to high level of imports	Resource person to work with cooperative Organize producers to identify local savings and fundraising options
NATURAL RESOURCES Degradation of old grazing areas	Provide incentives for pasture improvement through agroforestry and other such technologies	Develop agroforestry options Assess shrubs/trees for quality fodder and soil fertility	Demonstrate how to improve technologies, i.e., fodder bank, live fencing, trees/pasture
POLICY Lack of comprehensive and cohesive policy for livestock industry	Develop effective mechanism for Min. of Finance, Trade, Agric, Econ Dev to work together and with private sector, on above	Research policy objective to emphasize marketing, milk processing, public health and environment /NR impact.	Support and training for extension agents on above areas and dissemination of policy guidelines

Table 9: Identification of constraints and priorities for sheep production

Constraint	Policy priority	Research priority	Extension priority
GENETICS Sheep breeds inadequate, based on few imports Can utilize grasses and leguminous trees	Provide support for research stations Develop regulations enabling private enterprise to assume responsibility for breeding stock	Evaluate stock of private producers Check records and certify stock Requires MSc training	Promote appropriate breeds and train farmers on taking good records
SOILS AND LAND PREP Need to know which system (extensive, grass+fert, integrated small farm) is viable and profitable	Prioritize different models in terms of profitability	Analyze, computerize and update annually Conduct on-farm trials on pasture and forage conservation Test appropriate technologies	Disseminate information on best bet option
WATER Not a problem, sheep thrive in drier areas			
PESTS & DISEASES Intestinal parasites Vesicular stomatitis, TB, minimum residue test, brucella & aftosa, meat/plant inspection	Facilitate support from charges for quarantine and regulatory services Update diagnostic labs Trained meat inspectors needed	Conduct essential surveys and diagnostic tests to ensure good quality products	Promote preventive medicine in extension programs
LABOR Labor will not be a problem for small farmers because children can help	Special attention to small-farm sector with lower cost labor pools		Identify small farmers with interest and train on basics of sheep farming
INPUTS Sheep system does not require much unless option is an intensive production model		In case of intensive options, need to investigate feed resources and management	
PROCESSING		Later on, need to focus on market opportunity, product standards and processing needs	
MARKET Farmgate price very attractive: $2-2.50/lb. live weight, twice beef price Cannot satisfy local demand		Evaluate production cost and optimization options for increasing production	Extension agents must intensify farmer training
CREDIT Credit available but cost & risk are too high (15-22%)	Assist producers access resources Explore ways to extend fondo ganadero concept.	Assess credit and risk factors to propose better strategies for promoting sheep development	Organize producers to access and manage credit efficiently
NATURAL RESOURCES No problem now	Provide incentives for pasture improvement through agroforestry and other such technologies	Develop agroforestry options Assess shrubs/trees for quality fodder and soil fertility	Adopt a preventive strategy Demonstrate how to manage fodder bank, live fencing, tree/pasture mixes
POLICY Lack of comprehensive and cohesive policy for the sheep industry	Develop effective mechanism for Min. of Finance, Agric, Econ Dev to work together and with private sector	Research policy objective to promote production, marketing, and environmental protection	Support and training for extension agents on above areas

NATIONAL PLANS PROPOSED FOR 1996/97

The MAF has elaborated the main thrusts of work, which has direct implications and actions for livestock research and development. These are:

The production oasis model:

In light of the growing food import bill, the changing global trade environment, and the poverty situation in certain pockets of the country, there is an urgency to transform agriculture to ensure sustainable development. With support of CARDI, FAO and others, the MAF will assist local communities and the private sector to consolidate their own development priorities and production programs through the oasis models. This is already in progress in three sites across the country—Belize District, Dangriga and Corozal—and could be extended to other areas of the country where deemed appropriate, e.g., Orange Walk, Toledo and Cayo. Organization, training, technical backstopping, and assistance to access investment and other services, comprise the specific areas of support to be provided.

The rationalization and impact of the Ministry:

In an effort to rationalize strategic research and support services in Belmopan and Central Farm and to enhance their relevance and impact at the district level, the MAF plans—with support from IFAD, IDB and IICA—to reinforce the district-based teams by:

- Adopting a commodity focus within a farming systems research process;
- Placing greater emphasis on setting targets in terms of number of farmers reached, acreage increased and yields achieved;
- Providing essential logistic support (i.e., transport, computers for data analysis, fax, photocopier and audio visual equipment); and
- Motivating staff at all levels and carefully evaluating their performance.

With support of the ROC mission, Iowa State University, the European Union and FAO, the MAF plans to strengthen the Belize College of Agriculture and Lynam to be centers of excellence for multidisciplinary

research, education and extension for improved natural resource management, higher productivity, food and feed processing, natural resource management and agribusiness management. Helping them to be more self-sufficient and sustainable is a key objective of my Ministry. This is the reason for establishing BIAD.

Diversification and sustainability:

Excessive dependence on a few export commodities, exacerbated by their trading in preferential markets which are threatened by the impending trade liberalization movement, makes agricultural diversification most imperative for Belize. The compelling need to diversify expeditiously will require a multi-pronged strategy with clear priorities for each broad commodity group, supported by effective services, e.g., research, extension, marketing and financing.

On crop production, the MAF—with the help of IFAD, IDB, CARDI, CATIE and others—will endeavor to widen the range and genetic base of important crops, both for national food security and foreign exchange generation; improve soil fertility, water and weed management; and begin developing agroprocessing and food technologies to enhance income, reduce market risks, increase value-added benefits and employment, and increase the farmers' share of the product prices paid by the consumers. Agro-processing and food technology for root crops, vegetables and indigenous fruits is the key for consolidating and sustaining our primary production activities.

On livestock, the MAF plans to work closely with BLPA and CATIE (and perhaps with the CRSP) to promote and improve cattle and small ruminant systems for meat and milk products, which due to their income elasticity, will continue to expand in the coming years. Currently there are 1,234 cattle producers, and 87% of these have less than 50 head per farm. By improving traditional feeding systems with better grazing management, animal breeds and agroforestry, livestock production can fit very well into the small producers' farming systems, utilize resources whose opportunity costs are low, and be cost competitive with other countries in the region. Constructing a meat slaughtering and processing plant, following USDA requirements, is a must for 1996/97, as what livestock producers receive on wholesale is less than 30% of the price consumers pay for pork, sheep and beef.

To explore the means of increasing the productivity and sustainability of the farming systems of small farmers, the MAF will continue to support the beekeeping industry and will introduce and demonstrate integrated pest management, agroforestry and mixed production options.

On fisheries, there will be a continued focus on the sensitization of fishermen on matters of conservation as well as on activities leading to the maintenance of mangroves, reef systems and water bodies in general, to ensure that they remain in a good state of health. In 1996 a new licensing system for fishermen and boats will be implemented. In addition to the regular technical support provided to the fishermen-cooperatives to maintain the competitiveness of the industry, which continue to exercise the highest priority, the Ministry will place priority on the collection of biological data that will be useful in managing and conserving Belize's marine resources for future generations.

One strategic area of intervention and support is financing and credit. There is need for: a) stronger support to rural co-ops and producer associations (e.g., BLPA, Belize Assoc. of Producer Organizations); b) availability of small farm credit for production (e.g., NDFB, BEST, HELP); and c) investment capital for processing and marketing projects (e.g., marketing depots and transport, livestock feed industry, oil seed extraction, animal slaughtering and meat processing). We are willing to work with the relevant institutions to explore constructive and creative ways to address these urgent needs in all districts of the country.

International competitiveness:

The Ministry will focus on increasing investments in agriculture and fisheries and the marketability of products by:

- Supporting a national marketing service which will be responsible for international and local market intelligence, trade and investment promotion, and provision of advisory services to agriculture/fishery producers, processors and investors. This will be done in close collaboration with private sector institutions which will be supported financially by the IDB.

- Maintaining and expanding quarantine services (i.e., La Union, Corozal and San Pedro airport), upgrading the Medfly program (e.g., hot water treatment), improving product grading and quality

control (e.g., through the Bureau of Standards), and establishing central laboratory facilities, which together will provide protection and essential services to our local producers, fishermen and consumers and facilitate accreditation for exporting beef and marine products.

- Supporting a national applied research, education and extension program aiming to enhance germplasm adaptation (crops, livestock, trees), product quality, cost effectiveness and policy analysis. Production statistics and outlook analysis of major agricultural commodities will constitute a key component of this strategy, hence the high priority on the work of the Policy Unit, particularly on the economies of production systems and of production scales, and analysis of the disparities of local vs. world market prices for key commodities and inputs.

  With respect to extension, the MAF is working very well with producers' associations (e.g., CGA, BLPA, BAPO and the NGO community) and using innovative strategies (e.g., the Oasis and the Village Farmer Helper scheme) to reach and assist the largest number of producers.

- Assist in addressing the land tenure issue and suggest improvements which will increase the security of agricultural/ fisheries investment and productivity, prevent resource degradation and protect the environment in high and low potential zones of Belize.

- Strengthen scientific/technical collaboration with friendly nations such as the USA, Taiwan, Mexico and Cuba, and international centers such as CARDI, FAO, IICA, CATIE and the Universities of Iowa and Tuskegee. These efforts will have a significant impact on human resource development, through formal and in-service training in the short term.

"Buy-Belizean" campaign:

The MAF will champion the cause of agriculture. For example, the MAF plans to launch a "Buy-Belizean" campaign to counteract the traditional bias for foreign food products, which has had a high cost in foregone opportunities which could have created local income,

employment, investment, rural development and export capability. The Belizean people must be made conscious about the multiplier effects of "buying Belizean." However, this campaign will require concerted efforts to improve product quality and satisfaction for the Belizean farmers and consumers, as well as to excel in trade and export objectives.

At present, the MAF is intensively involved in program planning efforts to procure complementary technical and financial resources to put these ideas into action. These are:

- A pig production project in the most southern district, Toledo. A grant from USAID has been obtained to work with village farmers to modify the traditional free-ranging pig system by introducing hybrid breeds, building pens with local materials, and improving the husbandry and feeding systems. The project is following a strong village participation approach aiming to reduce destruction of crops and contamination of creeks, and to improve the socio-economic situation of the villagers. So far 132 farmers are participating in the planning and training phase.

- Agroforestry development in Cayo, Stann Creek and Toledo, with a budget of $150,000 provided by USAID. The project will focus on six agroforestry options, two per district site (CATIE/MAF 1996). The start-up date is April 1996. The specific livestock-related agroforestry technologies to be developed are: a) introduction of a fodder bank with adapted shrub/tree species (e.g., *Brosimum alicastrum*, *Guazuma ulmifolia*, *Leucaena leucocephala*) in pastures is the chief prototype to be considered for improving cattle production because of: farmers being keen to try this kind of improvement technology, high productivity of edible mass in the dry season with these species (5 tons/ha), reduction of weight loss in the dry season which can reach as high as 0.65 kg per day, carrying capacity on pastures can be increased from 0.43 to 1 animal/ha (supported from data from other efforts), establishment and management of fodder banks are not land and labor-intensive; b) introduction of tree legumes in pastures, which some farmers are already experimenting with and have planted leucaena in improved pasture; *Leucaena leucocephala* will not only increase forage supply for the animals but also will restore soil fertility since this legume can tolerate grazing and is known to fix significant amounts of nitrogen.

- Sustainable agricultural development for small farmers in Toledo and Stann Creek, a collaborative project of MAF, NGOs and local associations. IFAD will provide a loan for the proposed budget of $9 million for seven years, distributed among community development (16%), research and extension support (40%), financial services (33%) and project management (11%). The start-up date is April 1997.

- Trade promotion and business development, a collaborative project to be funded by an IDB grant, involving the Belize Institute of Management, the Belize Chamber of Commerce and Industry, and the MAF, to develop a marketing information service, with a proposed $4 million for 3 years. Start-up date is September 1996.

- Agricultural diversification, a collaborative project headed by MAF, with a proposed budget of $16 million, an IDB loan, distributed among institutional development (20%), research and extension (28%), regulatory services (12%) and financing (40%). The start-up date is April 1997.

All of these projects will have components of livestock-related topics and activities which could benefit immensely from the livestock research the Collaborative Research Support Program (CRSP) is known to carry out (and hopefully has plans of doing so in the near future). Thus, the Minister has indicated that the MAF stands ready and willing to collaborate with CRSP and, through them, with U.S. land grant universities, for the sustainable development of the livestock industry in Belize and in the Latin American and Caribbean region.

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Livestock Production in Trinidad and Tobago

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ABSTRACT

Trinidad and Tobago are twin island states. Situated approximately 61 degrees west and 10 degrees north, they are the southernmost islands of the Caribbean chain. The larger (Trinidad) occupies a total area of 4820 km^2 and Tobago (32 km northeast of Trinidad) an area of 303 km^2. Twenty-six percent of the land area in Trinidad is classified as arable. Eighty-five percent of the farmers occupy holding sizes of less than 5 ha. The population is 1.3 million.

Types of livestock include cattle (beef, dairy and buffalo) 41,705 head; sheep (7000 head); goats (28,500 head); and pigs (74,000 head). The paper does not deal with other species that include poultry, rabbits, deer, and wild species.

Due to pressure on the arable lands, production systems are becoming increasingly semi-intensive or intensive. Extensive systems are decreasing. There are also mixed systems (crop-animal) and home-yard production. Present production as percentages of total demand are fresh milk - 15 million liters (15%); beef - 1 million kg (25%); sheep and goat meat 55,000 kg (3%); and pork (100%). In 1994, 62,197 kg of processed pork was exported. The county is self-sufficient in poultry and eggs.

Major constraints to the development of the sub-sector are a) high cost of animal feeds, b) high cost of medicines, c) poor level of services, d), lack of availability of water, e) poor slaughterhouse facilities f) poorly developed markets and linkages, and g) quality control.

The GORTT is committed to trade liberalization within the next few years, and this will have a great impact on the sub-sector. At present price levels, locally produced chilled mutton and beef and fresh poultry are competitive with imported meat, and there is a high demand for these locally.

Four local agencies (the Ministry of Agriculture Lands and Marine Resources (MALMR), the Department of Agriculture of Tobago House Assembly, the Sugarcane Feeds Centre (SFC) and Caroni Ltd; two regional agencies, the University of the West Indies (WWI) and CARDI; and two international agencies (IICA and FAO) are involved in livestock research and development, in addition to some other associations.

A total of 19 Senior Professionals (11 MSC and 8 Ph.D. level) and 10 Junior Scientists or BSC undertake research and development in animal production; 22 professionals (19 Ph.D. and 3 MSC) provide research and training in veterinary science. Some research is conducted by Nestle, a multinational company

The paper also highlights some major regional constraints to livestock development

INTRODUCTION

Trinidad and Tobago, a sovereign state since 1986, lying roughly between 10° and 11° north latitude and 60° and 61° west longitude, is the most southerly of the Caribbean Archipelago. Trinidad lies east of Venezuela on the South American mainland. It is 88 km long and 59 km wide and occupies a land mass of approximately 4820 km^2. Tobago, the smaller of the two main islands, is situated approximately 32 km northeast of Trinidad and covers an estimated area of 303 km^2.

The topography of Trinidad is characterized by three mountain ranges which are separated by undulating lands, plains and wetlands. These ranges decrease in altitude from Cerro de Aripo (914.4 m), the highest point in the north, to Mt Tamana (310 m) in the central range and Trinity Hills (307.8 m) in the south; that of Tobago consists of a central main ridge, the highest peak measuring 576 m.

The climate is typically tropical with two distinct seasons—dry and wet—each of 6 months' duration. The rainy season, June to December, is broken by a three week dry spell (Petit Careme) between September and October. Average annual temperature is 20°C during the day and 21°C at night, with generally high relative humidity. Rainfall is influenced by topography and the Inter-Tropical Convergence zone. In Trinidad, precipitation varies from 2880mm in the north and northeast to 1200mm

in the west and southwest. In Tobago, heavy precipitation occurs in the rain season in the northeastern area. However, the southwestern area being in the rain shadow area experiences low rainfall.

The total population is estimated at 1.30 million and evenly distributed between males and females. During the past decade the annual growth rate was estimated to be 1.3%. The population density is 24.6 persons per km^2.

Total arable land accounts for only 141,000 ha representing 26% of total land area or less than 4 ha per farmer. The State is the largest single owner of arable land. A profile of the public and private agricultural holdings (1982, 1986) indicates that about 85% of farmers occupy holding sizes of less than 5 ha, with 50% being less than 2 ha. Land distribution is heavily skewed in favour of larger landholders (in excess of 5 ha each) cultivating 59% of total agricultural land (CSO - Agricultural Census 1982, 1986).

Land degradation results mainly from uncontrolled squatting, quarrying activities and unplanned forest fires. This causes permanent damage to the natural beauty of the landscape and contributes to other environmental problems of soil erosion, flooding, desiccation and loss of water recharge capabilities.

The Agricultural Small Holdings Act and the Agricultural Contract Act which allow occupancy for long periods at unremunerative prices, serve as disincentives to the release of lands through rental or lease arrangements for agricultural purposes by private landowners.

Current land use and land capability assessment indicate that a wide range of farming enterprises can be accommodated on the arable land. In this land-short economy (24.6 persons per km^2 and less than 4 ha arable land/farmer), the demand on the arable portion is acute and is exacerbated by surface and coastal erosion and the use of good agricultural land for urban and industrial development. A detailed policy for land administration, distribution and comprehensive land use planning was implemented in mid 1995 to address these problems.

PRODUCTION SYSTEMS

Livestock farming is characterized by four distinct production systems in Trinidad and Tobago:

Extensive

- Continuous grazing associated with large estates and rice growing/ lagoon areas
- Rotational grazing associated with restricted acreages utilizing improved pastures. This concept was utilized by the government in the development of dairy farms both in Trinidad and Tobago.

For dairy cattle in this system, animals are kept on pastures and open areas full-time except when housed at milking time. Most large dairy farms use this system. There are a few farms that milk outdoors as well.

For beef cattle and buffalo, this system is characterized by animals being held outdoors full-time, except for times when they have to be treated, fed supplements or placed in a feed-lot. Pastures may be pure-stand or, if along the coastline, grazing may be under coconut trees.

For small ruminants, the extensive system is not used because theft, predator dogs and possible conflict with crop farmers arise as problems.

Semi-intensive

Grazing at specified times, combined with a cut and carry system. This would incorporate the rotational grazing system, but restricts the animal to indoor feeding for some period of time.

For all species, this system is characterized by outdoor grazing for a part of the day, usually between sunrise and early afternoon. For the remainder of the day, animals are held indoors for milking, feeding and other management practices.

Under these systems, sheep are reared under citrus and coconut, or in conjunction with poultry (broiler) operations.

Tethering is widely used within this system both for small and large ruminants

Intensive

Here animals are kept entirely indoors, under a cut and carry system. This is characteristic also of the backyard operations with a small number of animals.

Generally, this sytem is used for dairy cattle and small ruminants. A few beef farms are totally intensive. Some beef and buffalo farms are extensive/semi-intensive with feedlot operations.

With the fully intensive system, all feedstuffs are brought in to the animals which are kept indoors full-time, except for brief periods when they may be allowed outdoors for "exercise."

Many small farms with large ruminants are intensive, with confinement by stall tethering.

Mixed farming

- This system attempts to optimize the land for crop and livestock production
- Small ruminants are the main livestock used in these mixed farming systems, with dairy cattle being the second option.

