

THE ROCKEFELLER FOUNDATION

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To: *Members of the Consultative Group on
International Agricultural Research*

From: *R.D. Havener, Consultant
The Rockefeller Foundation*

Subject: *STRATEGIC PLAN FOR LIVESTOCK RESEARCH IN THE CGIAR SYSTEM AND
THE ILRI INDICATIVE MEDIUM TERM PLAN*

Attached is the latest revision of these documents. Earlier versions were shared widely with members of TAC, the Directors General of other concerned CGIAR Centers, a broad range of experienced scientists and administrators from both developing and economically advanced countries, and members of the ILRI Implementing Advisory Group (IAG). The members of the Strategic Planning Task Force have, to the extent possible, incorporated the recommendations resulting from these consultations into the attached documents.

Readers should consider even these revised versions as interim documents; hence, the title of Indicative Medium Term Plan. The Board of Trustees and Director General of ILRI will of necessity want to revisit these subjects and revise their plans as circumstances permit and, indeed, dictate. But that is a normal and continuing process within the CGIAR System.

These documents should be read in association with the 1995 Program of Work and Budget for ILRI. The latter document explains concrete steps proposed in the coming year to move from two CGIAR-sponsored livestock research Centers focusing largely on problems related to Africa to a single Center focusing on a wider range of issues within a global mandate. It is proposed that the new Center will also coordinate the System-Wide Livestock Initiative and the Livestock Planning Group activities in developing and executing this research plan.

The contributions of the staff of ILCA, ILRAD, and the CGIAR and TAC Secretariats deserve special recognition. It is the hope of the various groups and individuals who helped to prepare these two sets of documents that together they constitute a cogent, coherent, and compelling case for continued and enhanced funding for livestock-related research activities within the CGIAR System. We will value your consideration and comments.

cc: *CGIAR Secretariat*

Report to The Rockefeller Foundation

**Strategic Plan for a New CGIAR
Global Livestock Research
Institution**

**Report of the Strategic Planning Task Force
August 1994**

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Executive Summary

1. This report was commissioned by the Rockefeller Foundation, acting on behalf of the CGIAR. It is the fourth in a series which addresses the reorganisation of livestock research within the system.
2. Having undertaken independent studies, done extensive consultation, and reviewed these earlier reports, the task force came to the following conclusions.
3. The livestock industry, expected to be the fastest growing major sector of agriculture in developing countries in the coming decades, has major constraints, some of which can only be resolved by research at international level.
4. The research agenda to respond to this challenge should contain significant work on feed resources, animal health, animal genetics, production systems, economic and social aspects of livestock development, and on management of natural resources.
5. Strategic Work on feed resources, nutrition, physiology and production systems will be largely eco-regional in nature, and should increasingly be carried out in cooperation with other CG centres and NARS. Benefits from collaboration between eco-regions are anticipated.
6. In animal health, the focus should remain on vector-borne tropical diseases, and on the use of advanced scientific methods to develop new control techniques. The creation of ILRI provides an exceptional opportunity to integrate different technologies in the control of these diseases.
7. In animal genetic resources, ILRI should develop a strong program on the basis of current expertise on molecular biology and animal genetics.
8. Economic, social and policy studies in livestock development should be expanded in cooperation with IFPRI and other partners.
9. Under natural resource management, there are substantial new challenges in the areas of animal genetic resources, monitoring and analysis of change in pastoral areas, and on the contribution of livestock to resource conservation in mixed farming systems.
10. The new agenda for Asia mainly concerns feed resources and production systems. This include pigs and poultry in traditional systems, but a specific program in monogastrics is not recommended. The scale of need and potential payoff from work in Asia will require a strong ILRI presence there.
11. In Latin America, the agenda is smaller than in Asia, and CIAT should be the focal point for the livestock program.
12. In West Asia and North Africa, the focal point should be ICARDA. The agenda includes strategic work on natural resource management in pastoral areas.
13. In extending the program outside Africa, the structure of choice should be a partnership with other CG centres, and with national institutions. The creation of eco-regional teams to tackle systems projects of specified duration would be a particularly good way of initiating such cooperation.
14. ILRI should be designated as 'strong convenor' of livestock research throughout the CG system. This should be more than a coordinating role, and can be made effective given the resources likely to be made available to promote cooperation.
15. In areas of advanced science, the in-house program should be complemented by a competitive contract system of engaging institutions of the highest calibre.

1 The Context

1.1 Introduction

The CGIAR system of agricultural research institutions has evolved over a 35 year period as a major part of the global response to the central challenge facing humanity: how to double food production in each generation in line with expanding world population. Doubling production without degrading the environment adds to the challenge. That mission is as urgent today as it was when the first of the institutions began work.

As the system faces into the next cycle of effort, the task confronting the CGIAR has changed in several important respects, and has also become more difficult. Economic stress in the developed world has led to a reduced flow of funds to international agricultural development (though 1994 has already seen a revitalised vision and a renewal of commitment for international and national research). Many of the easy gains in agricultural productivity have been achieved and concern is now focused on balancing the need for increased output today with the need to conserve resources for tomorrow. At the same time, the CGIAR system now has many more effective partners, not least among the national agricultural research systems in developing countries. With the expansion of these institutions, the CG centres now represent only 4% of the global research investment for developing country agriculture. The problems they address, and the level at which the research is carried out, must therefore be chosen for strategic effect.

Against this background, the CGIAR has decided to carry out a fundamental restructuring of its activities for the livestock sector. A TAC discussion paper on priorities and strategies for livestock research was presented at ICW 1992 (revised April 1993), a CG working group on livestock research reported in April 1993, and a steering committee presented recommendations in September 1993. At ICW 1993 a decision was taken to establish a new CG research centre with a global mandate. The present report is one element in the implementation of that decision.

1.2 The Livestock Sector

For livestock products, the needs created by expanding populations contribute only part of final demand. The remainder comes from the dietary changes which accompany growing real incomes. Recent experience, and estimates for the coming decades, point to annual increases in individual intake of over 2% for meat and 1 - 2% for milk. These figures translate into higher projected increases in demand for livestock products than for crop products. Annual production increases in developing countries in response to this increasing demand are projected at 2.4% for crop products, and 3.4% for livestock products (FAO, 1993).

Livestock products (meat, milk and eggs) make up 26% of recorded agricultural output in developing countries (as against 55% in developed). Unrecorded outputs (hides, fibre, manure, draft power) also have value, variously estimated at up to half the value of the recorded commodities. Much of this output is an essential input to crop production. At the same time, much of the otherwise unusable by-products of cropping systems are the raw material of animal production. In addition, livestock provide service functions as instruments of insurance and saving, are a medium for increased gender equality, and serve to promote better distribution of incomes in rural society. Furthermore, two thirds of the world's utilised agricultural area is involved solely in pastoral livestock systems, while animals are an intimate part of mixed farming systems in the remainder. The environmental consequences, both positive and negative, of livestock are therefore a fundamental element in the strategy for conservation and sustainability of natural resources for the future.

The developing world accounts for nearly two thirds of the world's livestock, while, using conventional calculations such as output per animal, production efficiency is only about a quarter of that of the developed world. In the past, uptake of research results has often been disappointing. Now, however, the prospects for adoption are improving rapidly, partly because of the dynamic response of producers to better market opportunities, and partly because of structural change including privatisation, organisation of producers, the availability of effective NGO partners in the process, and the better functioning of national institutions.

The path of development for the livestock industry in many poor tropical countries will inevitably be very different from that which has evolved in the developed world. In particular, the intensive feeding of grain and grain substitutes for meat production in large scale enterprises will not be an option in many cases. The course of development will therefore require greatly increased focus on the better use of indigenous resources, both of animals and of feedstuffs. The prospects for substantial gains in productivity from well directed research are excellent. Work in recent decades has given indications of the extent of the resources in genetic capacity for disease and parasite tolerance which are present in tropical animal breeds. It has also clarified the possibilities for intensification of feed production by judicious use of the enormous pool of tropical feed and forage plants. The research agenda in the past has often been inspired by an attempt to emulate technical developments in financially richer but biologically poorer environments. The emphasis for the future must be more on the harnessing of indigenous resources and the development of balanced farming systems which fully use the accumulated knowledge of local farmers.

1.3 Guiding Principles

The criteria guiding choice of the agricultural research activities that should be undertaken by the international community have been stated many times during the evolution of the CGIAR system. The most recent restatement is in the TAC review of priorities and strategies, (TAC, 1992). It states that for an activity to be considered part of a CGIAR program, it must meet the following criteria:

1. The activities must be research or research-related. The first objective is the generation of new knowledge or products, while the second includes dissemination, training and co-operative activities.
 2. The activities must be international in character, and target CGIAR priorities.
 3. The activities must be ones where the CGIAR centres have a comparative advantage.
- The following factors also need to be considered:
- CGIAR centres should be leaders, not followers, in the application of their particular fields of scientific expertise to developing country problems.
 - For practical as well as philosophical reasons, the CGIAR centres must seek active partnership with other institutions, particularly in developing countries, going beyond the production of research information, to include dissemination of the results to intermediate or end-users as appropriate. This process should be carried out interlinked with training and institution building activities.
 - The program must particularly acknowledge world concerns on environment, sustainability, food security, gender equality and poverty reduction.
 - Needs should determine program, and program should determine structure.

1.4 Developing the strategy

Logical development of the broad livestock strategy for the CGIAR begins with a restatement of the development needs of the sector, and a consideration of where internationally based research can best address these needs. These needs are determined by the following major trends affecting the sector:

- most of the increase in production will come from intensification of livestock in mixed farming systems.
- intensified crop production in poor countries will be largely dependent on animal power.
- urbanisation of consumers will tend to drive specialisation of producers, and for some products (poultry, pigs) a shift to industrial scale production.
- however, almost all of milk, beef and small ruminant meat, and most of pigmeat production will continue to be in smallholder systems.
- with growing intensification systems, research must increasingly take account of the need for ecosystem management.
- some pastoral areas will have scope for increasing production and off-take, but the major challenges will be in resource management.

- new scientific developments will provide possibilities for significantly improving productivity, particularly in animal health, nutrition and genetics.