It is to be noted that because of the small arable land mass available for farming, and the pressure on agricultural land for industrial and residential purposes, the systems most commonly utilized for livestock production are the semi-intensive and intensive.[1]

Between 80-90% of dairy and beef farms are classified as small (intensive), having under 25 head of cattle; 80% of sheep and goat production occurs on small (intensive) units. In the case of pig production, four large farms with a breeding herd of over 800 sows each account for 80% of total domestic production, while the remaining 20% occurs on units of 10-20 sows each.

PIG PRODUCTION SYSTEMS

Backyard

- 1-3 adult sows, unimproved or criollo breeds
- in crude housing/some tethered/some free ranging
- fed household waste/garbage and forage, little supplemental feed
- animal disposed of to generate special income, community marketing
- waste disposal problems and inadequate use of manure
- water problems

Semi-intensive

- 10-75 sows, improved but traditional breeds, e.g ., landrace, large white, duroc, etc.
- improved housing but often dilapidated, with farrowing crates, fattening pens, etc.
- on-farm mixes and commercial concentrate feed; high feed costs
- market to butcher, roadside vendors (sometimes themselves), meat shops
- may differentiate cuts in marketing
- increased pollution

Intensive

- 300 plus sows, high quality breeding stock, often obtained by AI with imported semen
- technical advice from foreign sources
- latest technology seen in facilities
- vertical integration of largest farms
  - completely for two farms: feed mixing, rearing and processing, canned/tinned/smoked products
  - others only partially integrated
- marketing to processors mainly, sometimes in fresh pork marked (which negatively affects smaller producers) and to supermarket chains. Also export markets
- pollution, only partially a controlled problem. There is need for improved systems and controls (and legal standards)

Limitations

- Waste recycling - improved manure effluent/collection including housing\
- Water for livestock -ponds/mini-dams
- Improved land use through integrated sustainable farming
- Greater use of local feed resources, agro-processing waste, "new feed resources" sugar cane, with more work on local feed resources, into use of by-products, agro-industrial by-products and effluents existing

LIVESTOCK STATISTICS

The livestock population in the country is as follows:

Dairy cattle	25,300	Goats	28,500
Beef cattle	11,500	Pigs	74,000
Buffalo	4,800	Sheep	7,000

A summary of the characteriztics of the major livestock subsectors and their relative importance to national agricultural development follows:

THE DAIRY INDUSTRY

Number of dairy farms

There are approximately 2,940 dairy farmers in Trinidad and Tobago. These farmers include approximately 600 farmers who supply Nestle, the largest and only UHT milk processing establishment in the country, with fresh milk, 40 who supply Ramsaran Dairy, a smaller milk processor specializing in pasturized milk, and an estimated 2,300 small-scale producers (5-10 animals) who either utilize the milk in its fresh state or in the manufacture of milk-based products in the household.

Supply of milk to major milk processors

Table 1 above shows that an estimated total of 9.3m kgs of milk were processed by the three major milk processors of fresh milk in 1995. This amount was estimated to be 1% more than the amount produced for the corresponding period of 1994. The data also indicate that Nestle utilized an estimated 98% of total milk supplied to the major milk processors. Milk supplied to Nestle was primarily used for the manufacture of UHT milk and other flavoured milk drinks. Ramsaran and Caroni (1975) Limited utilize the milk for the manufacture of pasteurized products.

Table 1: Milk processed by Nestle, Ramsaran Dairy and Caroni Limited, 1994-95

Year	Nestle	Ramsaran	Caroni	Total
	mkg	kg	kg	mkg
1994	9.2	111,967	63,321	9.4
1995	9.1	111,998	60,478	9.3

It should also be noted that while it is difficult to determine milk produced by the numerous small subsistence-type farmers, it is generally believed that the group accounts for approximately 1.2mkg or 10-15% of total milk produced per annum.

Total milk production from all dairy farms was therefore estiamted to be 10.5 mkg or 0.1% less than the previous year. This quantity of fresh milk, however, only satisfied an estimated 10% of total requirement for domestic consumption. The remaining 90% was imported, mainly in powdered form. There were no exports of fresh milk.

Powdered milk

Powdered milk continued to be the major form in which milk was consumed, both by households and milk processing companies. During the period under review, an estimated 12.6 m kgs of powdered milk was imported, valued at an estimated $28m (US). There is a 5% duty on imported powdered milk.

Price of milk/subsidy

The price of milk supplied to Nestle was increased from 16.6 US cents to 17.5 US cents/kg in August 1995. Based on price and quantity of milk supplied, it is estimated that farmers who supplied the company received an estimated US$1.6m.

The State maintained a subsidy payment of 16.6 US cents/kg for milk purchased by Nestle farmers. Total milk subsidy payments were therefore estimated to be US$1.5m. Nestle farmers therefore received a total of US$3.1m (from Nestle and as subsidy payments).

Government is in the process of demonopolizing the milk subsidy programme so that farmers who supply processing plants in addition to Nestle may also benefit from the subsidy.

Issues/concerns of the industry

The high and increasing cost of livestock concentrate rations and medications were identified as the major constraints affecting the viability of dairy farming operations.

The sector was also affected by the inability of the Artificial Insemination Unit to adequately respond to farm calls for insemination services, because of the lack of adequate transport and communication services. Theft of animals was also identified as another major problem of the industry.

A major concern of the industry is its inability of attract adequate investment capital for improving and increasing stock and for upgrading farm equipment and physical infrastructure.

Analysis of results

The data on milk production shows that the dairy industry has remainedstable over the past five years since there were no significant changes in output and price.

The upward trend in the price of powdered milk has renewed interest and has increased the demand for local fresh milk. This is borne out by the fact that Nestle has already increased the price of milk supplied to the Company and has recently recruited an animal scientist to strengthen its dairy programme. Another milk processor, Agrifin, also proposed to pay farmers more than the present price offered by Nestle for fresh milk supplied to the Company for its cheese processing operation.

THE BEEF INDUSTRY

An estimated 1.0mkgs of beef were produced by local beef farmers, the same quantity produced for the corresponding period of 1994. The majority of beef sold was supplied by the numerous small, subsistence-type beef farmers, particularly in the counties of St Patrick and Victoria.

A significantly smaller quantity was produced by the larger beef farms (over 50 animals) - estimated to be 10 farms. These farms continued the trend of scaling down operations, nothwithstanding the increasing competitiveness of local beef vis-a-vis imported beef which has been increasing steadily in price over the past few years. The principal source of beef animals were culled animals from the dairy herds. The local beef was mainly sold in a fresh or chilled state.

An estimated 2.7mkgs of beef were imported during 1995. This was approximately 0.6mkg or 17.6% less than the total beef imports for 1994.

The combined total of imported and local beef supplied on the market was therefore estimated to be 3.7 mkgs.

The protective regime

Beef was removed from the negative list at the beginning of 1996 and initially replaced by a surcharge of 20%. This tariff was subsequently reduced to 10% as a strategy for increasing the efficiency and competitiveness of the local beef sector, and to make that commodity more affordable to consumers.

The price of beef

Locally produced beef was sold in the municipal markets and roadside stalls at an average retail price of US$2.94/kg. This price was US$0.36 cents/kg or 14% more than the price at which it was sold in 1994. It is also instructive to note that the price of imported beef continued its upward trend, nothwithstanding the 50% reduction of the surcharge on that commodity.

The price of imported beef also increased. Beef clods, for example, increased from US$1.66/kg in 1994 to US$1.72/kg in 1995 - an increase of 3.4%.

Major issues

The profitability of the beef sector continued to be affected by the high cost of feed, medication and other imported inputs used in production. The sector is also affected by the lack of adequate modern facilities for the slaughtering of animals and storage of carcasses. It should be noted that while many beef importers have expressed a willingness to purchase local beef, they lament the fact that the product is not always available in the required quantity or quality, nor at the specific time required.

The level of investment and technology in the industry also remains particularly low. This affects the ability of the sector to function at optimum levels.

The sector is also greatly affected by the increasing incidence of theft of animals.

Analysis/interpretation of results

The beef industry continued to decline, generally as a result of competition from imported beef which comprises approximately 80% of total beef consumed. It must be pointed out, however, that the local beef is gradually becoming more competitive in price as imports from traditional sources increase in price. The price (cif) of imported beef, for example, increased by approximately 3.4% during the past year.

The lack of growth and viability of the local beef industry can also be ascribed to the increasing cost of inputs, particularly feed.

The stagnated state of the beef sector can also be ascribed to the lack of sustained and coordinated programmes for its development, coupled with its inability to attract adequate investment capital for conducting research, especially in the areas of breeding and nutrition and for improving the level of technology and infrastructure.

Beef producers are therefore not in a position to take advantage, now or in the near future, of opportunities resulting from the increasing cost of imported beef.

Further, the significant increase in the price of beef was largely a result of the tendency of local beef prices to be influenced by price trends of imported beef. It is also possible that the reduction in the level of imported beef may have stimulated higher demand for the local beef and higher prices as a consequence.

THE SHEEP AND GOAT INDUSTRY

Sheep and goats are managed as part of a small farm system in Trinidad and Tobago. Sheep production has increased markedly over the past five (5) years, mainly on small farms which account for 80 per cent of the total domestic production. The major breeds of sheep reared are the Persian Black Head, Barbados Black Belly, Suffolk West African and several crosses of the above mentioned breeds. Production over the past five (5) years is estimated at 55,000 kgs representing 3% of total consumption. The average importation over the same period was 1,673,000 kg.

Dairy goat rearing has not been widespread. A few farmers rear small numbers of goats which generally reflect poor nutrition, management and breeding practices. In an effort to stimulate dairy goat production the GORTT, through a grant from the European Community, imported 196 doelings and 24 bucklings of a mixture of breeds, viz, Anglo Nubian, Toggenburg, Saanen and British Alpine from the United Kingdom in 1989. These goats are being used as a nucleus herd which will be used to improve the genetic capability of the national goat herd.

Price of mutton and goat meat

The average retail price of fresh local mutton and goat meat is $3.66 US/kg. Imported frozen goat meat is sold at an average of $2.20 US/kg and provides stiff competition to the local product. On the other hand, imported lamb and mutton of good quality are available in a range of specialized frozen cuts from $3.58 US/kg to $6.80 US/kg. (HiLo meat sales)

Major issues/concerns

Theft of animals is the major constraint to sheep and goat production in the country. This is followed by the high cost of input supplies, mainly feed and medications. Producers are also concerned about the low level of tariff protection given to them against imports of low quality frozen goat meat from Australia and New Zealand.

The industry is also plagued by the poor facilities for the slaughter and storage of carcasses and the lack of a properly organized marketing system.

THE PIG INDUSTRY

At the end of December 1995 there were an estimated 294 pig farms in operation, of which 258 or 95% were private farms and 13 or 5% were stateland developed farms. The total number of farms represented a decrease of 29% when compared to the same period in 1994.

The supply of pork

During 1995, an estimated 2.6 mkgs of pork were produced. This amount was 0.3 mkg or 13% higher than local production in 1994. The

industry is still self-sufficient in the production of pork, but relies to a large extent on imported pork, mainly legs and shoulders for processing purposes, since the local industry cannot satisfy the demand both in terms of quality and quantity for the fresh pork and processed pork product market.

During 1995, an estimated 0.8 mkgs of pork were imported, mainly for the manufacture of hams and sausages. As estimated 62,197 kgs of pork (processed) were exported. The major export markets were Grenada, St Lucia and Antigua.

Price of pork

The average retail price of fresh pork (local) decreased from $2.75 US/kg in 1994 to $1.43 US/kg in 1995.

Major issues/concerns

The high and increasing cost of pig feed, medications and utility rates continued to be the major problems affecting the viability of pig farmers' operations. The average retail price of pig ration, for example, moved from $9.62 US/kg in 1994 to $10.08 US/kg in 1995, an increase of 4.8%.

The marketing system for fresh pork is also not very organized. The few small surviving pig farmers sell at the municipal and county market or resort to selling to butchers who purchase relatively small quantities at a time, with no fixed schedule for making purchasers. Very little of the pork produced by the small pig farmers is purchased by processors for the manufacture of pork-based products. Another problem which affects the industry is the difficulty in obtaining a reliable supply of water. Some farmers had to resort to purchasing truck borne supplies. This further adds to processing cost. The disposal of waste from pig farms is a matter of great environmental concern to the authorities. The cost of waste disposal will significantly add to the total production cost for pig operations and may reduce investment in this sub-sector.

The poor physical state of pens, equipment and general infrastructure also affects the performance of the sector.

Analysis/interpretation of results

The increasing cost of producing pork, particularly the increasing cost of feed, may have contributed to the further contraction in the number of pig farms.

The decrease in the price of pork may be attributed to the increased production of pork on the market, coupled with the continued declining demand for fresh pork because of health, religious beliefs and competition from other relatively cheaper and more nationally acceptable forms of meat.

The increased quantity of imported pork can be linked to the increased demand for pork for processing purposes to satisfy markets principally in the CARICOM Region for pork-based products.

It is also instructive to note that the increased pork imports were facilitated by the duty-relief licenses granted to processors and the removal of license requirements at the beginning of the year for such imports.

No significant quantities of fresh pork were, however, imported because of the relatively high duties payable.

POLICY GOVERNING THE USE OF LAND IN LIVESTOCK PRODUCTION SYSTEMS

The GORTT has undertaken a comprehensive review of land policies with the aim of promoting agricultural development, achieving greater equity in land distribution and facilitating improved environmental management,as well as formulating a new land policy characterized by greater effectiveness, coherence and improved coordination.

The country possesses a total land area (forested and non-forested) of 5,123 sq. km (512,600 hectares). Overall, 52% of this land area is owned by the State. However, in Tobago only 34% of the land, or 10,772 hectares, is state-owned.

State lands other than constituted forests cover 129,288 hectares in Trinidad and 3,665 hectares in Tobago. This broadly represents the extent of the land resources available to the State for promotion of the productive

activity and generation of income and employment. Of the total land area of the country, only 178,897 hectares or 35% is suitable for cultivation.

The total cropped area is 107,400 hectares and the area under cultivated grassland is 4,504 hectares.

Traditionally there have been two broad approaches to the distribution of agricultural state lands for livestock development on an intensive and semi-intensive system.

- Blocks of state lands are demarcated, upgraded with support services and infrastructure and distributed to selected livestock farmers (dairy and pigs) for settlement. These farms are approximately 8 hectares and located in areas based on the following criteria:
    - land capability classification
    - relationship to residential areas
    - relationship to main water courses and aquifers used for water winning and distribution
    - town and country planning approval
    - waste disposal and environmental pollution considerations

- Available isolated parcels which fit the criteria for livestock development are distributed to private citizens, groups, companies, cooperatives or other entitles who present to the state viable agricultural project proposals. These proposals must be consistent with government policy.

To date, the amount of state lands distributed for agricultural purposes (including livestock production) is on the order of 20,675 hectares, representing 15% of the total unforested land in public ownership.

Table 2 shows the distribution of dairy cattle, beef cattle and buffalo in Trinidad and Tobago by county. It is to be noted that dairy production is carried out under semi-intensive and intensive systems of management, whereas the majority of beef cattle operations are found under extensive systems of management in the coastal areas of the north, east, southeast and southerly parts of the island on coconut plantations. Farm distribution by county is also provided for dairy, beef and buffalo at Table 3.

Table 2: Population of dairy-cattle, beef-cattle and buffalo in Trinidad and Tobago by country

Country	Total of all types	Population		
		Dairy	Beef	Buffalo
St George	8766	7550	990	226
Caroni	10001	7646	883	1472
Nariva/Mayaro	2252	157	1178	917
St Andrew/St David	1660	1091	400	169
Victoria	5155	2938	1087	1130
St Patrick	10300	5348	4097	819
Sub-total:Trinidad	38134	24766	8635	4733
Tobago	3571	565	2856	150
Total Trinidad and Tobago	41705	25331	11491	4883

Table 3: Number of dairy, beef and buffalo farms in Trinidad and Tobago by county

County	Number of Farms		
	Dairy	Beef	Buffalo
St. George	478	50	18
Caroni	977	95	164
Nariva/Mayaro	50	115	168
St. Andrew/ St. David	136	63	15
Victoria	744	255	516
St. Patrick	1188	307	102
Sub-total: Trinidad	3573	1185	983
Tobago	148	408	1
Total Trinidad and Tobago	3721	1593	984

Table 4: Ruminant farms size by numbers of land held in Trinidad and Tobago

Farm size	Dairy		Beef		Buffalo		Sheep/goats	
(No of head)	Farms	Animals	Farms	Animals	Farms	Animals	Farms	Animals
1 - 2	1479	2408	156	250	706	911	—	—
3 - 5	1255	4648	143	534	212	751	—	—
6 - 10	539	3916	78	579	38	266	—	—
11 - 15	130	1661	12	157	5	69	—	—
16 - 20	79	1429	9	161	4	68	—	—
21 - 25	54	1257	2	45	1	23	—	—
26 - 30	47	1306	2	58	—	—	—	—
31 - 40	77	2685	1	36	3	103	—	—
41 - 50	30	1360	1	50	1	42	—	—
51 plus	31	4661	4	986	14	2650	—	—
Totals	3721	25531	408	2856	984	4883	—	—

Source: CSO 1987 Cattle and Buffalo Survey
1986 Central Statistical Office
Republic of Trinidad and Tobago

ANALYSIS OF CONSTRAINTS OF PRODUCTION SYSTEMS

Small farms

Small farms are characterized by almost total dependence on feed resources external to the farm. Table 4 shows that the majority of cattle and buffalo farms are small (1-10 head). No data are available for small ruminant farms in Trinidad and Tobago. The following picture emerges:

- They are part-time operations, with income earned either from other agricultural activities or even from non-agricultural activity.
- Many farmers have little or no land and depend on tethering on roadsides or open lands, and cut and carry of unimproved, uncultivated grasses, legumes, shrubs and crop residues. Where intensive or semi-intensive production is done, there may be dependence on commercial feeds.
- There are problems with water for livestock.
- There is total dependence on family labour.
- Reproductive efficiency is generally poor where animals are stall-tethered full-time.
- Hardy adapted animals are generally used, so other health problems are minimized. Parasites may be a problem, particularly for the younger stock.
- Where supplemental feeding—i.e., concentrate feeding and/or provision of mineral and other supplements—is not done, nutrition deficiencies may be a problem.
- Marketing is a problem. If a milk depot is nearby, the farmer can market. Other than this, there is no organised system of marketing milk. The farmer is at the mercy of itinerant purchasers/butchers. Since meat outlets are geared only to handling imported semi-finished products, there is restricted interest in handling local produce. The sllllaughterhouses that exist need to be closed or reorganized and upgraded, and personnel need to be trained in slaughtering techniques, meat handling and offal utilization (processing).

Medium and large farms

- These have leased or owned land; however, farming systems do not depend on the land for feeding the animals, i.e., there is excessive dependence in external feed sources which is encouraged by commercial concerns.

Table 5: Limitation of production systems

Production system	Constraint/limitation	Due to		
		Macro-policy	Capital	Research
Extensive	(a) Low productivity of land in terms of feed (pasture and forage grasses)	–	–	X
	(b) Low productivity of animals due to reproductive problems/loss of young/health and parasitism/replacement rearing	X	X	X
	(c) Marketing	X	X	
	(d) Water for livestock	X	X	–
	(e) Germplasm conservation/acquisition	X	X	–
Semi intensive/intensive	(a) Increasing land productivity including indigenous feed resources/forage conservation	X	–	X
	(b) Conservation of the environment through waste/nutrient recycling and integrated systems/crop waste and agroindustrial processing wastes	X	–	X
	(c) Reproductive efficiency and animals replacement rearing	–	X	X
	(e) Water for livestock including aqua culture	X	X	X
	(f) Marketing	X	X	X

- There are nutritional and water supply problems experienced by these farmers.
- A combination of family and paid labour is used (also owned or rented equipment).
- Livestock may be of better quality but not as well adapted.
- Reproductive problems exist, although not to the extent shown on the small farms. (Some reproductive problems result from having poorly adapted stock.)

Marketing is improved since, because of farm size, knowledge of markets and products, resources (vehicles etc.), and special arrangements, products can be sold. (Prices are still regarded as unsatisfactory.) There is a mixture of full-time and part-time farmers in these categories. The latter may depend on other farming or non-farm income. Limitations/ constraints which exist in the different production systems that result from macro-policy, lack of capital or new information which requires research are shown in Table 5.

INTERACTION IN THE DEVELOPMENT OF POLICY

Development of policy affecting the livestock sector is based on wide consultation between the public and private sectors, including farmers and farmers' organizations and local and regional government and NGO's. This has involved publications of drafts after consultative seminars with revisions and further consultations, e.g., the White Paper on Agriculture approved by the GORTT.

Consultations are ongoing on an ad hoc basis on various relevant issues between institutions and organizations.

From the White Paper, a national policy undertaking concerning all aspects of agriculture, a task force was set up under the chairmanship of the Permanent Secretary, Ministry of Agriculture, Land and Marine Resources, the highest administrative officer of the ministry. A prepared draft was widely distributed for public comment, and several public meetings were held with wide attendance from both the public and private sector, including farmers' organizations and NGO's, environmental interest groups, marketing organizations, cooperatives, etc. The inputs were distilled and directed the revision of the original draft document. Public meetings were chaired by the Ministry of Agriculture in the initial phases.

Within organizations, various mechanisms are pursued. A regional organization, the local CARDI office, convenes an occasional consultation on its proposed programmes, including livestock. A wide range of public and private organizations, including farmers' organizations, attend.

More representations and discussions which CARDI inputs into it finally decided programmes. Another mechanism within the organization is the permanent representation of interested organizations at the Sugarcane Field Centre (SFC). An advisory committee composed of representatives of the Ministry of Agriculture, Land and Marine Resources, Finance and Planning, University of the West Indies, Caroni (1975) Limited and a private farmer meet quarterly to consider all aspects of the Centre's progress and work.

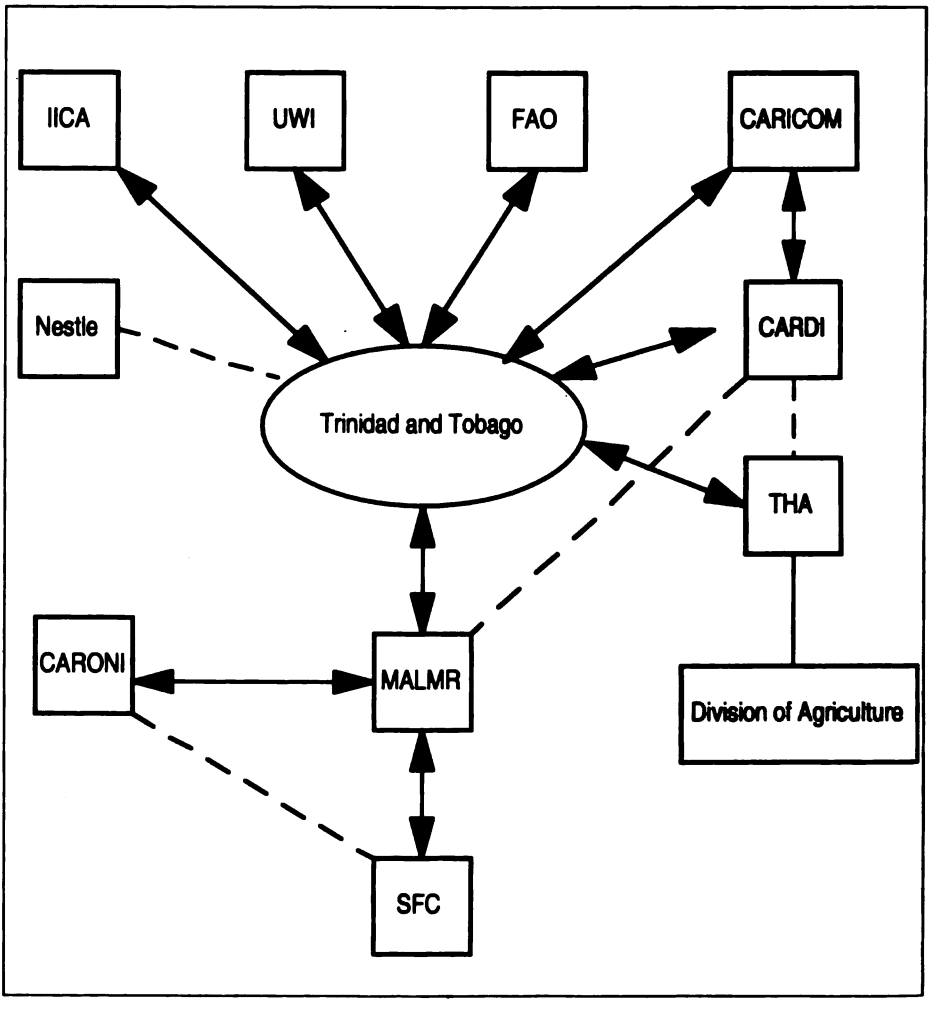
The Blenheim Sheep Project of the Tobago House of Assembly has a similar mechanism, its committee being made up of representatives of the Ministry of Agriculture, Land and Marine Resources, Tobago House of Assembly, University of the West Indies and CARDI.

Linkages

Linkages between national and regional institutions dealing with the livestock sector are shown in Diagram 1.

One private sector institution, Nestle, does not have any formal linkage with the other institutions. However, regular collaboration and consultations take place.

Diagram 1: Linkages between national and regional institutions dealing with livestock sub-sector



Reporting responsibilities

Reporting responsibilities of the national and regional institutions dealing with the livestock sector are shown in Table 7. Many institutions report at both national and regional levels.

Table 6 shows the number of scientists who are directly involved in livestock research in the various institutions.

REGIONAL ISSUES

- The liberalization of trade and the removal of all trade at regional and national consultations.

Table 6: Number of scientists in research institutions based in Trinidad and Tobago

Institutions	Animal science		Veterinary science
	Senior scientist	Junior scientist	
A. Ministry of Agriculture, Land and Marine Resources			
1. Research	2 Animal nutrition (2 MSc) 2 Animal breeding (2MSc) 2 Forage (2 MSc)	3 (B.Sc)	
2. Agric Planning Division (APD)	NIL	1 (B.Sc)	
3. Animal Production and Health (APH)	1 Ph.D. and 2 MSc	2 (B.Sc)	2 vet pathologist (DVM) 2 vet physiologist (DVM) 1 microbiologist MSc
4. Extension Information and Training (EIT)	2 MSc	1 B.Sc	
B. Sugar cane Feed Centre (SFC)	1 Animal productionist (MSc)	2 B.Sc	
C. University of the West Indies			
1. Department of Livestock Science	2 Snr Physiologist (Ph.D.) 1 Nutrition (Ph.D.) 1 Breeder (Ph.D.) 2 Production (Ph.D. and MSc)		
2. School of veterinary medicine			4 Pathologist (Ph.D.) 2 Anatomy (Ph.D.) 2 Physiology (Ph.D.) 4 Microbiology (Ph.D.) 2 Pharmacology (Ph.D.) 3 Clinical science 1 Ph.D., 1 DVM, 1 BVS)
D. CARDI	1 Animal production (MSc)	1 BSc	
E. IICA			
F. Ceroni Limited			

- Infrastructure support
- The provision of research and development at the regional level
- Adapted and improved breeds
- Networking as a strategy within the Caribbean and between Latin American countries and the Caribbean countries
- Cost and availability of feed and feedstuffs, local and foreign, and commercial utilization of by-products and waste
- The competition for use of available lands and extensive versions degrees of intensification of production and land reform
- Quality assurance
- Marketing sales and promotion
- Integration of livestock systems within the subsector and between other subsectors in the agricultural sector
- Processing
- By-product utilization
- Provision of technical support services, including extension
- Training

Table 7: Reporting responsibilities of national and regional institutions dealing with the livestock sector

Organizations/ Institutions	Local/regional	Trinidad and Tobago government	Mechanism	CARICOM region	Mechanism
(1) UWI	Regional	X	Campus council	X	?
(2) CARDI	Regional	X	Board of directors	X	SCMA
(3) IICA	Regional	X	Local office		
(4) FAO	Regional	X	Local office		
(5) MALMR	Local	X	Direct reporting	–	–
(6) CARONI (1975) Ltd.	Local	X	MALMR Board of Director	–	–
(7) SFC	Local	X	MALMR via Advisory committee	–	–
(8) Division of Agricultrue Tobago	Local	Tobago House of Assembly	Direct reporting	–	–
(9) Nestle	Local private sector	–	Informal	–	–

RESOURCE PRESENTATIONS

The Role of Animal-Source Foods in Improving Diet Quality and Growth and Development in Young Children

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ABSTRACT

In adequate diet quantity and poor diet quality are the leading causes of poor pregnancy outcome and poor growth and mental development of young children in developing countries. Low birth weight, underweight, stunting and deficits in cognitive and decreased immune function are expressions of protein-energy malnutrition and/or micronutrient deficits.

A large proportion of rural poor families cannot afford a diet of adequate quality, even if the quantity is reasonable. The bulk of energy is furnished by a few basic staples of cereals and/or tubers. Animal source products such as meat, foul fish, milk and eggs are infrequently eaten - and if available are saved for special occasions or sold for cash income.

Diets low or devoid of animal source products are often deficient in micronutrients such as iron, zinc, vitamins B_{12} and A and Calcium, however, where diets are low in quantity, they are also low in micronutrients. The presence of animal foods in the diet increases the absorption of iron and zinc from plant sources in a given meal. The iron and zinc, particularly in cereals, have low bio availability because of the high fiber and phytate content which form insoluble complexes with reduced absorption. For a young child to obtain sufficient mircronutrients from a cereal-based diet, a daily intake of over 2Kg of the staple would be required.

The adverse outcome of deficient micronutrient intake, particularly of iron, zinc and vitamin B_{12} and iodine (which is not considered here) are low birth weight, poor child growth, cognitive deficits and anemia. The human Nutrition CRSP studies, carried out in Egypt, Kenya and Mexico, a longitudinal study are "Food Intake and Human Function" demonstrated in all three country projects, not only the effects of low energy intake (mainly in Kenya), but the negative consequences of poor

diet quality and pregnancy outcome (low birth weight); physical growth of infants, pre-schoolers and school age childrens; selected neurophysiologic functions in newborns, motor and mental tests of infants and preschoolers, and on physical activity, cognitive function and school performance in school-age children. Anemia was associated with iron and vitamin B_{12} deficiency and seen in all age groups. Poor growth was associated with low intake of energy and available zinc (that percent absorbed when adjusted for dietary phytate). Both in Mexico and Kenya low B_{12} levels in breast milk were highly correlated with low animal food intake and were associated with poor infant growth.

Thus the improvement of diet quality through the addition of animal source foods with its contribution of bio available Iron and zinc and of vitamin B_{12} can promote intra uterine growth as well as infant and clued growth, cognitive development and overall health. The Small Ruminant CRSP and related live-stock projects can make a significant contribution through increasing the availability of affordable animal source foods to the rural poor in developing countries.

INTRODUCTION

Malnutrition, particularly mild and moderate protein-energy malnutrition (PEM), continues to be a global problem. Fetuses, infants, and young children, and childbearing and lactating women suffer disproportionately because of their increased nutrient requirements.

Although the percent of undergrown, underweight children (less than two standard deviations below the reference) declined from 42% in 1974-1976 to 34% in 1988-1990 (UN AAC/SCN, 1992), the actual numbers of people with PEM increased by 16 million due to population growth. Stunting still remains a formidable problem with as many as 60% of children in some Asian, African, and Latin-American countries affected (World Development Report, 1993). Given the adverse effects of natural and man-made disasters, the population growth and the increasing indebtedness of developing countries, food security and poor diet quality will continue to be problems for decades. Some attempts at structural readjustment appear to penalize the most vulnerable segments of the population.

Not only is the quantity of available food the issue, but the nutrition community is becoming increasingly aware of "hidden" or micronutrient

deficiencies. In most situations where the quantity of the diet is deficient, most certainly micronutrient deficiencies will also be present. Even where diet quantity is adequate, poor diet quality will contribute to micronutrient deficiencies. The nutrient deficiencies of most urgency and concern and with the greatest societal and economic burdens, are iron, vitamin B_{12}, and folic acid, vitamin A, iodine, and zinc. It is estimated that 42% of women and up to 70% of older infants and preschoolers suffer form iron deficiency anemia. Vitamin A deficiency is the leading cause of blindness and increased mortality from acute respiratory infection (AIR) and diarrheal disease. Iodine deficiency, particularly in Latin America, causes a wide spectrum of problems, including increased pregnancy wastage, cretinism (a severe form of retardation), poor physical growth and a wide range of cognitive and learning deficits. Deficiencies of zinc and vitamin B_{12} are also being increasingly recognized as causing profound problems. Other micronutrient deficiencies, with less dramatic expression than the above mentioned deficiencies, such as copper and selenium, are now under increasing study (Scrimshaw, 1994).

A considerable portion of the developing world is vegetarian or near vegetarian, not because of religious or philosophical reasons, but because of economic realities. Basically, the bulk of energy is furnished by a few basic staples of cereals or tubers, plus varying amounts of legumes, greens and vegetables. Animal-source foods such as meat and fish, fowl or eggs are infrequently eaten, or eaten only on ceremonial occasions. Animal milks are consumed in varying degrees and are often fermented. Subsistence farming on small plots of land or tenant farming is the main source of food-stuffs. The few animals that are kept are often raised for the sale of milk or as a source of security or income when sold, but not for direct dietary improvement.

Diets devoid of or low in animal products, i.e., meat, fish, fowl which contain heme protein, are generally low in energy density because of low fat and the bulkiness of the food. Moreover, these diets are also deficient in micronutrients such as iron, zinc, vitamin B_{12}, calcium, preformed vitamin A and other nutrients. Also, a highly absorbable and excellent quality protein is supplied by animal-source foods.

Not only do animal-source foods supply the above micronutrients, but heme protein promotes the absorption of iron and zinc, thereby increasing their bioavailability. Diets which are predominately vegetarian, particularly when cereal-based, are high in phytate and fiber content,

which form insoluble complexes with iron and zinc, and other metals, thereby reducing their bioavailability. For example, cooked maize contains about 0.5mg of iron per 100 grams, but only about 5% is absorbed, giving only 0.03mg available to the body. Although cooked beans have about 2.9mg iron per 100grams, absorption is equally low, yielding only 0.15mg available iron. However, beef, which contains about 1.7mg iron per 100grams, yields about 0.34mg 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. It would take a lot of maize and beans to meet children's iron requirements, and livestock consumption could be an important factor in reducing anemia rates (Murphy et al., 1992).

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 ten times as available. Zinc availability is very low in wholegrain cereal-based diets, probably 10% or less, due to their high phytate content. As with iron availability, zinc in plant products can be substantially increased by simultaneous consumption of animal protein. To meet the requirements for zinc, it would take far more maize and beans than a child is likely to eat, while 50 grams of meat per day would completely satisfy the average requirement of a toddler.

Again, animal products are good sources of vitamin B_{12} and vitamin A. Milk can be a good source of well-absorbed vitamin A—in addition to carotenoid supplied by leafy green vegetables. Animal products are the only source of vitamin B_{12} except what can be obtained from some fermented or contaminated foods. Both meat and milk supply substantial amounts of riboflavin. Dairy products are an important source of calcium; it is difficult for a child to even approach the average calcium requirement (estimated as 346 mg/d) on a cereal-based diet. Calcium in leafy vegetables is poorly absorbed if the vegetables are high in oxalate (Murphy and Calloway, 1991).

Food combinations also affect micronutrient absorption. Citrus fruits with high ascorbate levels enhance the absorption of zinc and iron, but, unfortunately, fruits are eaten mainly as snacks and not at mealtimes. Beverages such as tea and coffee, which are often taken at meals, decrease

the absorption of iron and zinc, forming insoluble complexes with the tannic acid in these beverages. Milk often is added to tea and further decreases the absorption of iron and zinc (Murphy et al., 1992).

CONCEPT OF BIOAVAILABILITY

This is an important concept in trying to understand the micronutrient situation in many parts of the world, and choosing possible approaches to dealing with micronutrient deficiencies. Iron and zinc, the nutrients of main concern, in vegetable-cereal based diets, may be present in adequate amounts in the food items as ingested, but only a small fraction is absorbed for use by the body. As mentioned, phytate, fiber, high calcium, casein, and tannic acid can form complexes resistant to absorption in the small intestine. To estimate the available iron or zinc, or that amount actually absorbed and available for use in the body, one must take into account the amount of phytae and fiber in the diet and what the ascorbic acid intake is apt to be. In practice, molar phytate:zinc or iron ratios are calculated to give such information. The higher the ratio, the less the available zinc or iron. The available iron or zinc levels then are used, rather than the actual concentration in foods (Murphy et al., 1991).

FUNCTIONAL EFFECTS OF POOR QUALITY DIETS WITH MICRONUTRIENT DEFICIENCIES

Inadequate micronutrient intakes can lead to important functional deficits. Poor diet quality or a diet containing little or no animal-source products with very low fat content and low energy density may lead to interrelated adverse functional outcomes, particularly in the vulnerable groups mentioned above. Examples mainly from the Human Nutrition (NCRSP) studies will be drawn upon. Because physical and mental development are interrelated and affected by prenatal influences, implications of poor diet quality during pregnancy and lactation on infant and young child growth and development will be discussed. Poor diet quantity and quality during pregnancy and nutritional anemias lead to poor pregnancy outcome such as low birth weight (LBW), with the risk of impaired physical and mental development. Decreased maternal activity and fatigue can result in decreased infant stimulation by an anemic and/or malnourished mother. Poor diet quality and micronutrient deficiency has been associated with early growth faltering, particularly of linear growth, starting in infancy. Stunting in toddlers and schoolers

is associated with poorer cognitive performance than in well grown children.

Increased infection episodes which are associated with iron, zinc, and vitamin A deficiencies, and PEM are, in part, mediated through decreased cellular immune function. Infections, particularly respiratory and diarrheal disease, impair growth and cognitive development (Neumann et al., 1992). Iron deficiency impairs cognitive development: decreased physical activity and exploration, important precursors of learning, are also diminished by iron deficiency. Vitamin B_{12} deficiency, found in vegetarian or near-vegetarian diets, is associated with abnormal neurophysiologic development of the infant and young child. Vitamin A deficiency can cause blindness, a major deterrent to learning. Severe zinc deficiency also impairs cognitive development. Thus, micronutrient deficiencies due to poor diet quality affect multiple and interrelated functional areas. Iodine deficiency, a ubiquitous problem, with far-flung problems of retardation and poor growth, is not covered here as its solution lies largely in fortification and may not be supplied by animal products in areas with iodine deficiency in the soil and water.

RELEVANT FINDINGS FOR THE HUMAN NUTRITIONAL COLLABORATIVE RESEARCH SUPPORT PROGRAM (NCRSP)

Many of the findings from the NCRSP will serve to illustrate the role of animal-source food in pregnancy and physical growth, and in cognitive development in infants and children. The NCRSP was a non-intervention observational study conducted in rural areas in Kenya and Mexico and in a semi-rural area in Egypt. Data were collected from late 1983 through 1986 (Calloway et al., 1988). Investigators were from six U.S. universities and three developing country institutions. Dr. Sigman and I were associated with the Kenya project, working collaboratively with Prof. N. Bwibo of the University of Nairobi. Dr. L. Allen was a Principal Investigator for the Mexico NCRSP project, in collaboration with Dr. A. Chavez of the Institute of Nutrition. Dr. G. Harrison, N. Jerome, and A. Kirksey worked collaboratively with the Nutrition Institute in Cairo with Dr. O. Galal. A strength of the NCRSP was its multicountry approach, using the same protocol in each of the three country sites.