Defining the research agenda to anticipate and respond to the needs of the sector is a task with many dimensions. These include regions, agro-ecological zones, farming systems, species. Considerations of poverty, equity, environment, sustainability should also be included. Areas of technology, and potential impact, are also relevant.

Many of these factors are confounded with each other, and in any case must be considered simultaneously. The number and complexity of these criteria makes it essential to approach the construction of the research agenda in a systematic way. We have chosen to present the quantified information on those variables for which it is available in an appendix table and figures, and to present the main conclusions in a simplified format, supported by discussion of the main challenges and work areas.

The three main TAC reference criteria are taken as a starting point. These concern the population affected, value of output, and agricultural land use, and are shown, with particular reference to the livestock sector, in Appendix Figure 1. This figure also links in the spatial dimension by showing, for each agro-ecological zone, the total population, with the numbers classified as poor; the value of agricultural output, broken into livestock and crops; and the total agricultural land in use, classified into grazing and cultivated. These figures are summarised on a per capita basis for the four developing country regions in Table 1.

Table 1. Population, output and land statistics for developing country regions

Item	Region				All regions
	SSA	Asia	LAC	WANA	
	<i>kg per capita</i>				
Beef & buffalo meat	4.6	2.4	22.7	4.2	5.1
Sheep & goat meat	1.9	1.1	0.9	5.1	1.5
Pigmeat	1.0	11.9	6.9	0.1	9.1
Poultry meat	1.9	3.1	14.3	6.7	4.5
Milk	26.4	33.5	98.6	71.5	42.9
Eggs	1.5	5.0	9.0	5.5	5.1
	<i>ha per capita</i>				
Cultivated land	0.35	0.18	0.43	0.29	0.24
Grazing land	1.28	0.17	1.27	0.84	0.49
	<i>dollars (US) per capita</i>				
Value crops	83.7	89.2	144.8	64.9	92.9
Value livestock (1)	19.5	25.7	78.1	39.9	31.9
	<i>million people</i>				
Population	501	2740	448	316	4005

(1) Leaving out the value of manure and draft power

A further perspective is given (Appendix Figure 2) on the relative importance of the different species and types of product in the overall set of commodities produced by the livestock sector.

Finally, the importance of each species was considered in the context of ten different livestock systems occurring in developing countries. Landless systems were omitted, and allocation of pigs and poultry was not feasible. The distribution of cattle and sheep & goats over the eight land-use systems is shown in Appendix Table A1.

2 A Unified Strategy for CGIAR Livestock Research

2.1 CGIAR Vision and Strategy over the next decades

The TAC vision for the coming decades (outlined by TAC in its 1990 paper on CGIAR Expansion, fleshed out in its 1992 Review of CGIAR Priorities and Strategies) sees a set of global and a set of ecoregional activities for the CGIAR Centres with the two strongly interactive. Global activities will comprise strategic research on selected commodity and subject matter areas. Ecoregional activities will focus on applied and strategic research on the conservation and management of resources, the development and management of production systems, and on applied aspects of commodity improvement often based on the outputs from global commodity research (see Figure 1).

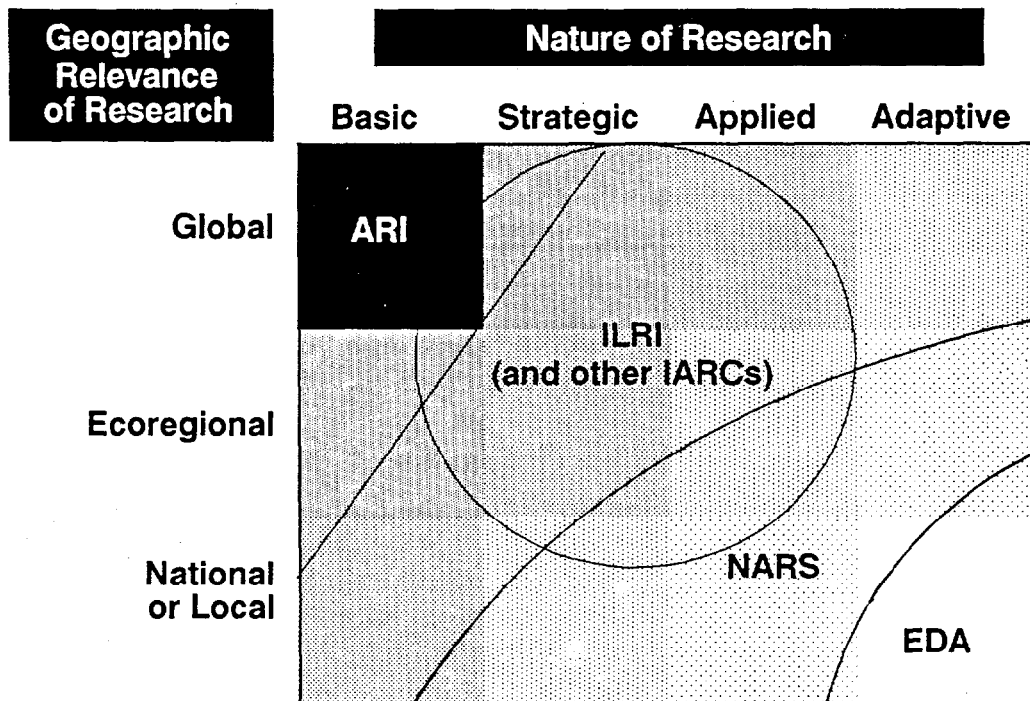


Figure 1: *Research for livestock agriculture in developing countries — the complementary roles of Advanced Research Institutions (ARI), International Agricultural Research Centres (IARC), National Agricultural Research Systems (NARS) and Extension and Development Agencies (EDA).*

Figure 1 is intended to display the separate and interacting roles of the main agencies involved in research for agriculture in developing countries. It encompasses only part of the global research commitment, since most of the work of Advanced Research Institutions (ARI) is directed elsewhere. Likewise most of the expenditure of Extension and Development Agencies (EDA) is devoted to activities other than research. It does, however, include the full field of relevance of the CGIAR centres and of their national counterparts (NARS)

CGIAR Ecoregional Centres in partnership and drawing on NARS' knowledge base will build a strong understanding of local agriculture. In addition to underpinning their own activities this understanding will be important to guide priority setting for global activities and to help mobilise global outputs for the benefit of farmers in their ecoregion. Ecoregionally mandated centres will also coordinate support for national and transnational research in their region. The wide range of skills required and the need for a multi-disciplinary approach to implement an ecoregional mandate will place a premium on collaboration between research organisations inside and outside of the ecoregion.

In promoting inter centre collaboration the CGIAR has recognised the need for its centres, in applying research resources in each major production sector, to ensure they are expended in a coherent and cost effective way. The need is to reduce duplication and gain synergies from collaboration in problem solving across the CGIAR as a whole. This need for unified strategy is as true for livestock as it is for other sectors. Its purpose is to bring CGIAR resources dedicated to livestock to bear on the priority under-researched livestock-related problems of developing countries as efficiently as possible.

2.2 Mandate and Objectives

The unified strategy will be implemented through ILRI, a new international livestock entity with a global mandate. This presents an opportunity for a coherent CGIAR program of livestock research underpinned by the TAC vision. Such a strategy requires ILRI to be linked creatively and effectively to other organisations with livestock-related research mandates, both inside and outside the CGIAR.

The mandate, consistent with the CGIAR mission statement, should inspire and drive every element in the program. That aim is to contribute to sustainable improvements in the productivity of animal agriculture in developing countries in ways that enhance nutrition and well-being, especially of low income people.

The operational goals for ILRI should seek:

- to serve within the CGIAR as a world centre for research on major problems of animal production and health.
- to provide ways and means of controlling major animal diseases which seriously limit livestock production.
- to strengthen the ability of national agricultural research systems (NARS) to conduct technical and policy research on sustainable livestock systems and thus to develop their own technical solutions to production problems and to promote environmentally sound animal agriculture and rural development;
- to develop, through its own research and in proactive collaboration with other organisations, technical solutions for increasing livestock production and enhancing the contribution of livestock to sustainable agricultural production and equitable income distribution; and
- to contribute to scientific knowledge in a way conducive to solving livestock production problems; such knowledge should relate to the understanding of production and natural resource management constraints and opportunities or to research methods and techniques.
- to act as lead organisation and also as catalyst for CGIAR livestock research.

2.3 CGIAR Resources for Livestock Research

The CGIAR brings a diversity of assets to a unified strategy for livestock research. ILCA and ILRAD have historically been dedicated to livestock in Africa and will be integrated into ILRI. ILRAD's laboratory facility has the capacity for research in the biotechnology of animal health and disease-related genetics. ILCA has accumulated a wide understanding of livestock in African farming systems and has identified important applied and strategic component research thrusts for system improvement. Organised with field teams located in dominant African livestock systems, it has expertise in implementing ecoregional activities. Thus there is considerable complementarity between the two centres in their coverage of the research continuum.

CIAT in Latin America implements a pasture and pasture legume research program of special relevance to acid soils. ICARDA in West Asia and North Africa implements a pasture and pasture legume program in the context of arid production systems in which the land resource is under pressure. ICRAF, the agroforestry centre with a global mandate, identifies fodder and browse as an important product of agroforestry technologies. Additionally, both IITA and ICRISAT have small agroforestry thrusts as parts of their natural resource management programs.

Finally and importantly, eight CGIAR centres have intimate knowledge of a range of crops which provide human and animal food as joint products in several regions of the world, and more widely provide livestock feed from crop residues or by-products.

2.4 Global and Ecoregional Priorities in Livestock Research

The CGIAR has recently identified six priority ecoregions and has designated convening centres for these. Table 2 lists the convening centres and the priority ecoregions, and shows that these ecoregions contain some 80% of developing country cattle, sheep and goats.