The collection of comprehensive quantitative dietary data over one to two years was a major strength of the NCRSP. Two days of measured intake data were collected each month for 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), and women during pregnancy to 6 months post-partum. Frequent measures of anthropometry, morbidity, and cognitive performance were also obtained longitudinally. The goal was to collect at least 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. Findings—primarily for infants, toddlers, and schoolers—will be presented, as well as some examples of pregnancy outcomes. Through the efforts of Dr. S. Murphy and D. Calloway, the development of an extensive food composition table for each country location allowed us to estimate intakes of a wide variety of micronutrients, and thus calculate the probability of deficiency for those nutrients with recommended intake levels (Murphy and Calloway, 1991). Thus it was possible to calculate the predicted prevalence of low intakes of a wide variety of micronutrients, (Murphy 1992; Murphy 1995).

DIETS IN NCRSP STUDY SITES

The diets in each of the three locations were generally low in animal-source products, Kenya being the lowest of all. In Egypt energy intake was adequate and the main staples were wheat bread, rice and legumes, with cheese, milk, eggs and vegetables included. Oil and sugar were subsidized so energy intakes were at or close to RDA's. 40% of kcals came from animal products.

The Kenyan and Mexican diets were somewhat similar, relying on maize, legumes and vegetables as staples, with occasional sorghum and millet eaten by the Kenyans and tortillas by the Mexicans. The diet was very low in fat and animal-source products with 8-12% of kcals from animal products. Phytate and fiber intakes of both the Kenyans and the Mexicans were very high, reducing the absorption of iron and zinc in the diet. Tea and coffee taken with meals further lowered the availability of zinc, iron, and calcium. Low milk intake was a problem for Kenyan children but not for Mexican children, because of the lime-treated tortillas.

Because of recurrent droughts, the nutritional situation in Kenya was the poorest of all, being deficient in energy intake for all age groups followed. The energy intakes of pregnant women, toddlers, and school age-children were particularly low in energy.

The predominance of maize and tortillas in the Mexican and Kenyan diets and the very low intake of animal products pose difficulties, particularly for young children, where 50-60% of energy intakes come from maize, tortillas and beans, and in Kenya, only 7% from milk (2oz/day) and less than 1% from meat (5gm/day). Schoolers ate even less animal products, with over 75% of their energy intake from maize and beans, 1% from milk (1oz/day) and less than 1% from meat (11gm/day) (Calloway, et al., 1990). Dietary bulk is a problem. Dr. Murphy calculated that to meet RDA for energy from maize, a toddler would need to consume 1.7 kg per day and a schooler 2.5 kg per day. By comparison, Dr. Murphy calculated that less than 0.5kg of an animal-source food would provide sufficient energy. In reality, a mixture would be more realistic. Providing more of the usual diet to improve the diet quality would only raise the required volume of micronutrient poor food.

RELATIONSHIPS BETWEEN DIET AND FUNCTION

To examine the relationship between food intake and function, animal-source food intake was expressed as the percent of energy derived from animal products or the actual grams ingested and was used as a diet quality variable. Intake of animal products correlated highly with zinc, B_{12}, iron, and fat in the diet. Poorer households depended much more on staples such as maize and tortillas, and better-off families generally consumed more animal products, milk, fat, fruits, and sugar. Because SES correlated so highly with intake of animal products, SES was controlled for in the analyses of growth and cognitive function. Dietary patterns were constructed from the above information by principal component analyses. Multiple regression analyses controlling for relevant confounders were used in analyses, as single micronutrients co-vary with many other nutrients and household and SES factors.

REPRODUCTIVE OUTCOMES

The overall dietary picture during pregnancy was one of very low energy intake in Kenya, but adequate energy intake in Mexico and Egypt. Yet in all three countries, pregnancy weight gain was from a half to a third of normal pregnancy weight gain. However, micronutrient intakes in all three countries were less than two-thirds of the RDA. In Egypt, intakes of iron, zinc, vitamin A, B_6, riboflavin, and calcium during

pregnancy and/or lactation were less than two-thirds of the RDA. In Kenya, during pregnancy and/or lactation, most women consumed less than two-thirds of the RDA for iron, zinc, vitamin A and B_{12}, riboflavin, niacin, B_6, and calcium. Additionally, a low percent consumed iodized salt; goiter was present in 24% of pregnant women. In Mexico, during pregnancy and lactation, women consumed less than two-thirds of the RDA for iron, zinc, vitamin A and C, vitamin B_{12}, riboflavin, niacin, and vitamin E. Thus, women at all sites are at risk for micronutrient deficiencies. Animal-source foods were extremely low in Mexico and Kenya and somewhat better in Egypt.

BIRTHWEIGHT

In Kenya, dietary quality, in addition to overall energy intake, promoted pregnancy weight gain and birthweight. Those women with lower B_{12} intakes and macrocytic anemia had infants with lower birthweight and experienced more miscarriages. This was also true for those with low iodine intake. A strong predictor of low birth weight, along with body mass index and SES, was low hemoglobin.

In the Egyptian sample, maternal plasma zinc and vitamin B_6 were statistically significant predictors of birth weight. Maternal intake of animal products during pregnancy predicted gestational age as well. None of the above relationships were found in Mexico sample.

GROWTH IN INFANTS AND CHILDREN

Early growth faltering as early as the third month of life, was seen in all three projects much earlier than generally seen in developing countries. Both length and weight were affected, but length to a greater extent, particularly in Kenya. Poor catch-up growth occurred, but by 18 to 30 months, children began to grow at a normal rate, albeit at a lower level.

In Kenyan and Egyptian children, early infectious diseases had a negative impact on growth. Early supplemental feeding did not have a large effect on growth, either positively or negatively. However, Kenyan infants under six months benefited somewhat growth-wise from B_{12} in their supplemental foods, as the breast milk they received was extremely low in vitamin B_{12}. In Kenya, the rate of growth of infants for both weight and length were related to maternal diet quality or to the amount

of animal products in her diet during pregnancy and lactation. Maternal intake of vitamin B_{12} and iodine, and breast milk levels of B_{12} (which were actually measured) predicted infant growth. In the Mexico sample, growth was related to maternal size and fatness. Although breast milk of the Mexican women was low in vitamin B_{12}, there was no effect on growth. Thus growth failure in infants was related to maternal malnutrition during pregnancy and lactation with poor diet quality. It is suspected that low breast milk micronutrient content may be a major issue here.

Toddlers

In examining the growth of children between 18 and 30 months, illness burden, socioeconomic status of the family, parental size and nutritional status affected their growth in all three countries. For the Kenyan children, where total food intake was very low, all other food variables positively predicted growth. However, animal products, in particular, and the intake of available iron and zinc and iodized salt were significant predictors of growth, both for height and weight. In Mexico, diet quality, as in Kenya, was an important predictor for growth.

Food patterns, constructed by using principal component analyses, identified groups of foods in the diet that were associated with positive and negative growth. In Kenya, the group including milk, fat, and sugar was a positive predictor of growth. The families with such a diet enjoyed higher SES, and more animal protein, fat, vitamins A and B_{12} in their diet. The food pattern associated with poor growth and lower SES included more maize, sorghum, beans, leafy vegetables and higher intakes of phytates and fiber (Murphy et al., 1993) than the pattern associated with good growth.

School-Age Children

The diet patterns, as in toddlers, predicted positive and negative growth for children in Kenya and Mexico. In Mexico, the strongest association was noted with higher diet quality with higher animal products intake predicting greater attained weight and height and rate of weight gain. In the Kenyan children, the diet pattern comprised of milk and animal products, and nutrients such as available zinc, total energy and iodized salt predicted attained height and rate of height gain. Thus it is clear that energy or total food intake and animal-source foods are

promoters of growth in children of all ages. As for specific micronutrients, available zinc, calcium, vitamin B_{12} and iodine (in Kenya) appear to be of particular importance.

Morbidity due to common infections, such as acute respiratory and diarrheal diseases and fever, were demonstrated to be deterrents to growth in all children, with illness causing a reduction in food intake and growth, particularly in the Egyptian and Kenyan children. Moreover, micronutrient deficiencies of iron, zinc, vitamin A and protein-energy malnutrition cause a significant decrease in cell-mediated immunity and in granulocyte antibacterial activity, thus making the children more prone to infections.

NEUROBEHAVIORAL, COGNITIVE DEVELOPMENT AND SCHOOL PERFORMANCE

Newborn

Maternal diet and size not only affect birthweight but were found to affect neurobehavioral functions birth of the newborn, as evaluated by the Brazelton Neonatal Assessment Scale (BNAS).

In both Egypt and Mexico,maternal intake of animal products and specific nutrients(vitamin B_{12}, iron and zinc) during pregnancy significantly predicted habituation scores, autonomic stability, motor behavior and consolability of the newborn. In the Mexican sample, the mother's diet quality during pregnancy also predicted habituation, with vitamin B_{12} and iron playing a role. Habituation is a behavioral process reflecting the ability of the infant to respond to then inhibit response to a discreet stimulus or to shut out a disturbing stimuli. These early measures have been shown to have moderate predictive reliability for later cognitive functioning. Thus,maternal size and diet quality affect the neurobehavioral performance of newborn infants.

Infancy

As seen above for the newborn, maternal size and diet quality appear to affect infant development in the first six months of life. However, infants with poor growth, particularly poor linear growth, which is probably mediated through poor maternal diet and deficiencies during pregnancy and lactation, also affect the infants' development.

It was found in all three countries that the smaller the infants the less they smiled in response to social stimuli at three and six months. Less drowsiness was seen in the infants of mothers who consumed more animal-source products. Furthermore, there were positive relationships between iron and between vitamin B_{12} status in the Mexican mothers and scores on their infants' Bayley Motor and Mental Tests at three and six months. In both Mexican and Egyptian infants, infant motor performance related positively to maternal diet quality. The best predictors of mental and motor performance in six-month-old Mexican infants, were not only birthweight, but the mother's diet quality during pregnancy and lactation. Although not statically significant, B_{12} in the Kenyan mothers' breast milk predicted the six month scores on the Bayley Motor Test, when controlling for birthweight and gestational age of the infant. Lastly, Egyptian women who were anemic spent significantly less time caring for their infants.

Toddlers (18-30 months)

Children on poor quality diets and were stunted and performed less well on cognitive tests in all three countries. Even when controlling for parental and SES factors and diet quality and quantity, stunting predicted poor cognitive performance. It appears that poor diet quality may account for poor linear growth as well as for diminished cognitive performance.

Allen (1994) points out that in the Mexican children, previous poor diet quality and stunting may be more important then the effects of current diet on cognitive function. An impressive finding in the Kenyan children was that intake of animal-source products between 18-30 months was significantly and positively associated with cognitive performance on the Bayley Test at five years, on a followup testing of the toddlers. The best set of predictors of cognitive function at age five years was previous intake of animal-source products, even when controlling for household and SES factors.

In regard to physical activity, in both the Egyptian and Kenyan children, those who were fed more animal products verbalized and used more symbolic play. Symbolic play is felt to be predictive of future cognitive performance. Strikingly, Mexican children on poor quality diets, displayed apathy and passivity and often did nothing at all.

Thus, it is seen that diet quality attributed to intake of animal-source

products, and probable resultant stunting, with or without deficits in energy intake, contributes to diminished play, activity and interaction with the environment and poor cognitive performance. Earlier diet quality appears to be an important mediator of current function. The reversibility of these deficits is not known, although nutrition intervention and mental stimulation can help to ameliorate the deficits, at least in part.

School -Age Children

As in the toddlers, the taller and heavier children performed the best on cognitive tests, particularly the verbal and performance tests. In Kenya, where both diet quantity and quality were low, all dietary variables and anthropometric indicators were positively associated with cognitive test scores and school performance.

Among the Kenyan children, intake of animal-source products was positively associated with attentiveness to classroom work and to the teacher, and to test scores of school performance. Also, schoolers with greater intake of energy, animal foods and fat in their diet were more active and showed more leadership behavior. Additionally, low or no intake of iodized salt and low thyroid hormone levels (T3) adversely affected school performance scores and a number of performance and verbal cognitive rests.

Among the Mexican children, it was noted that boys on poor quality diets were apathetic in the classroom. As for the Egyptian children, animal-source products, and particularly specific nutrients such as iron, zinc, vitamins A and B_{12}, all derived from meat and cheese, predicted developmental outcomes, behavior, verbal ability and involvement in classroom activities. These remained significant even when controlling for SES. Additionally, social and cultural expectations about behavior were also important factors in behavior.

SUMMARY

The NCRSP studies in three diverse areas of the world, as well as other studies, have amply documented that animal-source products, with their constituent micronutrients of iron, zinc, B_{12}, calcium and high quality protein, all in bioavailable form and a concentrated form of nutrients, contribute positively to anemia prevention, improved pregnancy outcome,

and positive physical growth and development and behaviors supportive of learning and school performance in infants and children. The ability to resist and contain infection via the immune system is also dependent on adequate micronutrient intake.

The Small Ruminants and other Livestock and related CRSPs, have an extremely important role to play in the sustainable and affordable improvement of diet quality of families in less technically developed and poor countries heavily dependent on subsistence agriculture. Improved physical growth, mental development and overall health is a critical and cost-effective investment in the future economic development of a country and improvement in the quality of life (World Development Report, 1993).

Animal-source foods incorporated into the daily diet, even in modest amounts, can supply critically needed micronutrients, in bioavailable forms. There no doubt will be formidable cultural barriers to overcome in some communities, which education and social marketing may be able to only partially overcome. Fortification will have to be resorted to for some micronutrient deficiencies, i.e., iron, iodine and vitamin A. Although this presentation has emphasized micronutrient deficiencies, energy deficits and poor food security are major and pervasive problems.

Well-designed intervention studies, particularly at sites similar to the previous NCRSP sites, using food-based interventions, would serve to better define the true impact of animal-food nutrients on human function and the minimum amounts needed at different ages and physiologic states. How best to convince families to produce and incorporate animal-source foods into the household diet, particularly for children and women of childbearing age, may even be the greatest challenge of all.

The Importance of Grazing for the Seasonal, Freshwater Marsh at Palo Verde National Park, Costa Rica

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INTRODUCTION

Recent efforts in the 80's to preserve two tropical wetland ecosystems on opposite sides of the globe, both internationally renowned for their importance to migrating and resident waterfowl, failed to continue to provide the necessary habitat to waterfowl, even after designation as "protected wildlands of the state," for one simple reason: the forced cessation of cattle grazing of each marsh. In both cases, in a sincere effort to protect a valuable ecosystem, just the opposite effect was achieved, with severe consequences for the birdlife that depended on that resource. One of these marshes is in Keoladeo National Park, south of New Dehli, India (see Ali and Vijayan, 1986, for a review). I describe here what happened at the second of these marshes, Palo Verde in Costa Rica, Central America, where the elimination of grazing gave way to a massive invasion of cattail (*Typha dominguensis*) that eliminated the necessary habitat for waterfowl, with a corresponding drastic decrease in use by such birds.

The Palo Verde marsh is a "back marsh" (Tarbuck and Lutgens, 1987) about 5 km long and 1 km wide, running parallel to the Tempisque River and about 20 km upstream from this river's mouth at the Gulf of Nicoya in the northwestern Guanacaste Province. Strong tidal fluctuations stir up riverbed sediment which is deposited along the bank during dry season high tides. The marsh, isolated from the river by this natural levee, fills to shallow depths of up to 1.25 m with rainwater during the wet season. The marsh commences drying in December, and by April is completely dry.

For decades, the marsh was probably the most important wetland area in Central America for about 60 species of resident and migratory waterbirds. In 1979, during a single count, it was common to observe up to 35,000 black-bellied whistling ducks, 25,000 migratory blue-winged teal and several hundred other species of migrating ducks such as northern shoveler, American widgeon, ring-necked ducks, and lesser scaup during

the dry-season concentration (Sánchez et al., 1985). In addition to these migrating birds, up to 500 muscovy ducks, and several hundreds of wading birds such as wood storks, roseate spoonbills, great blue herons, and up to 3 or 4 pairs of jabiru storks, (only 40 remain in Costa Rica) were observed in this marsh in the dry season. In reality, the marsh was a paradise of bird and plant diversity and numbers, and precisely because of this, the board of directors of the Agrarian Development Institute were motivated, after their expropriation of this cattle ranch, to donate this marsh and surrounding forest to the Costa Rican Wildlife Service in 1977 as the first National Wildlife Refuge in Latin America (4000 ha).

Traditionally, since at least 1923, the marsh and natural levee (1000 ha) were heavily grazed from November (end of wet season) until March or April by anywhere from 10 to 15,000 head of cattle. As the upland areas of this huge ranch dried out and water became scarce, the cattle were brought down to the marsh. This incredibly heavy grazing force (15 cows/ha), after decades left as a result, a very open marsh, with virtually no tall emergent vegetation, albeit a diverse flora of about 60 species. During the wet season, large expanses of deeper water were covered by floating vegetation (Nymphea) only. The undulating marsh floor created shallower islands where low-growing sedges (*Eleocharis mutata*) and small palo verde trees (*Parkinsonia aculeata*) thrived under shorter hydroperiods.

In December, with the onset of strong northeasterly trade winds and the entrance of cattle into the marsh, the floating vegetation was broken up and pushed toward the shallower areas of sedges, thereby creating open water in the deeper pools and channels. As water levels dropped, bands of exposed soil formed between the open water and the shallower sedgebeds. The combination of shallow, open water near exposed soil was the attractant for the varied bird life that descended upon the marsh at that time.

One of the first acts of the new administration (Costa Rican Wildlife Service) of this area was the elimination of cattle from the Refuge in 1980. From that moment on, we observed a rapid transformation of the marsh vegetation in this highly productive ecosystem. The small patches of cattail that existed in 1980 were able to capitalize and fill in the void until what was once an extension of only about 40-50 ha, had grown to cover 95% of the 500 ha marsh by 1988. By expanding first into the deeper channels, and then into the shallower sedgebeds, the very important

interface of "shallow, open water-exposed soil-sedgebeds" was not allowed to form during the dry season; thus the dramatic decrease in water bird usage during the decade of the 80's, during the dry season concentration. In February of 1988 we counted a peak of only 3000 black-bellied whistling ducks and 500 blue-winged teal and almost no wading birds arrived at all to the marsh. To make matters worse, the lack of grazing in upland areas created dangerous levels of a tall, fire-loving, non-native African grass. The resulting forest fires entered the marsh during several dry seasons. The flames from the dried cattail leaves wiped out virtually all palo verde trees (only nesting sites for six pairs of Everglades kites, in 1979) and essentially fertilized new cattail growth upon arrival of the wet season. Almost no other vegetation co-existed in the dense cattail stands that resulted, and much dry forest was also lost in the process. In fact, forest fires were never a problem in the area during its ranch days.

In other words, the ecosystem's biodiversity was maintained by severe overgrazing, a rather odd consequence. Upon removal of the grazing effect, the biodiversity of Central America's most important marsh (about 60 aquatic plant species (Hernández, 1991) and 60 aquatic bird species) was severely reduced to almost 100% homogeneous cattail stands, the largest cattail marsh in the region, in addition to leading to the destruction of the tropical dry forest. Many have asked what the marsh was like before grazing was introduced. Unfortunately we don't know. It is very possible that this highly dynamic ecosystem was not as good a site for waterfowl then. It is very possible that grazing created a somewhat artificial system, but very desirable to waterfowl. Some have suggested that the disturbance caused by grazing allowed the cattail to come in. This may be so, but the presence of the cattle kept the cattail in check. This same balance can be observed in two similar marshes on the other side of the Tempisque River where a small patch of cattail in each is not allowed to expand, supposedly because of the presence of grazing in these marshes to date.

RECENT RESEARCH AND MANAGEMENT EFFORTS

In 1987 we initiated research into the restoration of this marsh to conditions similar to those of 1979. We found that underwater mowing could eliminate cattail stands. Moreover, cuts at soil level in shallow water (15 cm) during early wet season promoted the natural re-establishment of the original floating vegetation, and cuts made in deeper

water (80 cm) produced little vegetation and mostly open water. As water levels dropped after opening up 30 ha with this method, bird response was nothing short of incredible. For the first time in a decade, that all-important interface of "open, shallow water-exposed soil-low sedges" formed along the margins in the deeply cut area. Black-bellied whistling ducks peaked at 17,000 and blue-winged teal at 4,000 (1990). Whistling ducks utilized the floating vegetation also as did many large wading birds such as white and glossy ibis, and one pair of nesting jabiru storks fed exclusively in this habitat. Wood storks and roseate spoonbills also utilized the open water area for feeding. Most of the original 60 species of plants came back on their own in treated areas. In 1991 a new method of cattail control consisted of crushing the stems in water with a farm tractor fitted with rear, iron paddle- or cage-wheels and complete kills were easily obtained. Whistling duck numbers in 1991 were close to 20,000, but blue-winged teal increased even more to 13,000 (McCoy and Rodríguez, 1994). More recently, during crushing activity in February 1995, whistling duck numbers peaked at 24,000 in the Palo Verde marsh.

Cattail control is solved with these methods, but we have experienced an increase of a tall water grass (*Paspalidium*) in the mid-depth and shallow water areas after we eliminate cattail. This grass can become a problem if it masks the "shallow water-exposed soil-sedgebed" interface and can reduce conditions for waterfowl. Preliminary tests with 30 head of cattle in 30 ha has shown potential to control this grass and at the same time provide forage for grazing. The Ramsar Bureau helped finance the fencing of two 25 ha experimental plots in 1994 to test the effect of different grazing intensities on marsh vegetation and waterfowl. Preliminary results have shown the importance of grazing during late dry season and early wet season. Grazing at these times keeps this grass short, allowing for its rapid submergence by rising water levels and the establishment of favorable floating aquatic vegetation preferred by water birds. The traditional grazing of this marsh is what kept this grass under control. This same species of grass has caused the problem mentioned above at Keoladeo National Park, India.

A grazing test at Palo Verde with six horses (about 1 per hectare) during the early wet season 1995 (June-July) gave significant control over grass biomass and increased biodiversity of marsh vegetation, measured at the end of the growing season months later in February 1996. Grass biomass (wet) of *Paspalidium* was only 0.30 kg/0.25 m^2

compared to 2.16 kg/0.25m^2 (F=21.3; d.f.= 1,3; P<0.02) in an adjacent exclosure (not grazed). A mean biodiversity index (Shannon-Weiner) was greater with grazing (0.63) than without (0.23) (F=30.3; d.f.=1,72; P<0.00009). Also, the mean number of plant species was greater with grazing (2.9) than without (1.6) (F=38.7; d.f.=1,72; P<0.00009).

MAJOR PROBLEMS ENCOUNTERED

First, many interested visitors, biologists, administrators or natural resource decision-makers have expressed reservations on the importance of grazing in the Palo Verde marsh, especially since 1991 when the national wildlife refuge became, for purely personal and political reasons, a national park. Unfortunately, none of these persons observed the marsh in its heydey in the late 1970's, before cattle were removed. I have spent much effort trying to document, with photographs and in writing, the recent history of the marsh. The grazing trial area with its exclosures was also placed in a very visible and accessible area in an effort to inform the doubters. However, many claim that other factors, besides the lack of grazing, led to the major cattail invasion experienced in the marsh. Unfortunately, most of these people were not around in the first few years after the cattle were removed (1980-85) and did not observe the immediate explosive response of cattail, due to the removal of grazing pressure. The cattail response was so immediate, after cattle removal, that I am totally convinced that other factors such as climate change, desertification, less frequent floodings, sedimentation, colmatation, etc. did not have enough time to have a major impact on this vegetative change.

Others have expressed a concern that cattle excrement will eutrofy the marsh. I have only this to say. If this was a major problem, the marsh would have been destroyed over a century ago. And this, in fact, is the strongest argument available in favor of grazing in this marsh. If cattle are detrimental to this ecosystem, it would never have evolved into the most important habitat for waterfowl in Central America by the late 1970's. It would have been destroyed long ago.

The major problem with those who doubt the importance of grazing is a lack of understanding of this **tropical** ecosystem. They have preconceived ideas, based on experiences in temporate regions of the globe, that marshes are stable entities that if left alone will maintain themselves. But they have failed to realize how much solar radiation falls on a tropical marsh. And if that marsh is freshwater and seasonal,

then most of the nutrients are in the soil. And when you mix all three: soil nutrients, shallow water and incredible amounts of solar radiation, what you get is the most productive ecosystem on the planet. And if this huge amount of vegetative biomass is not removed by grazers, then the marsh ultimately will fill up with that vegetation. Most water birds avoid such areas.

A second major problem encountered has been a lack of funding available for research and management. We have had to proceed with very limited funding, and at times invest personal funds. One current problem is the fact that grazing fees charged to ranchers by the park must go to a central fund and are usually not available for use within this park. Thus, all activities are based on how lucky we are each year with piecemeal proposals sent out to various potential funding sources. This is very time-consuming and not always successful, especially if the administrators of the funding sources fall into the above category of "doubters." This happened in 1991 when AID asked for proposals for Biodiversity Pilot Projects. I spent one month writing this proposal, and even included 40 slides documenting the marsh history and recent work. However, the environmental administrator in charge of reviewing the proposals rejected it on the basis that *cattle should not be present in a "national park."* In a meeting with this person I tried for over an hour to explain how cattle can increase biodiversity, but to no avail!

Two years ago a group of 20 families in a nearby town to the marsh expressed to me an interest in starting a cattle project cooperatively and asked for my assistance. I tried to get start-up funding through the Interamerican Foundation, who were very positive initially, and after one year approved the project, but never came through with the funding. This left the community somewhat disillusioned. The fact is that very little of the whole marsh is actually grazed, and there is a great potential to carry out community projects with cattle, but funding is limited and bank loan interest rates in Costa Rica (40%) are unaffordable. This is basically due to the international economic policy of the International Monetary Fund which, in effect, forces the Costa Rican government to continually devalue its national currency, which in turn fuels inflation (20%) and interest rates.

A third major problem has been a lack of researchers interested in dealing with grazing effects on the marsh ecosystem. Logistical conditions for researchers in Palo Verde are currently somewhat rustic,

but may improve shortly with the improvements planned for the Organization of Tropical Studies research station with a recent National Science Foundation grant. Also no research has been carried out on the effect of marsh grazing on cattle condition and productivity. This field is wide open.

A fourth problem has been with a local cattle rancher who currently contracts with the park. Although he has expressed a willingness to help cooperatively with the grazing trials we are trying to conduct, he doesn't always carry out prior agreements on when to put cattle into the marsh and when to take them out. He uses a calving operation and most of his cows are well adapted to marshy conditions. However, he usually takes the cattle out of the marsh sooner than I would like during the initiation of the wet season, and puts them in too late at the beginning of the dry season. Thus the only solution may be to obtain a study herd that we can manipulate the way we would like. I have noted that it is very important to have cows grazing in the water during the first months of the wet season. But this rancher doesn't like to do it, even though his cattle are not damaged by this.

One local rancher has a herd of 20 water buffalo and would like to do a test in the marsh with them. This may be one solution, since these animals do well in continuosly wet conditions. Some other local inhabitants have expressed an interest in water buffaloes. As mentioned before, there is a tremendous potential for development of projects of this type, if we can obtain initial funding to get started.

CONCLUSION

It is essential, as we open this marsh up with mechanical methods, that permanent cattle grazing, at least in the dry season, should be maintained. The new Management Plan for the park proposes such a necessity. This provides various benefits, some unexpected. In addition to maintaining a preferred habitat for waterfowl, an economic gain can be made by the administrators of the wildland area through modest grazing fees, and more importantly, an economic gain can be made by neighboring, small-scale ranchers. Such a benefit is important from the standpoint of a better identification of the park with the local inhabitants, who in the end will determine the destiny of this wildland area. Effort is under way to organize these ranchers not only to graze the marsh in dry

season, but also to graze the upland pasture areas during the wet season, to protect the dry forest, and thus return to the traditional grazing system that produced one of the most remarkable habitats in Central America.

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Livestock Development in the Latin America Region: Main Constraints

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ABSTRACT

The role of the livestock sub-sector within national economies of highly industrialized countries, and of the effect of high consumption of livestock products by a large number of consumers, have both received strong criticism in the last decades poor feed conversion rates, diversion of the use of grain as human food to improve livestock performance by using it as animal feed, contribution to pollution and to human health risks, are along the reproaches leveled against livestock. Unfortunately a good number of these criticism are true, but what always fails to be highlighted is the fact that they are specifically valid for intensive specialized livestock enterprises and diet patterns which are prevalent in highly industrialized countries.

However, many alternative livestock production systems now in use - and which can be further developed and improved - and normal diets or communities in developing countries indicate no harmful effects from livestock production activities and consumption of animal products. On the contrary, in these alternative production systems livestock provide the needed nutrients to family diets and play an essential complementary role to other farming activities while also booting overall sustainability of profitable farming. Inadequate formulation or project proposals have in the past favored direct replication of intensive livestock system, although socio-economic sorrowing was incompatible with such systems. The implementation strategies chosen by these projects also favored, very often, a very narrow technical overview of the livestock sub-sector. This overview has put the focus on specialized and isolated livestock units, and have not paid attention to important linkages among components of the livestock food chain. Thus, this lack of coordination among participants and of integrated management practices at farm level, reduce possibilities of attaining development goals that aim at well balanced and sustainable results.

Past development programs have stressed their aim at attaining economic growth, mainly through large investment projects financed by

international loans. In most cases the implicit assumption of such project proposals is that the lack of capital and financing mechanisms are the main constraint to development. Livestock investment projects advocated the adoption of intensive, highly specialized production system, and have also shown strong bias favoring export markets as their outlets. These projects have now been discontinued due to their very poor results and lack of effective contribution to development.

However, there is urgent need, now more than ever, for field programs that should provide international technical assistance to identify and assess development opportunities, and to elaborate efficient implementation strategies, before launching large investment projects if such initiatives are confirmed as having a high development priority. During the pre-investment phase international technical assistance should explore rational, accessible and affordable interventions to improve operations all along the livestock chain. Local validation of promising technologies, and their incorporation into well integrated management of commercial units, are the main output from these projects.

Traditional production systems and resource management can be changed to increase output but, only if efficiency levels (especially energy input/output ratios), distribution of benefits among community members, and a gradual devolution of decision-making power to local groups, will patters of balanced and durable development be established. In a summary listing of main constraints to livestock development in Latin America and the Caribbean, it must be highlighted that "technical problems" are but one of the main hurdles opposing progress, and that possible socio-economic and political problems represent a far larger and more difficult problem to be solved. Nevertheless technical solutions, to be effective, must always take into account the changing environment set by socio-economic and political factors.

The goal of technical assistance projects is to participate with local efforts in the adoption on an integrated approach to development that can satisfy, both technical issues linked to productivity and sustainability, while at the same time addressing issues related to socio-economic and political considerations closely associated with problems of equity and empowerment.

INTRODUCTION

Food security has been a central problem for human groups since the beginning of time. However, now that mankind counts so many incredible science and technology breakthroughs amongst its assets, this threat should no longer be present in any part of the world. Moreover, it is surprising that even the worst famines of the present century were not caused by a lack of food on either a regional or a world scale. The principal cause was a very acute food distribution problem and the lack of adequate prevention measures. But, unfortunately, hunger is still very widespread. In fact, the number of hungry people has not only never diminished, it is still growing; it is estimated that by 2010, perhaps over 700 million people will be counted among the undernourished groups (FAO, 1995).

In these last decades, the international community has established and strengthened special programmes that deal with emergencies, such as those brought about by natural disasters and which cause famine. These international agencies have also established development programmes that should prevent the occurrence of human-caused socio-economic problems and environmental degradation, or which should reduce the negative impact of elements that are beyond human control. Among these development programmes, there are numerous initiatives to encourage applied research and development efforts in Third World nations which, through strengthening of local institutions, could contribute to the improvements in the levels of food security and quality of life in these countries.

The present paper aims to contribute to the efforts to identify crucial constraints that slow down efforts to design and develop more efficient and sustainable livestock production systems for a multitude of different conditions found in Latin America. Adequate identification of constraints should assist in better use of resources made available for research in the region and improve chances of acceptance and adoption of better farming strategies by the agricultural community in Latin America.

PREDOMINANT VISION OF LIVESTOCK ACTIVITIES

In highly developed countries, animal production units and industries dealing with the manufacture of animal products have received very

biased and unfair press reporting in the last three to four decades. Nevertheless, in spite of very strong and powerful vested interests behind it, the world livestock industry has not yet succeeded in putting the record straight. However, important technical documents have skillfully argued, with irrefutable data, the essential role of livestock in developing better and more sustainable farming systems to meet conditions of different environments (Sansoucy, 1995).

NARROW OVERVIEW OF THE SUB-SECTOR

Most people visualise livestock activities as focusing on management and the exploitation of the productive potential of one type of farm animal, and often of just one very specific breed or a commercial hybrid. Under certain conditions, animal management is even seen as split into categories specialising in distinct outputs such as reproduction, rearing, finishing or training, and keeping animals to perform special skills.

The stratification described above, alongside with poor linkages with processors and traders within the "livestock product consumer chain," can obstruct not only the vision of a well structured economic sub-sector, but it can hamper its efficient performance as a sub-sector if these elements are not properly coordinated and do not enjoy a minimum of empathy.

Present educational curricula and academic diplomas also contribute to the dismembering of the livestock sub-sector, through the well-accepted and ubiquitous tendency of the sector's ever increasing professional specialisation. This frequently leads to communication difficulties between agricultural scientists and the farming and rural communities.

There is an urgent need to improve the internal cohesion of the livestock sub-sector. A more balanced overview of this sub-sector can be achieved by enhancing the much needed complementarity between highly qualified academic staff and hard working producers and processors. Research centres are needed to provide in-depth professional analysis of component parts of the many production and processing activities, and to develop worthwhile hypotheses for further testing. Promising new technologies should then be validated on-farm, and through long-term efforts; this should lead to the development of better integrated and more efficient commercial farming systems which are appropriate to each specific condition as well as affordable.

SINGLE TRACK PRODUCTION MODELS

Agricultural development is associated at present with major changes which were adopted by communities formerly adhering to traditional farming practices. Output from traditional production systems was, in general, low to moderate. But these systems were, and still are, very robust, accessible and reliable systems; in addition, they showed a high degree of autonomy in the supply of essential production factors. However, farming as practised nowadays in highly industrialised countries has become, in most of its activities, a farm-based assembly unit that is highly dependent on industrialised inputs, equipment and off-farm services. These production models are endowed with very high output ability, as long as they receive appropriate high inputs to keep up the production cycle.

Modern farming in highly industrialised countries is usually represented as a symbol of food production efficiency. High input production models can be operated on a very large scale and their total output is often limited only by the supply of capital. Powerful, fast and very costly machines—which exist in a very wide range to perform all key agricultural operations—are essential tools for large-scale operations. The chemical industry supplies fertiliser, pesticides, medicines, conditioners, packaging material, fuel and lubricants. All these industrial elements are directly responsible for the high agricultural output from modern farming: these models can show record yields per hectare and record yields per man/hour/year at work, but at a high cost in energy.

When farm accounting is based on the quantity of energy required to operate the system, it becomes evident that the high input/high output model is in fact a very inefficient system. Worse yet, practically all energy inputs it requires come directly from resources of non-renewable nature or are derived from energy stored in fossil fuel deposits. Therefore, even though this type of farming can increase yields by factors ranging from 2 to 5, when compared to those of traditional farming, the total amount of energy required to produce a standard unit of product is very much greater that the total amount used in traditional systems.

Pimentel and Burgess (1980) reported results on a study of maize production under a number of commercial conditions (30) of modern agricultural production in the USA. Total energy output in maize compared to total energy inputs gave an approximate mean ratio of 3

(range: 0.7 to 4.5), for physical maize yields ranging from 2.7 to 8 tonnes/ha, with an approximate average of 5 tonnes/ha. By comparison, slash-and-burn maize production, manually cultivated in Mexico, attained a yield of 2 tonnes/ha and the output/input total energy ratio was almost 130.

Data from this example were adapted and used to highlight the "fossil energy component" contained in the total amount of energy used by three maize production systems (Chirgwin, 1995). Slash-and-burn operations required an equivalent of 2.3 litres of fuel oil to produce 1 tonne of maize, while a production system using manual plus animal power and 60N/20P fertiliser input required an equivalent 37.6 litres. Fully mechanised systems making use of all necessary industrialised inputs needed an equivalent of 153 litres of fuel oil.

Present agricultural development strategies must very carefully weigh all implications brought in by a chosen production model. Traditional farming systems can be criticised for their general low output level and the frequent tendency, when managed by resource-poor farmers, to an over-exploitation of resources which often lead to significant degradation of the local environment. Likewise high input/high output farming is viable only where economic conditions allow price structures that can pay for the high energy input, which is the essential element to implement this type of technological option. In addition, many of these systems are directly blamed for increasing environmental degradation in soils and of pollution of water resources and air. Another aggravating factor is their poor contribution in attempts to tackle national unemployment problems and to reduce squalor in large, sprawling rural areas by not encouraging the creation of attractive job opportunities in rural places.

Alternative options for better farming prospects come from systems based on an integrated approach in commercial agriculture; these optimise the use of local resources and community skills, and make maximum use of the synergy arising from complementarities among crop/animal/trees/fish on-farm operations. Recycling of on-farm products and the use of cottage industries are very important features of this type of integrated farm management. Such operations strongly encourage organic farming practices and promote artisanal work to increase employment opportunities and improve mechanisms for increased value-added in processing farm products. These models are very promising on account of their better over-all farm output, moderate but sustained yields, strategic

use of industrialised inputs to optimise the output/input fossil energy ratio and to provide stable and well-remunerated farm employment.

National development plans must address the needs of the many different participants in the livestock sub-sector "product chain." All types of participants must be taken into account. Traditional farmers should be helped to improve basic management of farm resources and assisted in accessing modern markets with adequately processed traditional livestock products. High input/high output systems must aim at better efficiency levels in terms of energy ratios, thus reducing excessive waste of non-renewable resources and reducing pollution risks. Integrated and organic farming systems should improve production and processing technologies, and establish creative marketing systems.

EQUITABLE DEVELOPMENT ON A GLOBAL SCALE

Many of the problems analysed in the preceding paragraphs should become clearer if we consider the question: What is meant by ***development?***

As with the very partial and incomplete generalised overview that most people have of what constitutes "livestock," so it happens with development. Most people are contented to deal with a restricted view of development, focusing only on the economic aspects of development. National economic indicators are calculated on a routine basis and extensively quoted. Unfortunately, these indicators are only just a very rough guide to what is expected to be the average situation for a certain indicator in a certain population. On the other hand, indicators on how crucial economic factors are distributed within the population are difficult to find. Under such conditions, the trend of average economic indicators for a country often make an implicit abstraction concerning beneficiaries; they imply that a fair distribution occurs as a general rule among all potential groups.