Table 2 *TAC Priority Ecoregions and Estimated Livestock Populations*

Ecoregion	Convening Centres	Cattle		Sheep & goats		
		Million	LDC %	Million	LDC %	
Warm arid & semi-arid subtropics with summer rain	SSA	ICRISAT	47	5.4	88	8.0
	Asia	ICRISAT	179	20.4	221	20.2
Warm subhumid/humid tropics & subtropics with summer rain	SSA	IITA	39	4.4	68	6.2
	Asia	IRRI	186	21.2	265	24.1
	LAC	CIAT	203	23.1	43	3.9
Cool subtropics with winter rain	WANA	ICARDA	21	3.6	178	16.2

The six priority ecoregions are dominated by mixed farming systems with livestock important for milk and meat, as well as for draught power and manure.

The global priorities for ILRI derive from the nature of these farming systems, involving in most cases a close interdependence of the livestock and cropping activities. The most nearly universal challenge concerns feed production. This calls for improvement through component technologies (plant genetics, production methods, feeding practices). It also requires their integration with animal breeding, health and management to support farming systems which are viable in both economic and ecological terms.

The external environment is often critical to the successful application of technology at farm level, and research directed at economic, social and policy factors is therefore also a broad priority for ILRI.

The inevitable intensification of present farming patterns in many cases brings the risk of degradation or depletion of natural resources, whether they be genetic stocks, land, water or vegetation. Research in which natural resource management is explicitly addressed is therefore a further priority for IRLI.

These broad themes have application in all developing regions. The way in which the balance of priorities varies over the regions is best presented in terms of the existing TAC designated livestock research program areas (Table 3).

Table 3 *The Relative Importance of Research Program Areas by Region*

TAC Program Areas	Region			
	SSA	Asia	WANA	LAC
Animal Health	XXX	XX	X	X
Animal Genetics	XX	XX	X	X
Animal Nutrition	X	X	X	X
Feed Resources	XXX	XXX	XX	XX
Production Systems	XXX	XXX	XX	XX
Natural Resource Management	XXX	XXX	XXX	XXX
Policy Analysis	XX	XX	XX	XX

Africa and Asia are shown with the greatest frequency of high and higher priority themes including animal health, genetics, feed resources, production systems, natural resource management and policy analysis.

Animal health and genetics are recognised as globally relevant activities for which molecular science offers early potential and is already heavily exploited in ILRAD's existing programs. Sub-Saharan Africa continues to present the greatest challenge in animal health, because of the prevalence of costly and difficult diseases. The lower priority for West Asia, North Africa and Latin America for animal health and genetics reflects both the more advanced economic circumstances of these regions, and their more favoured situation in animal health terms. Animal nutrition only receives moderate priority for any region, largely because it is seen as closely connected to feed resources.

Feed resources and production systems research are closely linked. These areas are shown as having higher urgency in Sub-Saharan Africa and in Asia. In Africa, farming systems are at an early stage of adaptation and intensification, while in Asia already intensive land use systems are coming under great pressure to intensify further. Under natural resource management, SSA and WANA have the highest priority because of the widespread and varied threat to resources in the former, and because of the fragile nature of the natural resources in the latter.

The last four themes are strongly environmentally dependent and appropriately seen as ecoregional research activities. As with ILCA's work in Africa, or CIAT's work in forage research in Latin America, those activities based in dominant production systems will identify strategic sub-themes of global relevance in feed resources, natural resource management and policy analysis. Production systems are driven by local economic and environmental circumstances and are necessarily researched in specific locales in an ecoregional context. Finally, ecoregional activities, even on production systems, will generate advances in theory and methods of worldwide relevance.

Those strategic research themes, identified in the course of ecoregional activities, which are of global relevance and high priority will compete for a place on the strategic research agenda of ILRI, or of the other CGIAR centres with the skills, capacity, or locational advantage, to pursue them.

3 Defining the Program

3.1 Introduction

Since the plan for ILRI should serve and be driven by its work program, the recommendations for the work program are presented first. These have been developed with three main strands of input: systematic reconsideration of the main prioritising criteria; revisiting the conclusions of earlier working groups; and a rapid, though extensive, round of consultation.

3.2 Comparative Advantage

In addition to the task of setting the overall research agenda for different parts of the livestock industry, it is also necessary to identify those which the new CG institution and its potential partners will each be best equipped to address. This is presented in tabular form in Table 4. The table classifies the potential work program into the seven categories used by TAC, and shows the comparative advantage, in terms of competence and expertise, currently held by the different potential partners.

Table 4 *Comparative Advantages in Livestock Related Research Competence & Experience*

TAC Program Areas	Competence and Expertise			
	Other CG	ILRI	Developed Countries	Developing Countries
Animal Health				
Trypanosomiasis	-	XXX	XX	XX
Tick-Borne diseases				
East Coast Fever	-	XXX	X	X
Others	-	XX	XX	XX
Epidemiology and economics	-	XX	XX	X
Animal Genetics				
Improvement	-	XX	XXX	XX
Conservation	X	X	XX	X
Animal Nutrition	X	X	XX	X
Feed Resources				
Natural pastures	XX	XX	XXX	X
Forage, crops, crop residues	XXX	XXX	XX	X
Production Systems	XX	XX	XX	XX
Natural Resources Management	XX	XX	XXX	X
Policy Analysis	XX	XX	XXX	X

With limited resources, there is a need to concentrate the activities of ILRI on priority areas. For much of the program, this is also where its main strengths lie. In other cases, it will need to invest in improving its own skills base and to develop cooperative programs, networks and consortia.

Research for the livestock sector, like research for other areas of developing agricultural, extends across the full spectrum from basic work to strategic, applied and adaptive. Elements of the program may have global relevance, or relate to an ecoregion, or perhaps to a particular national or local situation. The role of ILRI, like other CG centres, will be to focus largely on strategic and applied work of global or ecoregional relevance (see fig. 1). For some of the strategic work, linkage with advanced research institutions will be necessary, while for much of the applied and adaptive work partnership with NARS is essential.

The first three areas, animal health, animal genetics and animal nutrition are mainly ones of strategic and ecoregional research. In all three areas ILRI will be in a position to play a leading role internationally, but it will need to cooperate intensively with international organisations and institutions in developed countries. The applied research in these areas will be done by institutions in developing countries with which cooperation will also be necessary.

The four other areas (feed resources, production systems, natural resource management and policy analysis) are mainly of an eco-regional nature. For this group of areas, the balance of cooperation will be more towards institutions in developing countries and with other international research centres.

3.3 Animal Health

Animal health is a major constraint to increasing productivity of livestock in tropical countries. It has been estimated, for example, that losses due to disease are equal in value to one quarter of annual animal production in Sub-Saharan Africa. (See Box 1)

Disease problems can be classified into three categories. The epizootic infectious diseases which form the first category are mainly virus diseases such as foot and mouth disease and Rinderpest. With some exceptions they have been important in the past in the developed world with the result that a great deal has been invested in good technologies for their control. The challenge in developing countries is essentially one of transferring this technology into effective programs to be carried out by national veterinary services, voluntary groups and agencies. The need for involvement of ILRI in this group of diseases would be limited largely to those cases where it may have skills (in diagnosis, epidemiology, vaccines) which could be useful in helping the process of transfer of technologies. As opportunities emerge, research to develop technologies more appropriate to the needs of low income producers could be pursued in partnership with national institutions and international development agencies. This could also apply to research on important epizootic diseases such as African Swine Fever, which have received relatively little attention to date.

The second category of diseases is the most important in terms of animal losses (see Box 1). This group is dominated by parasitic diseases, with some bacterial and viral diseases also. The two most important already dominate the program in ILRAD. Trypanosomiasis, a blood parasitic disease transmitted by tsetse flies, affects regions of Africa equal in area to that of the United States, and throughout this zone seriously inhibits livestock use. The disease is also present in both Latin America and Asia, where other vectors are involved and it also affects humans. Very considerable progress has been made in technologies for vector control, in diagnosis, and in understanding the parasite, the animal's response and the genetic basis of in-built tolerance of the disease. Producing a vaccine against the parasite is still problematic, but there are reasonable prospects for a vaccine against harmful enzymes produced by the parasite. ILRAD has played a leading role in much of these developments and ILCA has led a multidisciplinary field based multilocational research program on trypanotolerance and on the better exploitation of trypanotolerant livestock as an other option for trypanosomiasis control. ILRI will therefore have a tremendous comparative advantage. While continuing the research, in collaboration with institutions of developing countries (mainly CIRDES, ITC, ICIPE and NARS), it will be particularly well placed to optimise the combinations of technologies which are most likely to give results in the future.

Also included in the second group of diseases are those carried by ticks. The most important is Theileriosis or East Coast Fever, which has been the second focus of major work in ILRAD. The technical challenges are also very great, though the prospects for eventual production of effective vaccines seem better.

Research aimed at this second broad category of diseases should continue as major themes in the animal health program of ILRI. The reasons include the continuing importance of these diseases, the leading position in terms of knowledge and expertise which has been built up, the fact that such diseases must be studied where they occur, and the potential spill-over of research results from these programs into other important animal diseases. There are also potential benefits for human health, because of the very good animal model for cell immune response. The main related diseases which can profit from existing work include other forms of

Box 1: Costly Diseases

Animal diseases impose three kind of costs: losses through mortality and reduced performance, costs of preventive and curative treatment, and the cost of lost opportunities where development is prevented. All three cost elements are very high in the case of blood-parasitic diseases which are prevalent in tropical countries. They particularly inhibit development of milk production, which usually involves the upgrading of local cows to higher producing, but more disease-susceptible genotypes. Often such development is possible only at the price of an additional environmental cost - the heavy use of insecticides and acaricides to keep vectors under control.

Of the tick-borne diseases, anaplasmosis and babesiosis are a threat to over 700 million cattle world-wide, including two thirds of those in South East Asia. These diseases have been estimated to cause losses of 1.5 billion dollars annually in Latin America. East Coast Fever, specific to Africa, has been estimated to cause direct losses of 170 million dollars per annum.

Tsetse fly transmitted trypanosomiasis, which affects both livestock and humans, is endemic across some 10 million square kilometres in 37 African countries. Its cost in cattle alone is estimated at more than 500 million dollars per year. Other forms of trypanosomiasis are important diseases in Latin America and South East Asia.

As with malaria, an effective vaccine would be the ideal control method, but this has proved an elusive goal. New approaches to vaccine production for East Coast fever are being pursued, but for each of these diseases, the programme is being broadened to address all avenues of cost-effective control.

theileriosis, babesiosis, anaplasmosis and cowdriosis (all blood system parasites) and dermatophilosis (a bacterial skin infection), all with worldwide incidence.

Less specific, but very widespread and costly, particularly in swine and small ruminants, are a number of other diseases caused by internal parasites. It has been estimated, for instance, that over half of the \$4bn annual losses from animal mortality and morbidity in Sub-Saharan Africa are due to internal parasites. Drug control can often be effective, but expensive and inducing resistance. Research on forms of biological control, including use of inherited tolerance, is needed.

The third category of diseases includes those associated with intensification of livestock production (mastitis, salmonellosis) as well as zoonoses (tuberculosis, brucellosis, rabies). As with the first group, these are all diseases which have been the subject of extensive research in the developed world in the past, and where the challenge is now largely one of effective technology transfer. They do not constitute a high priority objective for ILRI, but opportunities for the development of low cost appropriate technologies should not be precluded.

The background against which the animal health research program of ILRI must operate is different from that faced by comparable institutions in early stages in development of the developed world. There, the market potential for drugs and vaccines stimulated enormous investments from the private sector, and many of the solutions have come from that quarter. There is no such volume of commercial research aimed at solving the problems of animal health in the developing countries. Part of the challenge, therefore, is not just to produce scientific solutions but to ensure that the cost of implementing these solutions is low enough for their deployment in the prevailing production systems and social and market circumstances of developing country livestock production.

One of the advantages of the new unified institution will be its ability to combine skills in livestock husbandry, animal diseases, epidemiology, sociology and economics to better understand the complex nature of diseases in different livestock production systems. The interdependence of health and nutrition is of particular importance. The combination of different technologies into management practices leads to the relatively new concept of Integrated Health Management. ILRI will also have available the range of skills and knowledge necessary to explore and exploit the range of natural resistance to tropical diseases which is now

recognised as a highly valuable part of the genetic heritage of domestic livestock in developing countries.

The goal of the Animal Health program will be the development of Integrated Health Management systems to maximise productivity by reducing the impact of the target diseases. The outputs will be knowledge and technologies usable in developing country economic and social conditions, and the benefits, potentially very large, will be proportional to the reduction in disease impact.

3.4 Genetics

The experience of improving livestock productivity in many countries has clearly demonstrated the enormous gains which are possible by improving the genetic capacity of the livestock involved. Such genetic improvement must, however, be part of a balanced advance in all aspects of production. Thus, while inadequate genetic capacity may be a constraint where the environmental conditions for production are good, equally, environmental constraints can often put limits on the ability of superior genotypes to perform. The potential for genetic improvement also differs with the species, with the potential rate of genetic change often being related to the reproductive potential.

Most of the genetic improvement achieved to date, as in the case of plants, has been through breed or strain replacement, exploiting differences that have been created by selection within-strains.

For most of the conventional production traits, such as individual growth rates, selection methods and criteria are well defined and there is no compelling reason for further research by ILRI in this area. For many of the adaptive traits, like diseases or drought tolerance, this is not the case and strategic research is required to identify practicable selection criteria and methodologies for such traits.

In many developing countries, livestock must perform under exceptional challenges from the environment: disease, under-nutrition, climatic stress. The study and exploitation of genetic ability to withstand and perform under these conditions cannot be undertaken outside the tropics. Work in this area addresses, in a potentially sustainable way, some of the major constraints to livestock production. It is furthermore an area in which components of ILRI already have a strong track record. Current work is directed at trypanosomiasis and helminthiasis, but the results of this research can have an important impact on other diseases also. The genetics of disease tolerance should therefore be an important theme in the program of ILRI.

The advancing front of molecular biology is steadily opening new possibilities for understanding and utilising genetic variability in animal populations (see box 2). It is very difficult to predict where the benefits will come. However, in the context of livestock in tropical environments, the most exciting possibilities lie in the area of genetic mechanisms which counter disease challenges. Furthermore, the mapping of the bovine genome is now almost complete, and the potential of that knowledge should become apparent in the next few years. Scientists at ILRAD have played a leading role in this development, and the momentum of that work should be maintained in collaboration with the advanced institutions of the developed world. The focus should be on the rapid adaptation of new knowledge in this area to practical livestock improvement in developing countries.

There is a growing awareness that the global heritage of types, strains and breeds of domestic animal which have evolved over the millennia are now, like much of biodiversity, disappearing at an unprecedented rate. There is therefore an urgent task to evaluate, document, and in certain cases conserve these genotypes. This is an activity which has both research and operational dimensions, and is therefore one which goes beyond the responsibilities of a research institution. However, there is a strong role for ILRI in developing the potential of new methods in molecular biology in this context. In particular, it should pioneer the development of methodologies for characterisation, utilisation and conservation of animal genetic resources. It could also have a particularly important role to play in relation to African livestock.

Taken together, these current and potential activities constitute the basis for a strong genetics program, in which all of the criteria used for establishing priorities are well represented.

The goals of the Genetics program will be, in co-operation with others, to develop specific techniques to identify superior genetic characteristics in tropical livestock, and to develop

Box 2: The Promise of the New Genetics

Early in 1994, scientists working in several countries provided the first comprehensive linkage maps of the bovine genome. Over 200 genetic markers, spaced throughout the genome, have been identified. The purpose is to create a reference set against which useful genes - for disease resistance or production traits- can be located.

ILRAD scientists were part of this activity, and the compilation of the maps is a key milestone in the application of a whole range of techniques in molecular biology to the problems of improving the performance of cattle world-wide, and particularly in developing countries. Similar work in sheep and pigs is at an equally advanced stage.

In countries where agriculture is highly organised, systematic selection has transformed the productivity of cattle populations. However, this has been possible only because extensive and accurate production recording, often linked to artificial insemination, combined with high reproductive rates and low mortality all permitted accurate and intensive selection. In most developing countries, it will be many years before such infrastructure is possible. The particular promise of the new molecular genetics is that it offers the possibility of putting in place effective selection programmes using molecular markers (marker assisted selection or MAS) without the need to develop a large infrastructure.

The prospects of success with MAS should become clear within the next five years. They depend heavily on the extent to which significant traits are controlled by relatively few genes. The sharp genetic differences in disease tolerance already documented in African cattle and sheep populations provide an ideal starting point from which to develop the potential of MAS over the full range of traits of economic value. Exploring the potential of this area requires a combination of knowledge and work in animal diseases, breeding systems and production structures, as well as in molecular and quantitative genetics. ILRI will therefore be strongly placed to play a leading role.

practices for the conservation of these characteristics and means of propagating them. The outputs will be information and molecular and quantitative techniques useful for these purposes. The benefits are difficult to quantify, but are potentially very large if simple techniques are developed. They would also be of particular value in developing countries where the infrastructure for conventional animal breeding programs is usually absent.

3.5 Nutrition, Feed Resources

Feed supply is the major input to most livestock systems. In developing countries, over 85% of ruminant livestock and pigs are produced in farming systems where the feed supply is a varying mixture of natural or specially grown forages, high energy feeds, and crop residues. Half of developing country poultry are produced in landless systems with bought-in feed, while the remainder subsist mainly as scavengers.

The broad technical challenges are:

- low digestibility of much forage
- shortage of available protein, which exacerbates the energy deficiency
- strategies to balance energy/protein in diets
- identification of critical nutrient deficiencies in feeds and their correction with locally available supplements
- production of high density feeds for non-ruminants, in a way which is non-competitive with grains for direct human consumption
- the presence of anti-nutritional factors in some tropical feeds
- detection and targeted correction of mineral and vitamin deficiencies

These challenges constitute an agenda of research priorities, some of which are strategic, others of an applied nature, but with most being questions of local adaptation of a range of existing technologies.

Nutrition: Nutritional research, particularly for monogastrics, is well-developed worldwide. Ruminant nutrition is also well advanced, but is inherently more complex, and there are opportunities for developing new knowledge in nutrition and physiology to the benefit of ruminant production in developing countries. It is also an area where advances in molecular biology may create opportunities for more efficient management of rumen function through the manipulation of rumen microbes to enhance fibre digestion, microbial protein supply and detoxification of anti-nutritional factors. ILRI will have the greatest range of expertise in this area within the CGIAR, though CIAT also has capability and capacity for work on feed quality. The research agenda, as well as the complementary notes of ILRI and other centres will be the subject of a planning workshop in 1995.

In order to conduct this nutritional program it will be essential to maintain effort in physiology. This will be particularly important at the eco-regional level where strategic research on the development of techniques to overcome nutritional barriers and generally improve the biological efficiency of animal production requires an understanding of the physiology of productive processes under tropical conditions. Furthermore, the use of animals for traction, an essential element in most tropical cropping systems, requires parallel work on nutrition and physiology.

The primary goal of the Nutrition program is improved efficiency of use of tropical feeds by ruminants. The outputs will be knowledge which can be used to guide feeding strategies, supplements or management practices. The probability of usable outputs is difficult to estimate, as is the extent of potential application.

Feed Resources : Production. The technologies involved in producing feeds for animals are largely agronomic ones involving food crops (which provide residues), special purpose forage crops or multi-purpose crops and trees. ILRI will need to address forage production on its own initiative in some environments, while in others the leading role will fall to other CG centres. Much of the research will be location-specific, and will need to be undertaken by NARS. There is therefore a continuum of work required, largely inseparable from farming systems research and needing close integration of effort by ILRI and its CG and NARS partners.

ILRI's research will be integrated with the studies of forages, pasture and the use of multipurpose trees conducted by CIAT, IITA, ICRAF and ICRISAT. Activities in SSA will be coordinated with activities in Asia, Latin America and the Caribbean and West Asia and North Africa, led by NARS and IARCs with regional mandates including CIAT, ICARDA and ICRISAT. It is anticipated that primary responsibility for feed production research will be handled increasingly by plant and agronomic scientists in partner institutions.

Feed Resources: Utilisation. ILRI will have a comparative advantage for research on nutritional value of forages, leaving agronomic and cropping system characterisation to crop centres and NARS. Since ILRI will have the only significant concentration of expertise within the CG system on animal nutrition and physiology, it has the leading role in all research on feed utilisation. This will require, as demonstrated in recent ILCA results, *in vivo* characterisation as well as *in vitro* studies.