Standard terminology, officially accepted in international circles, simplifies the description of such complex phenomena conveniently referred to as "development" by a series of values calculated for different countries. The United Nations has developed a special methodology to represent a much wider view of "development"; the "human development index (HDI)" includes economic aspects but goes beyond this and also

takes into account life expectancy, education, health, etc. In this global overview of development, as proposed by the United Nations, four concepts are essential components in the "development equation." These are: ***productivity, equity, sustainability and empowerment*** (UNDP, 1995).

Livestock development efforts must be fully integrated into national plans that encompass all productive sectors of the country. Only under such an approach can livestock producers, and communities making use of livestock, get full recognition for their contributions to the country and obtain valuable feedback and support from other partners (processors, traders, consumers).

MAIN CONSTRAINTS AFFECTING LIVESTOCK DEVELOPMENT

In the preceding chapters comments were developed in some detail, on the broader issues that could be considered as the global constraints to development efforts. These issues made reference to aspects linked with our concepts on **what constitutes development** and our ideas on **how to introduce changes and achieve results** that are **perceived as an improvement by groups targeted as beneficiaries**. Although this should apply to any discipline or subject matter, efforts were made to present this from a livestock development perspective.

A word must be added here to underline that, at present, the international community is withdrawing its traditional financial support to development plans, and this is happening almost on a worldwide scale. This is perhaps the greatest constraint in setting in motion a balanced development programme that addresses the issues of productivity, equity, sustainability and empowerment.

A strict scientific analysis of specific problems encountered in animal production systems would probably call for an extensive bibliographical search and review of published material on the numerous **systems** that have been described and analysed in the Latin American region. This type of assignment could not be undertaken.

In would seem, however, that in many developing countries considerable technical skills have been invested, such as the preparation of detailed descriptive materials of numerous systems. These efforts have been justified, on the other hand, by high expectations in using such well

documented systems in **modeling** schemes; these schemes, using specific assumptions and simulation procedures, could produce expected **projections** in certain key parameters. Up to now there has been little evidence from these countries of any practical contributions made by this new planning tool, in terms of assisting in the development of more efficient production systems. This approach, if dissociated from actual field work in permanent collaboration with producers operating the system, has no hope of making worthwhile practical contributions to improve the performance of the system.

The presentation of major specific constraints to livestock development has focused on three important livestock enterprises:

- smallholder subsistence farmer, by far the most numerous group
- large specialised farms, with grazing as a major production factor; usually this group is responsible for the largest portion of national production sold in the market
- industrialised agriculture, represented mainly by intensive units usually found in urban or peri-urban sites

Constraints are grouped into three categories which comprise:

- technical aspects
- socioeconomic aspects
- political aspects

A summary of the main constraints for livestock development, in the proposed matrix described above, and as perceived by the author, are presented in Table 1.

SMALL SUBSISTENCE ENTERPRISE

The major technical constraints refer to present difficulties of producers to adequately and consistently implement basic husbandry measures (mainly feeding, reproduction, health), and the lack of appropriate technologies which are accessible to them. Narrow choice of animal species: cattle are highly favoured, and use of horses and donkeys is diminishing. Grazing is often uncontrolled.

Table 1: Main Specific Constraints for Livestock Development

CONSTRAINTS	SMALL ENTERPRISE	LARGE SPECIALISED ENTERPRISE (Grazing Emphasis)	INDUSTRIALISED AGRICULTURE
Technical Aspects	Resource management Sub & Over Exploit.	Low productivity Per Ha or animal	Imported system
	Poor inputs: - Feed - Health - Reprod. & rearing - Animal handling	High Specialisation: - Lost complementarity - Idle resources - Shrinks diversity in rural artisan skills	Foreign Elements: - Basic prod. inputs - Technical assistance - Capital/credit
	Lack technical assistance	Lack efficiency selection for commercial traits: - Within herd - Regional population	Urban/Peri-urban sites - Pollution
	Narrow choice of species Uncontrolled grazing	Reproduction/rearing: - Management conscious - Economic vulnerable	
Socio-Economic Aspects	Access to Credit Ownership titles	Large assets: Overestimate of self-power	Select Markets: - Mainly urban - High purchase power
	Poor marketing options: - Input supply + sale - Surplus production	Inflexibility to change: - Very individualistic	Basically instable: - Competition from imported product
	Poor training opportunities	Group marketing often overlooked	
	Poor competitive level in modern markets	Poor technological handling of products	
	Strong traditional values can block better husbandry: Livestock as Safety Fund	Poor job offer Few stable posts Poor diversification	
Political Aspects	Low priority given in Government Plans	Strong links with Government Apparatus: - Equity problems	Production model favoured by urban economists & government managers: - Immediate & large support of product for city dwellers
	Poor prospects with diminished State Service		Production Model: - Subsidised through foreign for loans - Endorsed by local financial groups
	Lack of organised group lobbying: - Producers - Processors - Traders		

SOURCE: Adapted from Fernández-Baca (1996) and Cardellino (1996).

Socioeconomic difficulties relate to the precarious legal situation that restricts access to credit facilities. Livestock still represents the only physically tangible **safe fund** to people without access to monetary savings systems, social welfare and pension plans. This group also confronts serious organisational problems, such as their inadequate integration into the mainstream modern economic culture and its mechanisms, which could help them in gaining access to "quality sensitive markets."

The lack of effective organisation of these producers reduces their potential political representation; and having no lobbying possibilities, their political bargaining power in society is minimal.

LARGE SPECIALISED ENTERPRISES

Their major technical weakness resides in the fact that large estates can achieve large outputs merely on account of their size. Managers are contented with low productivity levels following a strategy of low input/ low output per unit. These units favour specialisation in one single output and overlook complementarity dividends that could be obtained by a more diversified output, because this would also require some greater diversification in the use of inputs which they prefer to avoid.

The large size of these farming units represent a formidable concentration of productive resources and, as such, can have destabilising effects on the welfare of communities in their vicinity. Traditional operations on these estates offer relatively few permanent jobs. A wide variety of rural skills are neglected because people are selected to accomplish specialised tasks, and therefore their additional skills become dysfunctional and are eventually lost.

The large concentration of resources also has a negative political influence through the disproportionate lobbying power vested on a few individuals. This situation is closely associated with the presence and persistence of widespread equity problems.

INDUSTRIALISED AGRICULTURE

The major technical problem resides in the fact that this is a foreign-driven technological model where labour and land are the only important local production components. Technical assistance is provided from specialised foreign staff or local staff specially trained abroad. These units, especially when they attain a large size, cause important pollution problems.

Output from these units is aimed at select markets, usually in large urban areas, and their products are mainly accessible to people with high purchasing power. These units are highly sensitive to foreign competition.

A major weakness of these enterprises is the highly volatile nature

of political support. Profit drive is very high and the assembly line-type of production allows owners to consider closing down operations until appropriate economic incentives are reinstated. Strong competition among rival local units often leads to major waste in terms of time, capital and labour security, when this is assessed from a sub-sector point of view.

CONCLUSIONS AND RECOMMENDATIONS

The following comments can be put forward to summarise very briefly what can be highlighted as the main conclusions and recommendations:

First and foremost, strong emphasis must be placed on efforts to establish a broader, more realistic overview of livestock operations at all levels of the sub-sectoral chain. This integrated approach should highlight potential dividends to be gained from better exchange and interaction amongst all productive components of the system to make it more efficient, and by introducing stability and equitable remuneration levels to all partners.

This new focus of the livestock sub-sector must be compatible with and contribute to the broader goals set by the overall development plans established at the national level. These highly justified expectations for a better future should not hide the fact that we are facing enormous financial difficulties to fund proposals in international development programmes. The persistent reluctance of many important traditional donors in maintaining their commitment to international development programmes is a major constraint in the implementation of effective long-term development proposals.

On specific livestock development issues, the following should be underlined:

On technical problems:

- A multipurpose use of livestock within integrated mixed-farming systems.

- A wider range of animal species should contribute to livestock output, most especially from small ruminants, pigs, camelids, and small animals which are largely under-exploited. Introduce animal confinement strategies.

- Technology development to improve such systems and on-farm validation should be encouraged, mainly to develop new animal husbandry measures for feeding, reproduction and health.

- Education curricula and practical training schemes should stress the need for a well balanced professional overview of mixed farming and its interaction within the food chain.

On policy issues:

- Macroeconomic initiatives should be elaborated from factual field data which is reliable, updated and representative of conditions in the livestock sub-sector.

- Local operators in the livestock product chain should be privileged and regular contributors in field monitoring activities.

- Local market demand, both rural and urban, should be the main target to be met.

- Initiatives should be taken to develop mini-credit schemes and to encourage supply contracts between producer and consumer groups.

- There should be integration of rural communities through effective access to benefits and facilities of modern mainstream economic mechanisms: financial savings, social security, pension plans.

On distribution of information and exchange of know-how:

- Training efforts must encourage active community participation to develop self-training.

- Appropriate training materials should be produced to assist communities in this effort.

- Networking groups could provide the necessary linkage to organise periodical meetings for the exchange of experiences.

On improving accessibility of livestock products:

- Producers and processors must be encouraged to use new technologies that increase efficiency and yield and thus contribute to lower production costs.

- Better storing, transport and distribution arrangements should make these products affordable to a broader range of consumers.

- Quality control and product presentation should improve market image of traditional products.

On employment and level of revenue:

- Mixed-farming systems which aim at a well-diversified output should be encouraged; these systems can compensate modest individual yields by good levels of overall production.

- Overall output needs to be better distributed over the year, reducing waste and idle periods.

- Market seasonality is made easier to handle and more stable employment and revenue flow can thus be attained.

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Consideraciones Sobre la Necesidad de Politicas e Instituciones para la Ganaderia

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INTRODUCCIÓN

El propósito de esta presentación es, explorar algunas consideraciones a tener en cuenta al definir una agenda de investigación que genere propuestas de política para la ganadería sustentadas en el reconocimiento de que es fundamental que las propuestas sean viables. La complejidad y amplitud del tema a ser abordado requiere el establecimiento de algunas observaciones.

La primera observación concierne al reconocimiento de que la ganadería en América Latina y el Caribe incluye una amplia gama de especies y sistemas de producción. Entre las especies, para propósitos del análisis, se pueden distinguir los bovinos, usados por su carne y leche; los equinos, usados por su fuerza y multiplicidad de otros usos; las aves, para la producción de carne, huevos y plumas; los cerdos, usados para la producción de carne; las ovejas y camélidos, usados por su carne y lana; y también los conejos y cuyes, usados por su carne. A ellos debe añadirse la consideración de múltiples ecosistemas, desde el trópico a las pampas y a las montañas, los cuales han dado origen a la adaptación de multiplicidad de razas y sistemas de producción.

En segunda instancia es preciso reconocer algunas características particulares de la ganadería, que la diferencian de la agricultura. Es una actividad genuinamente de inversión, que permite crecimiento a través del proceso reproductivo. Ello a su vez implica que no sólo genera flujos de ingreso, sino que permite la formación de un *stock* de capital; lo cual plantea el desafío de sacrificar crecimiento cuando se desea mayores rentas a corto plazo. Otra particularidad es que usa productos de la agricultura, no requiriendo siempre el uso de la tierra agrícola, sino más bien que los productos sean llevados a donde están los animales.

Y la tercera, es que en tiempos recientes algunas especies y en particular los rumiantes han sido vistos con malos ojos. Algunos los ven como destructores de la naturaleza y otros "acusan" a sus carnes como inadecuadas para la salud. Realidad o mito, ambos factores están creando

condiciones indeseables para el desarrollo de la ganadería de rumiantes.

Con estas consideraciones, esta presentación focaliza primero en la pregunta: ¿Por qué se requiere un marco de políticas y por qué tener una agenda de investigación sobre políticas para la ganadería?, lo cual se discute en la próxima sección.

Dado que dedicarse a la ganadería tiene sentido en la medida que genere ingresos, es importante contestar también a la pregunta: ¿Qué se puede vender, dadas las preferencias de los consumidores?, lo cual se trata en la sección 3. Es evidente que el mercado -la posibilidad de vender- es el indicador de lo que se debe producir, pero hay también otros factores que es preciso tomar en cuenta en relación a las preferencias de los productores pecuarios, lo cual se analiza en la sección 4.

Con las observaciones hechas en las secciones previas, se pone de manifiesto que cualquier propuesta de política debe valorar la ganadería como parte de un sistema o cadena agroalimentaria, a través de la cual se dan relaciones técnico-económicas en la producción y procesamiento de productos, así como relaciones contractuales entre todos los actores. Al respecto, las políticas deben valorar las relaciones técnicas, económicas y contractuales a lo largo de las cadenas , lo cual se analiza en la sección 5. Esto es muy importante por cuanto existe el riesgo de que los productores se queden marginados en las etapas iniciales de producción, sin disfrutar de los beneficios que están creando la apertura de mercados y la liberalización comercial.

Las políticas para la ganadería tendrían que valorar los aspectos antes referidos y para ello es fundamental que dichas políticas se den como resultado de un proceso de diálogo entre el sector público y el sector privado. Como se aprecia en la sección 6, ésta es una condición necesaria para que constituyan un aliciente para orientar el proceso de toma de decisiones y estimular la inversión, para que no se conviertan en una barrera al cambio. Se reconoce también que las buenas políticas ganaderas no son suficientes, sino que se requiere de otras que crean el entorno adecuado.

En la sección 7 se ofrecen algunas sugerencias para proceder a definir una agenda de investigación que alimente las decisiones de política. Es oportuno hacer la observación de que en el desarrollo de este tema, se toma en cuenta que las decisiones de política conciernen al Estado en

cada país y que la agenda de investigación se desarrollaría en el marco de la cooperación internacional. En dicho ámbito se complementarán los esfuerzos de las instituciones y organizaciones privadas a nivel nacional (con intereses focalizados) con instituciones a nivel internacional (con interés público) y organizaciones transnacionales (de interés privado).

LA JUSTIFICACIÓN DE UNA AGENDA DE INVESTIGACIÓN SOBRE POLÍTICAS

Si la ganadería no fuera importante no justificaría un marco de políticas para promoverla. Entendemos claramente el concepto de "promover" asociado al de "fomentar", el cual no incluye ni se asocia a la noción de "subsidiar". Por ello, promover la ganadería se justifica en la medida que reconozcamos que es una fuente importante de ingresos para los productores, que genera productos valiosos para los consumidores y que puede practicarse en armonía con la conservación de los recursos naturales.

Las preocupaciones ambientalistas, muchas veces sustentadas en insuficiente conocimiento, se han convertido para algunos en cartelón de combate. Ello aunado a movimientos desincentivadores del consumo de proteína de origen animal y especialmente carnes rojas, está creando fuerzas desalentadoras para la ganadería. Por ello estos movimientos deben ser contrarrestados con planteamientos concretos para producir sin destruir, y así evitar la desaparición del mercado para los productos de la ganadería. Si esto último ocurriese, no tendría mucho sentido pensar en la ganadería como actividad productiva. Los recientes eventos sobre la enfermedad de las vacas locas evidencian lo rápido que se puede destruir un mercado y una base productiva en los tiempos actuales.

Las políticas se justifican en la medida que crean un entorno favorable; inducen actitudes positivas; motivan el desarrollo de otras actividades y servicios conexos; y orientan las decisiones de producción-inversión-venta y manejo de inventarios. Las políticas también pueden jugar un papel importante creando condiciones que estimulan el consumo. Las políticas por lo tanto, se definen como un conjunto de normas, leyes, programas y proyectos que establecen condiciones en las que se desenvuelve la empresa privada y los consumidores y proveen la normativa para la provisión de servicios.

Al definir estas políticas es importante hacer la separación entre

aquellas que son específicas para la ganadería, y las que son de carácter general para la actividad económica, social y ambiental a nivel del país. La tendencia generalizada es que, en el campo económico, desaparezcan las medidas de política que crean condiciones especiales para determinados sectores productivos o de comercio. En el campo social, la tendencia, presionada por la necesidad y la evidencia de algunas limitaciones del mercado, es hacia el establecimiento de programas especiales para atender la pobreza y afrontar los innumerables problemas sociales. En el ámbito ambiental, afortunadamente se está pasando de la retórica de un conservacionismo a ultranza, a la internalización de las consideraciones ambientales en las decisiones de la empresa a fin de que ésta sea sostenible.

Con estas consideraciones, las políticas para la ganadería deben ser focalizadas, para no inmiscuirse en los temas que son de política general. Este es el desafío que confrontan los países; por ello una agenda de investigación que alimente estas decisiones de políticas para la ganadería debe ser cuidadosamente elaborada, a fin de que las propuestas tengan la máxima posibilidad de ser puestas en práctica.

Es evidente que los límites del conocimiento se amplían cada día más, y que es necesario generar dicho conocimiento en forma permanente. Las medidas de política requieren sustentarse en dicho conocimiento. En tal sentido, el desafío más grande es el de generar información valiosa y el de persuadir a quienes gobiernan, de que ellos no lo saben todo y que deben escuchar y analizar opciones de política, para tomar las mejores decisiones. Este es un reto muy grande, especialmente cuando los gobernantes y dirigentes políticos se creen omnipotentes, y demuestran su desdén por la investigación. Debe admitirse sin embargo, que se ha hecho mucha investigación inútil para generar propuestas de política; además hay evidencia de la duplicación de esfuerzos de investigación sin ningún propósito.

La agenda de investigación sobre políticas para la ganadería, por lo tanto debe sustentarse en dos principios básicos. Primero, en generar conocimiento que respalde las propuestas de política, y segundo, que dicho conocimiento ayude en la cada vez más difícil tarea de administrar las políticas. Esto último es particularmente importante si reconocemos que las políticas son un instrumento del Estado y que los ejecutores son en unos casos las instituciones públicas, y en otros las organizaciones del sector privado y de la sociedad civil, todas ellas con serias limitaciones

de carácter institucional.

En relación a los resultados de las investigaciones, es muy importante que ello se traduzca en propuestas de políticas y que digan qué resultados producirán, a qué costo y en cuánto tiempo?. Deben ser explícitas en el cómo llevarlas a la práctica; de modo que no se hagan propuestas sin viabilidad operativa. Al respecto es importante reconocer que muy buenas propuestas de política no son viables, porque no existe la base institucional para ponerlas en práctica. Esto es por lo tanto un tema explícito para la agenda misma.

La referida agenda de investigación podría correr el riesgo de ser demasiado amplia si se refiere a todos los ámbitos de la ganadería, a todas las especies y a todos los temas. Por ello, lo primero que se debe hacer es limitar el ámbito del análisis a lo prioritario y a aquellos campos en los que cada institución tiene competencia. En las próximas secciones se ofrecen algunas consideraciones que se deben valorar para delimitar el campo de la investigación.

ENTENDIENDO LAS EXPECTATIVAS DE LOS CONSUMIDORES

Hasta hace pocos años, el Estado orientaba los procesos productivos a través de una serie de medidas como las fijaciones de precios, el control de importaciones, los subsidios a los insumos, etc. La evolución económico-social es hacia una economía de mercado, en de la cual se trata de satisfacer las preferencias de los consumidores a través de la competencia entre las empresas, para poner en el mercado los productos deseados. Como se verá más adelante en esta sección, muchas de esas preferencias son inducidas. En tal entorno el Estado se limita a ser vigilante y orientador, pero ya no dicta lo que se debe producir, ni mucho menos condiciona lo que se debe consumir.