Eco-regional work, much of it strategic in nature, will be required to investigate protein sources and supplementary strategies, technology for improving the digestibility of crop residues, and techniques for storage of residues and forage crops. In particular (see also 3.9), it is clear that in Africa and Asia the intensification of livestock farming cannot, at least in the short term, follow the same cereal-feed based path as in the developed countries. This means that the search for increased efficiencies in the use of forages and crop residues has heightened priority. Since protein supplementation is a big factor, research on protein sources and use is also highly important. Most of this work will need to be conducted in the context of farming systems research, and therefore offers good opportunities for interaction with other CG centres, and with national institutions in developing countries.

The objectives of the Feed Resources program are to improve the efficiency of animal production by the provision of better balanced diets, using indigenous or locally produced feeds.

The outputs will be information usable for that purpose. The probability of useful results is very high, and the potential benefits are very large.

Forage Genetic Resources The documentation, conservation and testing of global forage-plant resources is already a significant activity of several CG centres. CIAT, ICARDA, ILCA and ICRAF have ongoing programs addressing forage genetic resources. CIAT has identified grain and legume species adapted to low nutrient acid soils for the humid and subhumid tropics. ICARDA has focused on pasture species adapted to sub-tropical/mediterranean dry areas; ILCA on legume, tree and grass species for smallholder mixed farming systems - plus conservation of indigenous species from major ecological zones in Africa; ICRAF concentrates on multi-purpose tree species.

The program has two principal components:

1. Acquisition, characterization and evaluation for adaptive traits (resistance to plant disease, parasites, climatic stresses, etc.); for agronomic traits; for traits affecting cropping systems; for nutritional/anti-nutritional factors.
2. Preservation of genetic diversity, both *in-situ* and *ex-situ*. CIAT, ICARDA and ILCA maintain large cold storage gene banks for *ex-situ* preservation. ICRAF plans to develop such a gene bank. CIAT and ILCA have capacity for *in-vitro* propagation and forage seed health research.

ILRI will also inherit major capacity for *ex-situ* preservation; in Ethiopia, ILCA has sites for forage characterization and seed multiplication at different altitudes/temperatures, soil types, rainfall amounts / patterns, etc. This capacity can be utilized to support national needs for forage germplasm, seeds and training to strengthen and build national programmes in feed resources.

The creation of ILRI provides both the need and the opportunity to integrate the System-wide activities on forage genetic resources. In partnership with CIAT, ICARDA, ICRAF and IPGRI, this will be an important objective.

3.6 Systems

It has become very clear in recent times that since research results must find their application in complex farming systems, the research itself should increasingly extend to the study of these systems and to the technical, social and economic interactions they involve. The goal is to exploit the synergies between factors to achieve results which are greater than the sum of their individual potential contributions. The challenge for the new centre is to broaden the nature of its research in this direction without at the same time losing the professional sharpness and accountability which goes with clearly defined discipline based research.

Systems research can operate at two levels, which should be linked. The first is the evaluation on the ground, in real farming situations, of a range of technologies and of their efficient and integrated management (see Box 3).

ILRI will need to be involved in a carefully selected number of such systems studies. However, most of such work is still to be carried out by colleagues in NARS. The second kind of systems work involves the use of modelling techniques, based on good field data, to explore and extend the understanding of how the elements of the system interact. This can operate at a micro level(e.g. for nutrient flows) or at a macro level (e.g. for land/livestock use). ILRI will have a comparative advantage in conducting such systems research.

An important goal of this work will be the development of indicators of ecosystem health or sustainability, which could be used by system managers on different levels. Knowledge and methodology developed for this purpose could be truly global in relevance. Historically, each CGIAR centre has developed its own network of systems and studies. This is one area in which the eco-regional initiative can take concrete form, by consolidating inter-centre interests in carefully selected systems studies. These sites could be used to demonstrate the full R & D process, and could act as focal points for technology transfer of research methods, knowledge and technology, as well as training for scientists in NARS and NGOs.

In addition to providing the most relevant medium for inter- centre cooperation, the development of eco-regional systems studies in the main areas where livestock are important is a primary means for ILRI to respond to the needs and expectations for its activities in Asia, and

Box 3: The Mombasa Dairy Project — An Example of Systems Research

Demand for milk for East African urban centres is expanding rapidly. Local production has lagged because of technical constraints (feed supply, disease, genotypes), policy disincentives, and poor market links. This challenge is being successfully met by the multi-partner, multi-disciplinary KARI / ILCA smallholder dairy project, a model for ecoregionally relevant livestock systems research to serve high priority development needs.

In 1988, ILCA established a joint research project with the Kenya Agricultural Research Institute (KARI) to develop intensive smallholder dairying in the Coast Province. The KARI / ILCA team works closely with the National Dairy Development Project, national and international research institutes (including ILRAD), and extension agencies. KARI scientists have generally emphasised locally relevant research with ILCA scientists addressing the broader issues relevant to market oriented dairy production in east and west Africa.

The project has made considerable progress in advancing local production as well as in developing and testing more general models of dairy systems. Improved feed production, based on grass/legume mixtures, has reduced farmers' reliance on bought-in feed. Cost-effective feeding practices increased milk yields by 25% and reduced dry-season liveweight losses by 75%. Milk sales increased household income by the equivalent of the salary of one casual wage earner per lactating cow. Moreover, 2 litres of milk per day were available for family consumption.

While many of the technical problems and their solutions are specific to the Mombasa area, the general model is seen by World Bank and other agencies serving East Africa as having wider relevance.

to a lesser extent in Latin America. Systems research will also ensure the relevance of ILRI's other programs to potential end-users, and provide the criteria for evaluating the impact of interventions.

The objectives of the Systems research program will be the improvement in the efficiency, and the conservation of the resource base, of tropical livestock and mixed farming systems. The outputs will be a better understanding of the interactions between the factors which contribute to these systems. The benefits are dependent on how this information is used, are potentially large, and will generally be specific to particular ecosystems.

3.7 Natural Resources

The conservation of natural resources should be an integral part of good farming practice. If it is, the system is sustainable. When farming systems undergo rapid change, this balance may be disturbed, with long-lasting damage to the sustainability of the system. This process is underway in farming systems in many parts of the developing world, as population and economic pressures force the pace of intensification of use of natural resources. Management of natural resources has therefore become a focal point for concern and for action, including action at the level of international agricultural research.

In the livestock sector, this concern presents a number of challenges appropriate to the CG. The first is in the world's pastoral areas. These constitute two thirds of the utilised agricultural area of the developing world. The production systems involved are solely concerned with livestock. The production systems have evolved with animal genotypes and management practices adapted to the nature of the environment, which is usually one with rainfall too sparse or infrequent for cropping. The most important adaptation has been the evolution of patterns of mobility of livestock.

The three livestock production systems into which these areas are classified are estimated to contain about 12% of the cattle and 20% of the sheep and goats in developing countries. However, their share of total production is considerably less. The prospects for intensification are in many cases limited. However, there are also many opportunities for reducing losses through better disease control, and for increasing offtake by improved linkages to areas of settled agriculture. The research agenda focuses strongly on the conservation of the natural resources. The new international livestock research institute will be uniquely qualified to contribute to the understanding and management of the livestock populations which are the sole instrument through which these fragile areas in turn are managed. This is largely a new theme and should form part of the strategic program as resources permit. The role of NARS will be crucial, and strong collaboration will be necessary between ILRI and national and international partners, and particularly with ICARDA.

The proper management of the livestock element in most mixed farming systems is important in the resource management and hence to the sustainability of these systems. The research in this case, however, is likely to be very much part of the research agenda under livestock production systems, and to be geared to local or regional conditions. It therefore falls at the eco-regional end of the spectrum, to be conducted in collaboration with national institutions.

The techniques necessary for these studies include economic, social and technical analysis at field level, together with the use of geographic information systems and appropriate system modelling. The work is therefore by nature interdisciplinary, and has relevance over a wide area of application.

An area not yet addressed by the CGIAR system is the issue of the management and development of wildlife and particularly their interaction with livestock farming systems. This has a particular and urgent relevance in Africa. Using some of the additional funding expected for livestock research, ILRI could explore opportunities to develop work in this area as a matter of priority.

In the developed world, production increases have been achieved via a process of intensification. This is particularly observable in the areas of pig, poultry and milk production. These technologies are now being adopted in developing countries and, as with developed countries, are associated with significant environmental problems like eutrophication, and soil, water and air pollution. In recognition of the significance of this problem, especially in Asia, where the concentration of monogastrics in urban and near urban areas is high, ILRI should explore opportunities to alleviate these pollution problems and to develop alternative production technologies for developing countries that are more environmentally friendly.

The objectives of the Natural Resources Management program will be better conservation of the environment, particularly as it constitutes the resource base for farming systems in developing countries. The outputs will be methodologies for on-farm R&D, and information which can help farmers and policy makers in developing and implementing better management practices. The benefits will be region-specific, but can be of very great importance for the long term sustainability of farming systems.

3.8 Policy, Economics, Social Sciences

It is now generally acknowledged that the constraints on technical improvement in agricultural productivity very often lie at the level of economic policy and factors of social and economic structure. These factors are usually intimately involved with the technical elements of the production system. Their analysis and resolution therefore requires the deployment of expertise across the range of technologies and economic and social factors involved. The new CG livestock research institution has a strategic advantage in tackling these problems, because it can bring the technical, economic and social expertise together in an integrated way. This broad area should therefore be a substantial part of the agenda for ILRI, and should involve a significantly higher set of resources than the combined current activities of ILCA and ILRAD.

The research agenda, in certain areas, will need to be worked out carefully in collaboration with other CG institutions, particularly IFPRI and ISNAR. ILRI will need to be in a position to speak with authority on the broad economic background of the livestock industry, particularly in developing countries. Part of the agenda will therefore need to be concerned with important

aspects of economic strategy as they affect this sector. This will involve close interaction with IFPRI, World Bank, FAO and others.

A particular focus of social and economic research should be the analysis and improvement of factors affecting technical change in livestock agriculture. This area would include, for example, impact assessment of disease control strategies, and economic analysis of technical innovations such as forage improvement techniques, or changes in breeding systems. Much of this work will need to be carried out in close cooperation with parallel research on systems and natural resource management, as well as with national institutions.

Ruminant livestock is very directly based on the use of natural resources, mainly land, and frequently in marginal, fragile ecosystems. Understanding, and improving, the factors involved in natural resource management will require economic and social studies, with a technical dimension.

A further area where social and economic studies are required is to develop a better understanding of the commodity system. As population growth, urbanisation and economic development impose a pattern of rapid change on developing country livestock production, the marketing chains which link demand and supply will also be changing very rapidly. Research with the objective of understanding and better guiding these changes should be an important element in the program.

Despite the evident advantages which ILRI will have in combining technical, social and economic expertise, the agenda where these intersect is far too broad for a single institution to provide leadership in all aspects, even within the CG system. IFPRI has a special responsibility in this area, but commodity research centres like IRRI, ICRISAT or ILRI also have important role in policy formulation. Careful choices will therefore need to be made with, for example, IFPRI playing the leading role in market and macro economic studies, but ILRI taking the lead in impact assessment and economic analysis of technical innovations including animal health interventions.

The objectives of the program in Policy Analysis, Economics and Social Science are the better formulation of public policies and individual decision making for livestock producers in developing countries. The outputs will consist of knowledge and understanding of the interaction of technical, social and economic factors involved. The probability of useful outputs is high, and the impact on the welfare of producers and consumers is potentially large.

3.9 Non-ruminant Meat Production

Half the value and nearly two thirds the volume of total meat production in developing countries currently comes from pigs and poultry. The dominance of pigs and poultry is particularly marked in East Asia (including China), where half of the developing country total meat is produced, and where 90% of production is from monogastrics (75% from pigs, 15% from poultry). Up to the year 2010, poultry production in developing countries generally is expected to expand at over 5% per annum, pig production at 4% and output of meat from ruminants at about 3% per annum.

Pig and poultry production in developing countries, and particularly in East Asia, is therefore a huge and dynamic sector whose research needs must be considered in the context of the extended mandate of the new CG centre.

In all previous reviews of priorities, the conclusion has been to exclude these sectors from the agenda on the following grounds:

- the demand was mainly in Asia, outside the geographical mandate of ILCA.
- the species were outside the mandate of ILRAD.
- these industries appeared to be developing rapidly, largely with the transfer of existing technology.
- because of the rapid evolution of industrial scale production, private sector resources were likely to be rapidly deployed to resolve any technical constraints.

In fully developed economies, smallholder pig and poultry production essentially no longer exists. The transition to industrialised production has taken place in a few decades. The same pattern can be seen in the wealthier developing countries. How far and how fast it will proceed throughout the developing countries generally is by no means clear. The process depends primarily on the prices of grains and animal products. The conventional view is that the market

price of grains available internationally will continue to decline. However, shortage of, and other priorities for, scarce foreign exchange will prevent industrialisation of these sectors in the poorer countries (the Nigerian experience in the 1980s is instructive). Furthermore, the conventional wisdom is challenged by the view that low world grain prices are not sustainable in the long term, because they are dependent on fossil energy inputs, and do not include high imputed costs in terms of soil loss, land degradation and global warming. This view leads to the conclusion that longer term strategies for meat production must shift to the use of alternative feeds for pigs and poultry and a greater reliance on cellulose digesting ruminants and other animals.

If it is accepted that the commercial sector can resolve its problems from its own resources, the principal question then is whether the traditional sector will continue to be large enough to justify attention; whether there are opportunities for improving its productivity; whether research is needed to promote this; and whether some of this research should be the responsibility of an international centre.

It is difficult to produce clear answers to all of these questions. However, 87% of pig production and 50% of poultry production is estimated to be still in mixed farming systems in developing countries. It seems that the traditional sector will continue to serve rural areas and small towns and that its development will need applied research (adapted vaccines and drugs, adapted feeding with local feeds), transfer of technology and good extension services. These are not activities appropriate to ILRI, and it is therefore not recommended that the new centre devote significant resources to this area initially. However, within this very broad spectrum of production systems there are undoubtedly specific technical constraints to which ILRI's range of expertise can respond. In addition, the developing systems work in Asia will clearly involve work with swine, ducks and other poultry. It is, therefore, recommended that the centre should undertake a consultation with the principal NARS and other agencies in Asia. This might be expected to lead to the establishment of a research network, which in turn could involve the development of specific lines of research within the CG system.

3.10 Asia, LAC, WANA

ILRI inherits a global animal health mandate, and takes on a new global responsibility for other aspects of animal production. The consequent research requirements for the three regions outside Africa were separately addressed.

In *Latin America*, the research agenda is smaller than in Africa, and strong national and other institutions exist. Strategic work undertaken by ILRI can readily be extended, along with local partners, in the following areas: animal health, animal genetic resources, systems studies and natural resource management. However, initiatives in this direction should where possible build on existing structures. CIAT has a strong presence in the area, and a strong program in forage resources. This program should be more closely integrated with that of ILRI which, in turn, should use CIAT as its operational base in Latin America.

Asia has a large research agenda, in many ways different from that in Africa, and serving a more dynamic pattern of growth in the livestock sector. Buffalos and monogastrics are much more important. It also has some very strong national research programs. Livestock production is important for very large temperate and sub-alpine areas, for which the experience of ILCA in the African highland zones will have relevance. As in Latin America, some strategic themes can and should be extended to Asia. Several issues, already under examination in Africa, like those associated with the use of lactating cows for traction and the problems associated with anti-nutritional factors which inhibit production, lend themselves to the development of highly effective South-South collaborative research programs. If support for the global mandate and research in Asia is strong then an ILRI presence in Asia could be established in association with a national institution or another CGIAR centre. Irrespective of this initiative a web of collaborative networks should be established. These linkages will be mainly with national institutions, though specific cooperation with IRRI, ICLARM and ICRISAT, as well as co-operation with CIAT in the forages area, will also be desirable.

The larger developing countries in Asia are special cases. China, with a quarter of humanity, and a rapidly expanding economy, has special requirements which must be met principally from its national research system. India has a large, well organised commitment to agricultural

research, which has been highly productive, and which has much to offer the rest of the world. Interaction of ILRI with these systems will be very much on a basis of mutual contributions to the benefit of all developing countries.

The phasing of ILRI's response to its new challenges in Asia is important. It should begin in early 1995 with a structured consultation of the principal stakeholders in Asian livestock. This should be followed by the establishment of linkage groups or networks to take maximum advantage of existing investment. The third stage would involve the deployment of ILRI staff on carefully selected programmes. The pace of which these new responsibilities can be taken up will depend on the extent of donor support for ILRI's new global mandate.

In the *West Asia / North Africa* region the research agenda relevant to ILRI is mainly coincident with the problems of natural resource management in pastoral areas. The existing programme at ICARDA addresses the principal requirements in crop-livestock systems. Given its new global mandate and the fact that two thirds of the world's agricultural land is used in pastoral systems, ILRI will need to develop its capacities in the types of ecosystem which predominate in the WANA area. In collaboration with ICARDA and other partners, it will contribute the complementary livestock expertise.

3.11 Institution Building

The responsibility of an international research institution is to communicate its results and information efficiently to a wide range of clients, and to assist, by training and cooperative activities, the development of national institutions.

In addition to research capacity building activities for NARS in Asia and Latin America the particular continuing needs of NARS in sub-Saharan Africa have been widely recognised. ILRI should assist in building research capacities in support of livestock research with emphasis on NARS needs in sub-Saharan Africa.

The policy of collaboration with NARS should lead to full integration involving joint planning of research protocols and execution of the research agenda of ILRI by ILRI and NARS scientists. This procedure which is already in place at ICARDA and IRRRI, among other IARC's, should result in the effective discharge of the institution's responsibility to NARS by promoting efficient communication, assistance in training scientists and technologists and effective transfer of new technologies, thus contributing to the development of the capacity of NARS to carry out research in livestock.

Progressively greater involvement with Universities in countries where ILRI is active should also be promoted. Particular importance attaches to collaboration with CIRDES and ITC. These are internationally supported regional centres which have gained the respect of African governments. Their strong links with national programs throughout West Africa make them effective partners in applied research for the region.

The use of collaborative networks to deliver training and cooperative activities will have increased importance in ILRI because much of its increased mandate will have to be conducted in this way. Mechanisms should also be developed to ensure the greatest impact of training on NARS needs in integrating crop-tree- livestock research training by drawing on the expertise and facilities of other CGIAR centres.

The collection and dissemination of information is a crucial service of any research institution both in direct support of its own research, and indirectly as a mechanism for strengthening the research process of its partners, including NARS. ILRI should maintain its involvement in this area, and should contribute actively to the adaptation of new developments in information technology to the needs of international research and development. This is also an activity in which collaboration with other providers of information will allow the development of a comprehensive and global service in support of livestock research without duplication of effort and resources.

Economies of scale in institution building will be possible from the combination of the existing resources on information and training, as well as their administration, in ILRAD and ILCA. The existing networks, mainly based in ILCA, can now serve the wider institution. In addition, plans for inter-centre training, as already developed by ILCA and IITA, can be extended. All of these activities can be put on a more cost-effective basis with the use of

computer assisted methods for information sharing and instruction. Finally, the opportunity for South-South information transfer should be considerable under the new wider mandate.

3.12 Wider Horizons

The present report has been prepared in parallel with a number of other initiatives. The first of these has been the necessary preparation of a Medium Term Plan for ILRI, based on the tight financial parameters provided by the TAC, and on the need to both continue and adapt the programmes inherited from ILRAD and ILCA. This MTP was issued in May 1994, and proposes considerable reallocation of resources (See Box 4).

Box 4 : ILRI's Medium Term Plan

1994 is a transitional year, and the mandates and resources of ILCA and ILRAD will pass to ILRI when it is established. An MTP for the new institute, incorporating the programs and plans of its two predecessors, was prepared in May. It looks in more detail at the changes needed in the period 1995-1998. Its main points are as follows:

With the establishment of a single institute, some economies in management and administration are anticipated (percent of senior staff positions declining from 16% to 11%) The two major sites at Nairobi and Addis Ababa will be retained, while resources will be redeployed to take up the new mandate in areas outside Africa, and particularly in Asia.