Considerando las preferencias de los consumidores, debemos reconocer que éstas están dadas por los niveles de ingreso y educación, estratos de edad, etnia y otros factores. Ello implica que los mercados son en general muy segmentados, es decir, con un universo de opciones muy variado. En términos generales, los productos tienden a diferenciarse cada vez más por su calidad, definida ésta por el contenido nutricional, grado de higiene y salubridad, y presencia de residuos tóxicos o no deseables (hormonas, agroquímicos, etc.). Los productos se diferencian

también cada día más por particularidades (sabor, olor, frescura, etc.) que permiten la creación de marcas.

Estas diferencias de calidad están asociadas a un nivel de precios, por ello el concepto amplio de mercado permite poner a disposición de los consumidores muchos productos cuyo costo de producción es diferente. Estos costos reflejan la escasez y calidad de los recursos que se usan para producirlos, así como la complejidad de los procesos, mezclas, presentación y otros aspectos que permiten la diferenciación.

Las influencias en la formación de los mercados están contribuyendo a que la demanda por productos de la ganadería tienda a segmentarse en dos grandes categorías. En la primera se agrupan aquellos que no proveen "amenazas" para la salud, entre ellos las carnes blancas, y en general todos los productos con niveles bajos de grasa y colesterol. En la otra categoría se agrupan las carnes rojas, los derivados lácteos de alto contenido de grasa y colesterol, las menudencias, etc.

Esta segmentación, vista a la ligera, puede ser muy perniciosa para el futuro de la ganadería. Las razones para esta preocupación estriban en que detrás de esta diferenciación de categorías de productos, hay intereses creados, que han aprovechado algunos resultados de investigaciones científicas y médicas para forjar opinión. No se trata de cuestionar la validez de las investigaciones, pero sí de levantar una voz de alerta hacia lo que puede ser el inicio de un proceso de muy caras consecuencias para la ganadería.

Es necesario por lo tanto, difundir los resultados de investigaciones que respaldan la importancia del consumo de proteínas de origen animal y no penalizan el consumo de carnes rojas, por ejemplo. Es oportuno también reconocer marcadas diferencias en los niveles de ingreso y en las necesidades de proteína animal entre los pueblos del mundo. Lo que para algunos es exceso, para otros es lo más deseable y necesario. Una proporción creciente de la población del mundo vive en severos estados de desnutrición y con ínfimas ingestas de proteína de origen animal y su atención debe constituir alta prioridad.

A estas consideraciones debe aunarse la apreciación de que los animales vivos y sacrificados, generan muchos productos con grandes perspectivas en los mercados. En el primer caso la lana, la leche y huevos seguirán teniendo una demanda creciente a nivel universal. En el segundo

caso, es notoria la capacidad de industrialización de las partes de los animales sacrificados. Esto último plantea seriamente la importancia del valor real de un animal, del cual no solo se va a extraer carne, sino decenas de productos que se logran a través de complejos procesos industriales, de los que no se dispone en los países en desarrollo.

¿QUÉ QUEREMOS LOS PRODUCTORES PECUARIOS?

Quienes estamos en la actividad agropecuaria, anhelamos como en cualquier empresa, lograr un ingreso estable y creciente. Es incuestionable que para ello hay muchas opciones de producción de distintos rubros, la adopción de distintas tecnologías y sistemas, y la participación en diferentes niveles de integración vertical. Resulta claro también que en cada caso se requieren distintas capacidades y recursos financieros.

Además de esta búsqueda del ingreso, el productor agropecuario espera que su actividad satisfaga otras condiciones. Estas otras condiciones tienen variados pesos específicos entre distintos segmentos, y son particularmente importantes en el caso de quienes se dedican a la ganadería.

La minimización de riesgos es, sin lugar a dudas, una de las consideraciones más importantes, y que ante las inestabilidades climáticas, está haciéndose cada día más relevante. Es creciente la inestabilidad de los rendimientos; del uso de plaguicidas e insecticidas para controlar plagas y enfermedades, lo cual repercute en los costos de producción; y también es creciente la inestabilidad de los precios. Por lo tanto, una estrategia de minimización de riesgos es fundamental en los tiempos actuales y futuros.

En el caso de la ganadería, la formación de *stock* animal es una consideración de alta significancia, no sólo por razones económicas, sino por algunas de carácter social. Lo más importante en este caso es reconocer que la venta de vientres (de cualquier especie), para generar más ingreso al corto plazo, significa disminuir las posibilidades de crecimiento.

Las nuevas condiciones de entorno ofrecen oportunidades y exigencias para internalizar a la empresa ganadera las consideraciones de orden ambiental. Ello permitirá que la conservación de los recursos en las fincas, la no contaminación de ríos, la no producción de desechos, la no emisión de olores desagradables, etc., sean tomadas en cuenta por

los productores, con criterios económicos y con la intención explícita de internalizarlas a la estrategia de la empresa, para generar rentas. En esta forma se podrán generar productos limpios y nuevos productos a partir de desechos, y se cumplirá con las exigencias de no ser contaminador, lo cual generará nuevas oportunidades. Esta visión contrasta con aquella focalizada en el ecologismo que ve en la ganadería sólo defectos y monstruos.

La transformación de la economía universal nos plantea también otra exigencia y es la integración vertical. No podemos seguir siendo abastecedores de animales o de leche y lana para que otros actores generen las rentas abundantes que provee la transformación y la comercialización. Es fundamental evolucionar hacia una estrategia en la que "mantenemos un pie en la finca y el otro en el mercado". Crearemos marcas, haremos alianzas y adoptaremos estrategias de *marketing*, para salir de ser solo criadores de animales y pasar a ser empresarios en la producción, la industria y el comercio de productos de la ganadería.

La última, pero no menos importante exigencia que ponemos a nuestra actividad en la ganadería, es que genere satisfacción, es decir, que el trabajo sea llevadero, que las condiciones laborales se den dentro de un marco de armonía y que nos sintamos orgullosos de lo que hacemos. Esta consideración solía ser muy importante en la ganadería dedicada a muchas especies y en todos los ámbitos del planeta, sin embargo, la excesiva preocupación por los aspectos meramente económicos, la ha ido dejando de lado. Es importante recuperar este criterio para poder visualizar una ganadería sostenible, y lograr que más gente se dedique a ella . De no conseguirse ésto, será creciente el numero de personas que abandona la actividad.

De esta breve reflexión resulta claro que las políticas para la ganadería requieren definirse sobre la base de un entendimiento de quiénes son, cómo son y qué quieren los actores que se dedican a la ganadería. Ello será tanto más importante que entender cómo son los animales, su reproducción y su crecimiento.

LA CADENA DEL PRODUCTOR AL CONSUMIDOR

En las dos secciones anteriores, se ha señalado a los productores y a los consumidores como los extremos de una cadena, pero es necesario conocer el conjunto de eslabones entre ellos. A lo largo de la cadena los

productos primarios se van transformando y mezclando hasta llegar a su forma final y ponerse al acceso del consumidor.

A través del proceso se va forjando el valor agregado, pero también se van generando rentas para comerciantes y transportistas y otros oferentes de servicios. Al final, el producto llega al consumidor con determinadas características que satisfacen sus preferencias, y con un valor en el que el producto primario representa la menor parte. Este es el caso generalizado de los animales que se sacrifican para carne fresca y embutidos; de la leche que se transforma en cientos de derivados; de la lana esquilada que se convierte en suéteres de alto valor, etc.

La cadena es también un conjunto de relaciones contractuales entre actores, que en muchos casos traspasan los límites nacionales. Lamentablemente la mayor parte de estas relaciones contractuales, se han dado con más ventajas para unos que para otros, siendo casi siempre los productores los que han llevado la peor parte. Estas relaciones contractuales deben reconstruirse bajo los principios de una alianza estratégica en la que los costos, riesgos y beneficios sean compartidos. Esta es una condición fundamental y sin ella no se podrá lograr la calidad que se requiere en los productos; ni puede esperarse que los que se dedican a la actividad primaria permanezcan en ella como proveedores de insumos baratos para quienes industrializan y comercializan.

Algunos argumentarán que si los insumos no se consiguen baratos en el medio local se pueden adquirir en el mercado internacional, ya que para eso hay apertura comercial. Esto, que para muchos pareciera ser la mejor opción, claramente apoyada por los criterios que privilegian la eficiencia, está en proceso de revisión , dadas las particularidades de la agricultura y la ganadería. De ello dan fe las nuevas políticas para el fomento del sector agropecuario en la Unión Europea y la vuelta del péndulo que comienza a observarse en los organismos internacionales y entre destacados economistas que empiezan a sentir que "economía pura sí, pero pura economía no" para lograr el desarrollo.

Estas observaciones ponen de manifiesto que, la definición de políticas para la ganadería debe tener el propósito explícito de fomentar la relación entre actores. Estas relaciones serán muy beneficiosas para transferir innovaciones tecnológicas, para movilizar recursos financieros y para aprovechar las economías de escala en la comercialización. El fortalecimiento de estas alianzas será también una de las mejores formas

de afrontar la desaparición del Estado protector.

LAS INSTITUCIONES EN LA DEFINICIÓN Y MANEJO DE POLÍTICAS PARA LA GANADERÍA

Como se refirió en la introducción, las políticas son el conjunto de medidas, leyes, normas, programas y proyectos que el Estado establece para orientar las acciones de la empresa privada y de los consumidores. Los ejecutores de las políticas son a veces las instituciones públicas y a veces las organizaciones del sector privado que tienen responsabilidad social (gremios, asociaciones, cámaras, etc.), y en ocasiones la propia empresa privada que establece relaciones de complementariedad con las instituciones públicas. El reconocimiento de estos actores no públicos como posibles ejecutores de las políticas es crucial, en un momento en el que el Estado se retira de muchas acciones que se habían considerado como de su exclusiva competencia.

Como parte del proceso de reforma institucional, les compete a las organizaciones del sector privado la posibilidad de ofrecer servicios que antes ofrecía el Estado, como por ejemplo los servicios veterinarios, la asistencia técnica, los servicios financieros, etc. Sin embargo, el Estado tiene autonomía y potestad para mantener la responsabilidad directa por la ejecución de algunas políticas como la vigilancia cuarentenaria, la certificación de calidad de insumos pecuarios, el control de calidad sanitaria de productos, la normatividad técnica, etc.

Hay también muchas políticas que se pueden llevar a la práctica por la vía de la complementariedad de muchos actores, entre ellos públicos y privados. Tal es el caso de las investigaciones y los procesos de innovación tecnológica, especialmente cuando los resultados de dichos esfuerzos, permiten apropiar los beneficios por parte de la empresa privada.

En el proceso de definir las políticas, es fundamental la participación de los interesados, a fin de que las medidas que se tomen, privilegien el interés colectivo y el bienestar social. Lamentablemente la insuficiente organización de los interesados -productores y consumidores-, ha dado como resultado muchas medidas de política que privilegian grupos de poder. Esto era más notorio aún cuando las medidas de política, especialmente en el ámbito económico, se orientaron a fomentar la oferta

de productos, y por lo tanto se recurría a instrumentos que privilegiaban a quienes mas producían, tenían más tierra, usaban más fertilizantes y adquirían más crédito subsidiado.

Para la definición de políticas para la ganadería, como se había mencionado antes, una tarea importante es la precisión del ámbito de su competencia. Ellas se pueden circunscribir a aquellas medidas que directamente tienen que ver con la productividad de los animales en el sentido más amplio. Ello incluiría lo concerniente a nutrición, sanidad, genética y manejo en general. Sin embargo es preciso reconocer tres aspectos complementarios.

El primero tiene que ver con las políticas que afectan las capacidades y actitudes de quienes se dedican a la ganadería. Esto es muy importante porque al final de cuentas son las personas las que toman las decisiones, las que administran las empresas y las que manejan a los animales. Lamentablemente se ha tenido una visión del cambio demasiado focalizada en los animales, en los recursos tecnológicos y en los recursos naturales y mucho menos en los actores.

El segundo tiene que ver con las políticas que crean condiciones favorables para las decisiones de producción e inversión en general. Ellas son tanto o más importantes que las políticas específicas para la ganadería, ya que sin un entorno adecuado, de nada servirían buenas políticas ganaderas. No es de incumbencia para quienes definen y manejan políticas ganaderas, alterar el manejo económico general, pero tampoco se puede permanecer impasible si no hay condiciones favorables para hacer posible la inversión productiva. Por ello hay que estar preparado para analizar los efectos del entorno económico en la actividad pecuaria y para participar en el debate del cual surgen los cambios de política.

Finalmente, el tercero tiene que ver con las políticas para la orientación y educación del consumidor. En este campo el potencial es muy grande para fomentar el consumo de productos de calidad procedentes de la ganadería. Ello estimularía la demanda y ampliaría el mercado, creando así oportunidades y ejerciendo una presión positiva sobre los precios de los productos.

LA AGENDA DE INVESTIGACIÓN PARA APOYAR LA DEFINICIÓN Y MANEJO DE POLÍTICAS

Toda la discusión previa, ha tenido el propósito de hacer explícitas las complejidades del tema de las políticas para la ganadería. Si ello es complejo, más complejo aún es definir una agenda de investigación para alimentar las decisiones de política. Al respecto se ofrecen algunas sugerencias.

El primer punto a considerar, ya mencionado en la introducción es: ¿Para quién es esta agenda? Al respecto cabe señalar, que la agenda debe ser compartida por un conjunto de organizaciones , las que deben hacer explícitos sus intereses capacidades y recursos. A continuación los participantes en el desarrollo de esta agenda de investigaciones para generar propuestas de política, requieren definir una estrategia de complementariedad de esfuerzos en el ámbito nacional e internacional.

Otro aspecto importante concierne a la desagregación de la agenda, por especies animales y por temas. Se puede reconocer la importancia del enfoque de sistemas, y de los esfuerzos multidisciplinarios, pero también debe reconocerse que no se puede valorar un bosque desde las copas de los árboles. Es preciso internalizarse en los sistemas e identificar factores críticos para el cambio. Existe amplia evidencia de los beneficios del enfoque de los incrementos marginales a través de acciones estratégicas, en lugar de las recomendaciones de paquetes tecnológicos.

Una vez más es preciso insistir en que la agenda de investigación sobre políticas valore en su mejor dimensión las características de los actores, quienes toman las decisiones de innovación y de inversión. Ya se conoce bastante sobre los animales, y necesitamos conocer más sobre quienes manejan a los animales y los factores claves para motivarlos, inducirlos y apoyarlos para hacer mejor las cosas.

Uno de los aspectos mas importantes en la agenda debe ser el papel, funciones y capacidades de las instituciones y organizaciones para su participación efectiva; en el proceso de definición e instrumentación de las políticas. Sin instituciones capaces y comprometidas, las propuestas no tienen viabilidad. Es necesario por lo tanto investigar sobre cómo construir la capacidad que las instituciones requieren forjar.

Finalmente, la tarea más difícil en la definición de una agenda de investigación es la priorización de temas. En un sector tan amplio como

la ganadería, extendido sobre tantos ecosistemas, esta tarea de priorización es crucial. La priorización debe considerar también el efecto marginal como criterio para definir importancia; es decir, a través de qué acción se logra más impacto y qué lo hace más duradero.

La labor de concertación entre las organizaciones internacionales, proyectos y centros de investigación es crucial en la construcción de la agenda de investigación que genere propuestas para la definición y manejo de políticas para la ganadería y que evalúe los resultados que se logran con tales medidas. Su esfuerzo puede focalizar en el apoyo a los países para definir sus agendas nacionales; podría estimular la cooperación horizontal en la conducción de investigaciones y podría identificar los temas en los que hay espacio y necesidad para acciones conjuntas de varios países.

En cuanto a la forma de realizar las investigaciones conducentes a las propuestas de políticas, las organizaciones internacionales podrían ayudar mucho a la construcción de nexos entre la empresa privada a nivel transnacional y las empresas e instituciones nacionales. Pueden también ser de gran apoyo para los países, manteniendo un sistema de información sobre investigaciones, instituciones y personas que están trabajando en estos temas, y poner esa información a disposición de los países.

Una versión previa de este documento fue presentada en la Reunión de Consulta Regional para la agenda del ILRI, en San José, Costa Rica, 16-20 Octubre de 1995.

Desafios de la Investigacion Agropecuaria y la Configuracion de un Nuevo Modelo Institucional de Innovacion Tecnologica

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EL CONTEXTO DE LA INVESTIGACION Y TRANSFERENCIA DE TECNOLOGIA: DESAFIOS Y OPORTUNIDADES

Antecedentes

En la década del 50, existieron instituciones de tecnología diseñadas para modernizar la agricultura, por medio de transferencia de tecnología. Poca o ninguna investigación se gestaba; principalmente se hacía transferencia surgiendo así los servicios de extensión.

En la década del 60, se reconoce la necesidad de mejorar las capacidades de investigación y se crean, en la mayoría de los países, unidades ministeriales relativamente fuertes e INIAs desconcentrados de los MAG o separadas pero adscritas a ellos. INTA 57; ICA 62; EMBRAPA en el 73; INIA, Uruguay en 90; CENTA en 92. Características: trabajo en fitomejoramiento; fuerte rol del Estado, casi monopólico; sector privado suplidor de semillas y agroquímicos, dependiente del apoyo del sector público; salvo en el caso de algunos productos de exportación, la investigación privada era inexistente. Creación de los CIIA del CGIAR. Todas ellas instituciones centralizadas, sistemas de planificación de arriba abajo y orientadas hacia la oferta.

Nuevas Tendencias

Aspectos generales: apertura de las economías; integración (regional o por bloques); democratización, desregulación, estado más reducido; agricultura diversificada; nuevas tecnologías; preocupación por el ambiente; sostenibilidad de los recursos naturales, equidad y combate a la pobreza.

Desafíos y Oportunidades para los Países desde la Perspectiva Tecnológica

1. Adecuar sus sistemas productivos agrícolas y agroindustriales a las exigencias de la competitividad agrícola, derivada de los procesos de apertura y de las transformaciones y tendencias geopolíticas, sociales, científico-tecnológicas y comerciales globales.

2. Desarrollar un nuevo patrón tecnológico orientado a posibilitar el crecimiento de la producción y productividad agropecuarias; la distribución equitativa de los beneficios económicos, sociales y de los conocimientos; a disminuir los impactos negativos sobre el medio ambiente y a garantizar el uso adecuado y a la conservación de los recursos naturales.

3. Crear y fortalecer capacidades de innovación científico-tecnológica para responder a los requerimientos de la competitividad y la sostenibilidad de la agricultura, tanto a nivel interno de los países, como en el contexto internacional.

4. Replantear las políticas tecnológicas, los modelos institucionales y la gestión institucional en los sectores públicos y privados, para hacer posible el aprovechamiento de los avances tecnológicos producidos tanto nacional como internacionalmente.

5. Establecer, considerando los actuales procesos de integración regional y subregional en el hemisferio, los mecanismos y condiciones propicias para la armonización de políticas tecnológicas supranacionales, actividades conjuntas de innovación tecnológica y la búsqueda de un desarrollo agropecuario sostenible en ecosistemas frágiles compartidos por los países.