The baseline MTP (i.e.. after restructuring, but before any extension or contraction) shows a reallocation of a quarter of SSY resources. This entails a reduction in animal health (mainly trypanosomiasis), an increase in genetics, a substantial increase in systems (including feed resources and natural resource management), and a small increase in socio-economic and policy studies. Institutional strengthening is maintained, and administration and operations are reduced.

From existing resources, a shift of 9 positions to other regions (mainly Asia) is planned. Practically all additional resources are also targeted outside Africa. Within the span of the MTP, this would give 20% of senior scientific staff positions deployed outside Africa.

A new form of CG-wide management structure is proposed to integrate the global programme. It has ILRI in a "strong convenor" role. Funds deployed in this programme will come from a special common pool, augmented by funds from participating centres. Disposition of these funds will be on a competitive basis.

A new competitive science linkage programme is proposed to link advanced research institutions to the more difficult scientific problems being faced.

Assuming confirmation of the TAC-approved budget for institutional livestock research at US\$ 23.8 million in current dollars in 1994, rising to an ILRI budget of US\$25.1 in 1995 and US\$ 31.8 in 1998, ILRI will enter the plan period with 105 SSY, rising to approximately 120 SSY in 1998 as programmes in other regions are initiated.

The second initiative is that proposed by the chairman of the CGIAR at its mid-term meeting in May 1994. He indicated that up to \$500 million would be made available annually for the next five years to support the development and improvement of national agricultural research systems. The deployment of these funds can be expected to reinvigorate the NARS, and to greatly increase the opportunities for effective partnership within institutions such as ILRI. To help make this new cycle of investment effective, ILRI must therefore pay increased attention to networking, cooperative research, and other activities which will support professional development and effective research in national institutions.

The third development, also initiated by the CG chairman, gives the prospect that financial support for the CG system will improve in the coming years. This is particularly important in the case of ILRI, which takes on expanded responsibilities with its establishment. Detailed planning for an expanded program will require careful setting of clear targets, and assessment of costs and benefits in each program area.

4 Implementing the Strategy

4.1 Introduction

Pulling all the program and structural elements together into a strategic plan for ILRI is not easy. A particular challenge is the fact that it starts with an enlarged mandate but a reduced budget. However, these circumstances provide both a need and an opportunity for some innovation in the way CGIAR centres do their business. Furthermore, the plan for ILRI must form part of a global CG plan involving other centres, as well as fitting in with a network of national and international research activities of which it constitutes a relatively small part.

4.2 The Present Balance of Livestock Research

As a starting point for considering CG-wide activities on livestock, the budgetary listings for the five centres which reported expenditure on livestock are shown in Table 5. Other centres (eg ICRISAT & IITA) identify fodder as a possible by-product but do not identify any expenditure as directed to livestock.

Table 5 MTP 1994 listed program expenditure on livestock by TAC category

TAC Category	ILCA & ILRAD	CIAT	ICARDA	ICRAF	TOTAL
	('000 USD planned 1994 expenditures)				
Animal Health	5164				5164
Animal Genetics	1374				1374
Animal Nutrition	804	200			1004
Feed Resources	1472	2140	424	353	4389
Livestock Production Systems	2078		2137		4215
Natural Resource Management	1066		1871	353	3290
Policy Analysis	440	65			505
Total	12398	2405	4432	706	19941

This presentation (which relates only to program expenditure listed as livestock) indicates that over one third of current livestock expenditure occurs in centres other than ILRI. This non-ILRI expenditure is equally spread over three research categories; Feed Resources (mostly in CIAT), and Production Systems and NRM (mostly in ICARDA). The remaining four categories (Health, Genetics, Nutrition and Policy Analysis) are the almost exclusive preserve of ILRI.

This broad balance of resource commitment for livestock over the CG system reflects both historical developments and present capacity. In some respects, it is a desirable pattern for the future: Animal health, Genetics and Nutrition are likely to remain almost solely in ILRI; the involvement of CIAT, ICARDA and ICRAF in feed resources, production systems and NRM is also likely to continue. However, in other respects, changes in the distribution of resources are called for. Policy analysis will require the involvement of IFPRI; genetic resource conservation will involve IPGRI; while the new responsibilities for Asia will provide opportunities for cooperation between ILRI, ICRISAT and IRRI. In addition, the increased emphasis on carrying livestock research through into systems work will call for closer cooperation with several crop centres, including IITA and ICRISAT.

The balance of effort between CG centres and NARS has not been quantified in the same detail. However, ISNAR figures show that in national systems in developing countries, livestock scientists account for about 20% of the total. Livestock expenditure within the CG is

now significantly less than 20% of total expenditure. The CG livestock effort is therefore a lower proportion of global livestock research than the CG system is of all developing country research for all commodities. This latter figure has been quoted as 4%. It can therefore be said with some confidence that CG livestock research represents less than 5% of all livestock research in and for developing countries.

4.3 Managing the Unified Strategy

ILRI will inherit most of the CG resources required for its livestock program from ILCA and ILRAD. The first challenge is the integration of their programs and resources. The structure within which this will be accomplished has already been decided - a single budget and management. The process then consists of further refinement of the program objectives, adjusting the manpower and resources to match the agreed program, and making best use of such economies as are possible in combining existing activities.

While most of the future CGIAR livestock activities will undoubtedly be within ILRI, substantial activity is also present in some other CG centres, notably CIAT and ICARDA. There are opportunities for increased collaborative work with several of the crop-related centres (CIAT, IITA, IRRI, ICRISAT) on crop-livestock systems, and on the inclusion of livestock feed aspects, where appropriate, in crop breeding programs. Collaboration with IFPRI and IPGRI will also be necessary.

Structures designed to manage the new CG-wide livestock program do not exist at present.

The options are as follows:

- To bring these activities under one management, that of ILRI. This would involve transferring substantial blocks of resources and budget in the case of CIAT and ICARDA, and lesser amounts elsewhere.
- ILRI could be allocated the resources to give contracts for livestock-related activities in other CG centres.
- ILRI could be designated as convenor of livestock activities throughout the CG, with supplementary funds to support cooperative activities.
- ILRI could function as coordinator of livestock-related activities throughout the CG system.

These options are on a decreasing scale of integrated control, and therefore an increasing scale of difficulty in making them effective.

The challenge in devising structures for an integrated program is to find a mechanism that sufficiently respects the autonomy of individual centres but ensures efficient collaboration towards agreed research goals. Whatever the level of integration chosen, willing cooperation between centres, with agreed procedures for sharing costs, responsibilities and credit, is necessary to produce genuine collaboration. Identification of such areas of common interest, together with advice and encouragement, can be facilitated by the TAC.

The minimum level at which an integrated program is likely to be achieved is that where ILRI functions as a 'strong convenor'.

Ecoregional Coverage: Following the TAC vision of interactive global and ecoregional activities, coordinated coverage of the main research themes and the main geographic animal concentrations will be the framework for the cost effective application of CGIAR resources for livestock research. This will be the first major area in the CG system to employ the new strategic concept of global- ecoregional management.

In the unified strategy ILRI, with its global mandate and an inherited capacity in animal health, genetics, feed resources and production systems research will play a central role. It will need a presence, or the presence of a collaborating centre, in TAC designated priority ecoregions, as livestock play an important role in mixed farming systems in all these areas. Its global overview will aid identification of strategic themes which will benefit from research in a variety of environments. At the same time ILRI's overview will enable it to put in perspective the strategic themes emerging from ecoregional activities in terms of their global importance and therefore their priority for CGIAR resources.

Two of the centres named to convene ecoregional research, CIAT and ICARDA, have long established pasture improvement programs and the skills and facilities for work at the strategic and applied levels in this specific research area. These two centres are logical focal points for

livestock activities in Latin America and West Asia and North Africa respectively. ILRI would need to complement their expertise as researchable issues of global importance emerge in these regions.

In Africa the major livestock production systems have historically been covered by outposted ILCA staff. ILRI will consolidate its outposted staff into TAC priority ecoregions. This will require continued close coordination with ICRISAT, convening centre for the arid and semiarid ecoregion, and with IITA, convening centre for humid and subhumid West Africa. ILCA has long standing successful collaboration with both centres through outposted teams.

The major gap in geographical coverage is in Asia. An early step towards a unified strategy will be a presence in the major livestock concentrations in priority ecoregions in Asia. This will mean the addition of livestock research skills, particularly in feed resources, to the ecoregional initiatives being organised by ICRISAT in arid and semi-arid Asia, and by IRRI in humid and subhumid Asia.

Coverage of the main ecoregions will allow a contribution to the sustainable improvement of productivity through the livestock subsystem. It will also allow globally important strategic research themes in feed resources, natural resource management and policy analysis, to be explored across a variety of site conditions worldwide. Early benefits from this unified strategy should include wider diffusion of ILRAD's diagnostic technologies to Asia, and the strengthening of CIAT's program of extending the application of its pasture know-how and materials to acid soil areas worldwide. It will also facilitate access to the experience and research results from the work of top level NARS in Asia and Latin America, to the benefit of other regions.

With the CGIAR ecoregional initiative in its infancy, pursuit of a unified livestock research strategy is timely. There is the opportunity for ILRI to negotiate participation in key ecoregional consortia now in formation. In the course of the ongoing characterisation of priority ecoregions it will be important to include descriptions of livestock systems, particularly in terms of feed sources and market environment. It will also be important to identify farmers' criteria for selection in areas where crops are grown for animal feed as much as for human consumption. Such information can be expected to influence the breeding goals set by CGIAR crop improvement centres.

The Inter-Centre Livestock Program Group (LPG): Within the CG system, the unified Livestock Research Program will require a sharing of authority and responsibility between centres. The key to success in this is a clear and agreed delineation of responsibilities and a corresponding division of credit for inputs and outputs. This must be achieved while preserving the primacy of the centres' roles. The mechanism proposed is to manage the unified program through an Inter Centre Livestock Program Group (LPG). The TAC could have an oversight role in the implementation of the unified strategy through this Group, though the external review process will hold ILRI primarily responsible for the effective implementation of the unified strategy.