Desafíos para las Instituciones Tecnológicas

1. Diversidad de la demanda tecnológica

- La agricultura tiene hoy una connotación más ampliada
- Nuevos productos y exigencias de calidad
- Nuevos productores; ya no es sólo el grande y el pequeño
- Nuevos programas nacionales: riego, rehabilitación

- Productores empresariales con tecnologías sofisticadas
- La exigencia de los consumidores por alimentos limpios
- Investigación en productos, disciplinas y recursos naturales

2. Tecnología y equidad

- Hay ambigüedades sobre la tecnología para combatir pobreza
- La no neutralidad de la tecnología en la transferencia productiva
- Los sesgos de la revolución tecnológica verde a no pobres
- Los DRI y el IFS utilizando tecnología para estratos pobres, aunque costosos en su aplicación
- Importante la tecnología para incrementar productividad de los pequeños campesinos
- Enfasis en pobreza urbana; la pobreza rural es aún creciente
- La tecnología se requiere para combatir la pobreza (AC y Car) - Tecnología para romper el círculo vicioso Recursos Naturales-pobreza

3. Tecnología y competitividad

- Producción sí pero calidad también sin desperdicios
- Desarrollo de tecnologías para economías no protegidas
- Desarrollo de nuevos productos para la exportación
- Tecnologías para reducir costos y mejorar calidad
- Productos orgánicos
- Aprovechar ventajas comparativas sur-sur
- Apropiación de tecnologías

4. Comercialización administración y procesamiento

- Responder a la competitividad, a la demanda (no ofertista y de producción no masiva) requiere otras habilidades
- Tecnologías de postcosecha, almacenamiento, mercadeo, procesamiento
- Gerencia del cambio tecnológico

5. Sostenibilidad de la agricultura

- Producción creciente vs. conservación
- Producción de alimentos combinada con la de "recursos naturales"
- Nueva investigación: objetivos múltiples, usuarios la visión

sistémica, resultados integrales; usuarios, la sociedad
- Enfoque agroecológico y de sistemas productivos

6. Nueva base científica y tecnológica

- Anteriormente las tecnologías eran genéticas, mecánicas y químicas
- Hoy: biología molecular, bioquímica, agroecología, ciencias sociales, telecomunicaciones, microelectrónica, informática
- Cambio del concepto de tecnología básica vs. aplicada
- Biotecnología, vínculo ciencia e industria o aplicación comercial derivada directamente de la investigación básica

7. El desarrollo humano sostenible

- Se está saliendo del siglo de las sociedades industriales
- Se está entrando en el siglo de las sociedades cultas, instruidas y de la economía de la información
- En este siglo el conocimiento será el factor estratégico de poder
- Incorporación de las ciencias sociales
- Un nuevo perfil de recursos humanos
- Asegurar la participación del agricultor como investigador
- El concepto de género

Modelo Institucional

El concepto. El concepto de modelo institucional implica una representación ordenada de un comportamiento o conducta para el desarrollo de innovaciones tecnológicas fundamentada en una organización apropiada al medio externo para interactuar con éste.

La definición. Esquema ordenado caracterizado por arreglos de comportamiento, normas legales y de conducta y formas organizativas para el desarrollo de innovaciones tecnológicas dispuesto, de tal modo, que pueda relacionarse y ganar aceptación de la sociedad da la cual sirve.

Los componentes. Externo e interno. El primero, o sea el externo, se descompone en los elementos: i. medio ambiente superior que comprende políticas de ciencia y tecnología, políticas sectoriales y políticas intersectoriales; ii. medio ambiente específico que son los usuarios y la clientela; iii. medio ambiente complementario, relacionado

con la comunidad científica y universitaria nacional y transnacional. El segundo, o sea el interno, hace relación con la organización interna del modelo, para ejecutar la investigación y transferencia o más ampliamente desarrollar un proceso de innovación tecnológica. El concepto de efectividad tiene incidencia directa con el primer componente, y el segundo, con la eficiencia del modelo.

CIENCIA, TECNOLOGIA E INNOVACION

La Ciencia y la Tecnología

Ciencia: Cuerpo de doctrina que metódicamente formado conlleva al conocimiento cierto de las cosas por sus principios y causas.

Tecnología: Conjunto de conocimientos propios de un oficio o arte organizados para desarrollar productos en la forma de bienes y servicios.

La actividad científica se desarrolla más desde la perspectiva de la oferta (supply push) para resolver tensiones entre el paradigma actual y otro nuevo que siempre se aproxima. La tecnología se desarrolla más desde la perspectiva de la demanda (demand driven) del sector productivo.

Las dos actividades representan sistemas sociales diferentes con tensiones distintas. En ALAC hay algunas concepciones erróneas alrededor del rol de una u otra actividad: i. se conciben estrictamente como procesos lineales para llegar a obtener conocimientos y productos tales como bienes y servicios; ii. se diferencian en exceso, compiten entre sí y a veces, se muestran como antagónicos; iii. las organizaciones se ubican marcadamente en una u otra actividad, aunque en la práctica combinan ambas actividades.

En una sociedad y gobiernos afanados por competir exitosamente se puede caer en extremos de valorar sólo lo tecnológico, captar a cualquier precio las tecnologías y emplearlas con fines productivos. Sin embargo, esto puede conllevar a varias cosas: i. una "descientificación" de nuestros países, perder la capacidad de autonomía para decidir el otorgamiento de "visas" (que entra y que no) y "licencias tecnológicas" y caer en una total dependencia foránea; ii. perder capacidad para desarrollar conocimientos y tecnologías autóctonas al medio tropical. Eso es muy importante en el caso de la búsqueda de un desarrollo sostenible, donde el manejo y conservación de los recursos naturales, requiere de muchas

cosas, pero determinante es el desarrollo de conocimientos básicos sobre los mismos.

Los INIAs, deberían preocuparse por ambas cosas bien bajo la propia ejecución o la promoción o de dichas actividades; además, procurar disminuir las tensiones entre los dos campos buscando armonizar los mismos. Así el INIA puede jugar un importante rol en la construcción de una interfase entre la generación del conocimiento original y su aplicación a las demandas.

La ciencia puede esta en ocasiones muy cerca y vinculada con la industria, como en el caso de las nuevas biotecnologías. Sin embargo, tecnología no es sinónimo de industria; hay tecnologías sociales, tecnologías agrícolas, tecnologías médicas.

Innovación tecnológica

La concepción lineal de las diferentes fases del proceso tecnológico (investigación básica-investigación aplicada-transferencia-desarrollo tecnológico-innovación-mercado) no es la única forma de alcanzar la modernización productiva vía la tecnología. El concepto de innovación tecnológica y su aplicación es una forma alternativa de incorporar el componente tecnológico en los proceso productivos.

Innovación es la capacidad de disponer de conocimientos y llevarlos al mercado. Ello implica inversiones en información y conocimientos. Esta inversión se hace hoy en día para conquistar mercados y permanecer en ellos.

Las innovaciones son procesos y productos mejorados o nuevos; nuevas formas organizacionales; la aplicación de la tecnología a nuevos campos, el descubrimiento de nuevos recursos; y la apertura a nuevos mercados.

Innovación entonces va más allá de generar y transferir tecnología. Ella implica: crear, adquirir, acumular, mejorar y usar tecnologías.

La innovación tecnológica ha tenido diversos estados evolutivos:

1. Ha pasado de circunscribirse de los individuos a las organizaciones
2. El énfasis del mercado y de la demanda

3. La incorporación dentro de las compañías de actividades de investigación y desarrollo tecnológico
4. La interacción entre las firmas
5. La naturaleza sistémica de las innovaciones
6. El rol de la base científica y tecnológica
7. El vínculo del estado con el proceso de innovación, para producir el factor de producción más importante: conocimientos científicos y tecnológicos
8. Alianzas estratégicas técnicas y acciones colaborativas entre las firmas que compiten.

Se propone que un INIA se vaya moviendo a actuar más en el contexto de un Sistema de Innovación Tecnológica Nacional (SIN) que el estar circunscrito solamente al marco de un Sistema de Investigación y Transferencia de Tecnología.

Bajo el contexto de un SIN se tiene:

- La existencia de ciertos dispositivos organizativos y de mecanismos de funcionamiento que posibilitan la vinculación efectiva entre ciencia, tecnología, producción y mercado, y a partir de ellos, poner en marcha los procesos de generación, difusión y utilización de innovaciones. La investigación, transferencia y desarrollo de tecnologías son una vía para fortalecer el proceso de innovación tecnológica.

- La interacción de organizaciones públicas y privadas, universidades y organismos gubernamentales todos ellos con el propósito de producir ciencia y tecnología. La interacción de estas unidades del SIN puede ser en los campos técnicos, comerciales, legales, sociales y financieros, teniendo en cuenta que la meta de dicha interacción es el desarrollo, protección, financiamiento o regulación de la nueva ciencia y tecnología. En los países desarrollados los sistemas de innovación están conformados por muchas unidades de origen privado pero el Estado es el elemento dominante.

- El concepto de sistemas de innovación traspasa las fronteras del Estado. Cada vez que se avanza más en el proceso de armonización de políticas tecnológicas, se está construyendo la base de un sistema de innovación internaciones.

- Los SIN se pueden medir en términos de sus unidades (número, tamaño, rol) de los flujos (de conocimiento, financieros, sociales, políticos) y del "performance" del sistema (patentes por investigador o patentes por dólar invertido en el sistema).

Conclusiones sobre los SIN:

- El concepto de SIN está muy relacionado con la evolución de las actividades económicas; innovación es un fenómeno estrictamente económico;

- Se basan en una red de instituciones en las cuales el producto de una de ellas es el insumo de otras instituciones dentro del sistema;

- Su producto final obedece a una demanda, es comercializable, apropiable y sujeto a protección (por lo general por patentes);

- Estos sistemas son más característicos de países desarrollados; sin embargo, en los países en desarrollo se empiezan a formar cada día más estos sistemas, a juzgar por el número de patentes que empiezan a solicitarse. Ellas son indicativos d ella existencia de innovación;

- La innovación, refiriéndose a un producto o proceso, está asociada al concepto de empresa. El agente básico del proceso de innovación es la empresa.

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ANEXOS

Actividades que contemplan cooperacion internacional sobre temas de produccion animal apoyadas por el IICA en la decada del 90.

-RISPAL (IDRC)

-Prociandino: Subprogramas de Doble Proposito y de Ganaderia Alto-Andina (Paises Andinos Y Guatemala-IDRC)

-Proyectos de Sistemas de Produccion Ganadera de Surinam y Guyana (CARDI)

-Vinculos LAC-ILRI (CGIAR)

-Rimisp (IDRC)

-Sistema Interamericano de Recursos Geneticos Animales (FAO-USDA)

-Programa Regional de Apoyo al Desarrollo de Camelidos Suramericanos (FIDA)

-Escuela de Lecheria de Colonia Suiza en Uruguay (BID)

-Salud Animal:

- Programa de Radicacion de Amblyoma Variegatum (USDA, FAO)
- Reactivacion Servicios de Sanidad en Surinam y Guyana
- Red de Hemoparasitos de las Guyanas (CIRAD,FIC)
- Apoyo a los Servicios de Salud Animal para Facilitar el Intercambio Comercial Pecuario (Areas: Sur, Andina y Central)
- Fortalecimiento de Servicios de Sanidad Animal en Mexico

APPENDIX

Appendix A

AGENDA

Monday, April 15, 1996

Moderator: Dr. Manuel Ruiz

9:00 - 9:15	Registration	
9:15 - 9:30	Welcome	Dr. Aquino Director General, IICA
9:30 - 10:30	Introduction	Dr. Demment Program Director SR-CRSP
10:30 - 10:45	*Break*	
	Country Presentations	
11:00 - 11:30	Peru	Dr. Enrique Flores
11:30 - 11:45	Discussion	Univ. Nacional Agraria
11:45 - 12:15	Bolivia	Dr. Luis Iniguez
12:15 - 12:30	Discussion	RERUMEN
12:30 - 1:30	*Lunch Break*	

Moderator: Dr. E. Gonzalez-Padilla

1:30 - 2:00	Honduras	Dr. Miguel Mejia
2:00 - 2:15	Discussion	DICTA
2:15 - 2:45	Guatemala	Dr. Sergio Ruano, IICA
2:45 - 3:00	Discussion	
3:00 - 3:15	*Break*	
3:30 - 4:00	Ecuador	Dr. Ballesteros
4:00 - 4:15	Discussion	SANREM
4:15 - 4:45	Costa Rica	Dr. Richard Taylor
4:45 - 5:00	Discussion	EARTH

5:30 - 6:30 Meeting of Thematic Group Leaders with Dr. Demment

Latin America Regional Livestock Assessment Workshop Agenda (continued)

Tuesday, April 16, 1996

Country Presentations (continued)

Moderator: Dr. Enrique Flores

9:00 - 9:30	Caribbean	Dr. Parasram, CARDI
9:30 - 9:45	Discussion	
9:45 - 10:30	Belize	Dr. Marcelino Avila
10:30 - 10:45	Discussion	Ministry of Ag. & Fisheries
10:45 - 11:00	*Break*	
11:00 - 11:30	Mexico	Dr. Gonzalez-Padilla
11:30 - 11:45	Discussion	INIFAP

Resource Presentations

11:45 - 12:15	Human Nutrition	Dr. Charlotte Neumann
12:15 - 12:30	Disucussion	
12:30 - 1:30	*Lunch Break*	

Moderator: Dr. S. Parasram

1:30 - 2:00	Policy/Economic Growth	Dr. Carlos Pomareda
2:00 - 2:15	Discussion	
2:15 - 2:45	Livestock/Environment	Dr. Michael McCoy
2:45 - 3:00	Discussion	Univ. Nacional Heredia
3:00 - 3:15	*Break*	
3:30 - 4:00	Livestock Prod. Systems	Dr. Juan Carlos Chirgwin
4:00 - 4:15	Discussion	FAO
4:15 - 5:00	Thematic Workgroups	Group Leaders
	Livestock/Environment	Flores/McCoy
	Human Nutrition	Ballesteros/Neumann
	Economic Growth	Avila/Pomareda
5:00 - 5:30	Full Group Discussion	

Latin America Regional Livestock Assessment Workshop Agenda (continued)

Wednesday, April 17, 1996

9:00 - 12:00	Thematic Workgroups	Group Leaders
	Livestock/Environment	McCoy/Flores
	Human Nutrition	Neumann/Ballesteros
	Economic Growth	Pomareda/Avila
10:00 - 10:15	***Break***	
12:00 - 12:30	Full Group Discussion	
12:30 - 1:30	***Lunch Break***	
1:30 - 4:00	Thematic Workgroups Regional Integration and Prioritizing	
4:00 - 5:30	Reporting and Discussion	
7:00 - 9:00	***IICA Reception***	

Thursday, April 18, 1996

9:00 - 10:00	**Thematic Groups** Revision and Finalize Report
10:00 - 12:30	Final Reporting and Regional Priority Setting

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

LATIN AMERICA REGIONAL 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.

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 do not provide tractors or fertilizer, but they might well analyze why policies that affect their supply may be 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

Enrique Flores & Michael McCoy, Group Leaders

1. Manuel Ruiz
2. Jorge Benavides
3. Arnoldo Ruiz
4. J.C. Chirgwin
5. Luis Iniguez

Economic Growth

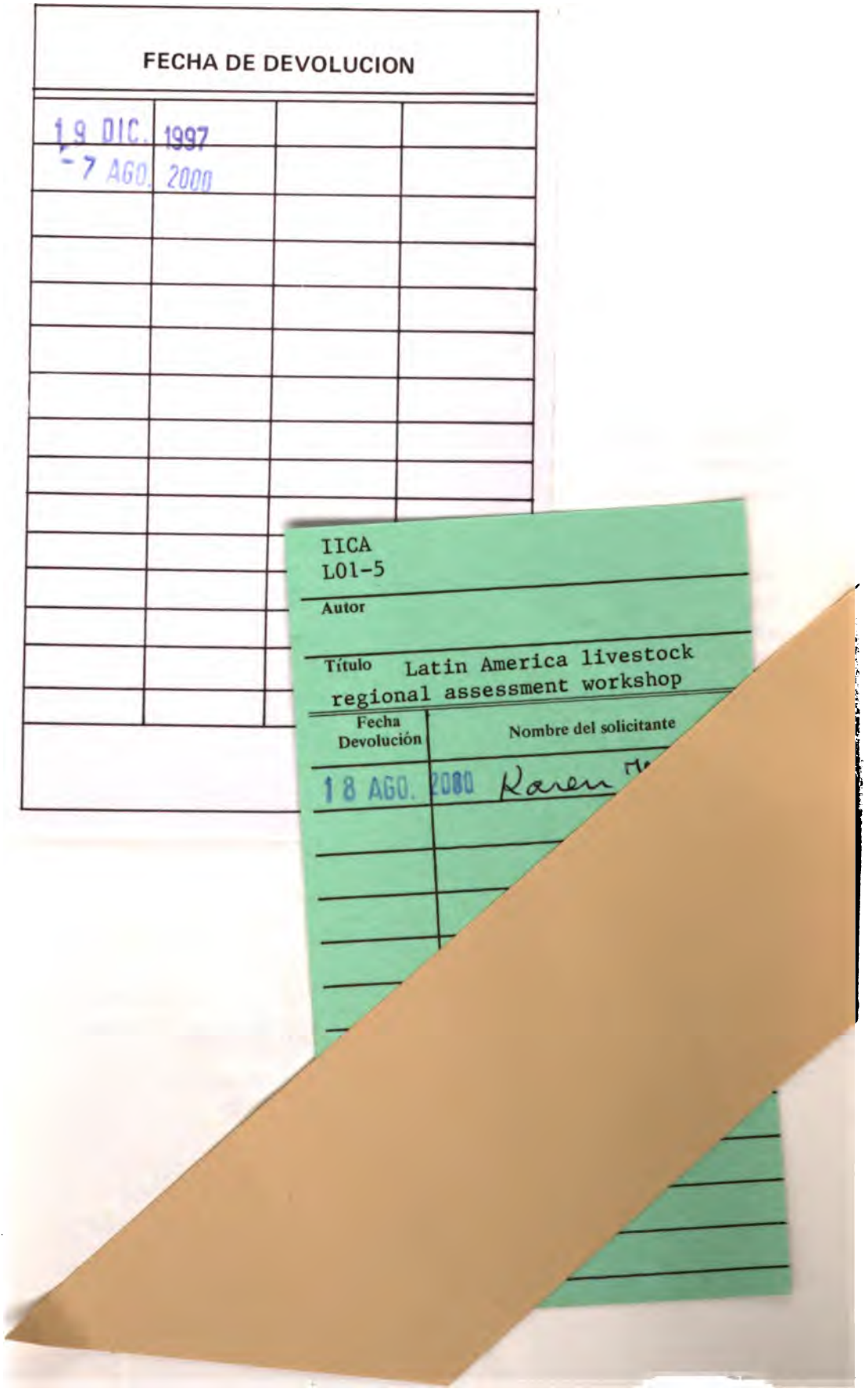
Marcelino Avila & Carlos Pomareda, Group Leaders

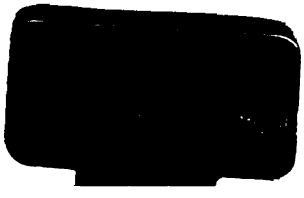
1. S. Parasram
2. Alejandra Jiménez Salas
3. Miguel Mejia
4. Everado González-Padilla

Human Nutrition

Hector Ballesteros & Charlotte Neumann, Group Leaders

1. Sergio Ruano


FECHA DE DEVOLUCION
19 DIC. 1997
- 7 AGO. 2000
IICA
L01-5
Autor
Título Latin America livestock regional assessment workshop
Fecha Devolución
Nombre del solicitante
18 AGO. 2000 Karen



Published by the Management Entity, Small Ruminant CRSP, University of California, Davis, California 95616. Telephone: (916) 752-1721. Fax: (916) 752-7523. E-Mail: srcrsp@ucdavis.edu. World Wide Web Site: http://www-srcrsp.ucdavis.edu.