The main functions of the group would be:

- To bring global coherence to and efficiency in the application of CGIAR livestock research resources.
- To agree priorities for new strategic research on livestock themes to be pursued by the CGIAR
- To agree which CGIAR centres, national centres or advanced institutes are best placed to lead and collaborate in priority research thrusts, and to allocate responsibility for convening consortia to support such lead institutions.

The LPG should not be seen as a committee to seek a lowest common denominator accommodation of existing institutional positions, but as a group charged with developing and guiding the system-wide program in a coherent way towards agreed goals. Its authority derives solely from the centres it involves (i.e., all centres with elements of the livestock program). They should each be represented in it. It should be chaired by ILRI (perhaps by ILRI's DG). Since it must balance the program requirements and centre interests, it should also have some independent members and the TAC should oversee its operation. The LPG should aim to minimise transaction costs, in part by ensuring that reporting procedures used for the program are the same as those of the individual centres

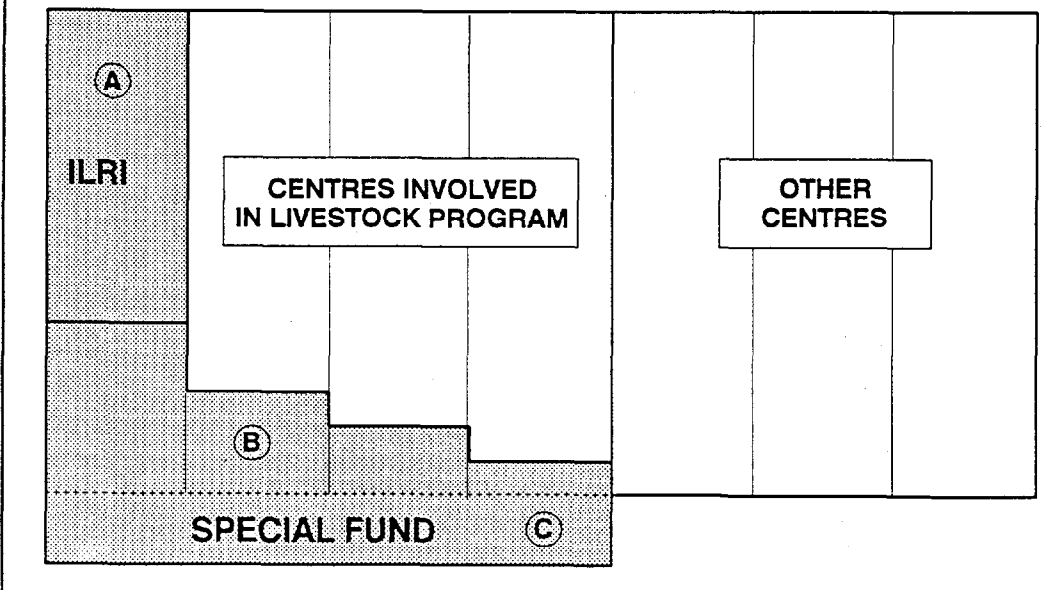
The structure proposed for the management of the system-wide livestock program is shown in Box 5.

Box 5: A Management Structure for the System-wide Livestock Program

The system-wide livestock program will consist of three parts (See Figure 2). The first (A) comprises that work which falls solely within the remit of ILRI. For that ILRI is responsible in the normal way to its board and the CG. Much of this work will be global and strategic in nature. The second (B) is livestock-related work, in ILRI and in other centres, which has some common themes across centres. Most of this will be ecoregional, and a good example is in forages. This part will include a section of ILRI's program and all livestock work in other centres. The third part (C) will include new initiatives funded from the special fund. All work carried out in parts (B) and (C) will also be within the responsibility of ILRI or of another centre, with normal reporting and management procedures. In addition, this work will also come within the jurisdiction of an Inter Centre Livestock Program Group (LPG), which will apply competitive evaluation of proposals and results.

ILRI will act as a 'strong convener' for the system-wide program, and will be responsible for reporting on the overall program, and for the operation of the LPG. The LPG will be responsible to ILRI and those other centres involved for the planning and evaluation of the program elements which are not the sole responsibility of ILRI.

Figure 2: *The CGIAR system-wide livestock program*



In four areas (feed resources, systems, NRM, policy) more than half of the CG's current commitment lies outside of ILRI, and is spread over three centres in particular. On a declining scale, a further six centres could be involved, particularly those with ecoregional convener responsibilities. The LPG would act as the overall linking mechanism between centres for these areas. Most of the budgetary and staff provision for program elements within the different centres should continue to come from those centres, and be subject to the normal management process of those centres. Special financial provision, as outlined below, should assist new initiatives in inter centre work, and the LPG would have the responsibility of agreeing the disposition of these funds.

The necessary extent of LPG oversight of other areas is less clear. Animal health, animal genetics (other than the conservation aspect), and animal nutrition are areas mainly of global relevance and predominantly the domain of ILRI. In the case of these areas, the CG system

already has adequate management, supervision and review procedures in place, in the form of the board and management of ILRI and the TAC. In order to be able to view the whole livestock program in perspective, the LPG will need to take these areas also into account, but should do so without unnecessary duplication.

As the convening centre for the CG-wide livestock program, ILRI would have responsibility for preparing an annual report on the overall program. Program components would of course also be reported on through the centres to which they belong.

While quite specific proposals have been put forward here on how the LPG should be constituted and operated, it is recognised that this body can function only with the consensus of those centres involved. Its structure and functioning must therefore be negotiated between ILRI and these centres. The experience of developing the Inter-Centre Working Group on Genetic Resources (ICWG-GR) will be particularly relevant. Furthermore, since the system-wide program will be strongly interactive with non-CGIAR partners, the mechanism and extent of their involvement in the LPG remains to be developed.

The Special Fund: In order to help the development of the system-wide livestock program, TAC has proposed the creation of a special fund rising to 4 million dollars annually. This fund is a new concept within the CG system, so minimal ground rules exist. However, certain guidelines can be suggested. It should be competitive, i.e., devoted to projects which have been selected on their objective merit in an open and competitive process. It should support co-operation, i.e., focus on projects which involve real commitment from more than one partner within the CG and preferably also links other institutions. Allocations should be multiannual. The fund, and the program it supports, should be operated against a clear background of where responsibility lies for financial matters, and for program planning, selection, execution and reporting. These activities in turn fit within a distribution of responsibility for all aspects of the system-wide livestock program.

That distribution of responsibilities should be as follows;

ILRI	-	Responsible to Centre Board for its centre program in the normal way
	-	Provides secretariat, chair, support for LPG
Other Centres	-	Responsible to Centre Board for implementing elements of the livestock program
	-	Report on these elements both to Centre Board and to LPG
LPG	-	Responsible (To ILRI and other centres with elements of the livestock program) for evaluating proposals, recommending allocations within the special fund, and reviewing outputs.

In most large national agricultural (and other) research programs in developed countries, there has been a trend in recent years towards competitive grant funding, and a parallel decline in assured institutional funding. The experience is generally regarded as having been satisfactory in ensuring appropriate allocation and in promoting change in the programs. Carried too far, it can have negative effects in undermining the stability and continuity which are also required to retain top quality staff and sustain worthwhile long term programs. In the CG system there is a good case for increasing the proportion of funding available in the competitive mode.

This is an important consideration at this stage in the formation of the system-wide livestock program. The new special fund provides an opportunity to move in the direction of competitive funding. It would also be desirable that an increasing proportion of the common livestock program should be exposed to competition for resources. However, this would require the agreement of the centres concerned, and would probably be feasible only in the context of a system-wide move.

4.4 Cooperative Links With NARS

The purpose of cooperative work with national institutions is a mixture of effective conduct of research, adaptation to regional requirements, and assistance in institution building. Such

networks of cooperation already exist. In ILRI, they will have an increased place, particularly because of the need to extend activities outside of Africa.

Because of the existence of strong research capability in national institutions and universities in some countries in Asia and Latin America there will be opportunities for conduct of appropriate ILRI research at these locations. This can be done on a contract basis, or with the creation, for a defined period, of a joint team of ILRI and local scientists.

The existing livestock centres, particularly ILCA, have established very effective networks of cooperation with African institutions. A limited number of similar networks will need to be established on an intercontinental basis. In some cases these can be extensions of existing activities. However, there are opportunities to capture and transfer significant benefits through additional networks. A good example would be one on milk production, in which the Indian expertise and experience could be made available to other continents.

4.5 Scientific Consortia, Competitive Contracts

While ILRI will have the necessary critical mass for effective work in those areas where the research is close to the moving front of science, its effectiveness can be greatly enhanced by close collaboration with other institutions which are at the forefront of scientific developments. These are mainly, but not exclusively, to be found in developed countries. Such cooperation already exists, but in ILRI should be given a new dimension by the allocation of reasonable funds for contracts with selected partners. Such a contract system is best managed through competitive bids, and the structure to manage a competitive contract system should be set up in ILRI.

4.6 What is New in the Strategic Plan?

The strategic plan for livestock research within the CG, and for its new centre, ILRI, has a number of new elements.

A new thinking is brought to livestock in the CG by a global approach with three important dimensions : it is geographically comprehensive, research will be integrated from farmer's fields to the laboratory, and it is implemented in a collaborative and complementary mode with other national and international institutions.

Under the new structures, some two-thirds of the CG's commitment to the livestock sector will fall within the responsibility of the new centre, ILRI. A new management structure is proposed to integrate the program which involves more than one centre.

In program terms, there is a shift to new approaches in some key animal diseases, and a broadening of the program in animal genetics to take advantage of new developments in biotechnology and molecular biology.

The program contains a new emphasis on feed resources, and new opportunities to recognise and integrate the contribution of centres across the CG system.

The animal physiology expertise will be reoriented to support and strengthen research in animal genetics, nutrition and health.

There is a new recognition of the reality that improvement in productivity of livestock and the welfare of people who depend on them requires the balanced advance of different technologies. These advances may sometimes be simultaneous, and sometimes sequential, and they interact also with social and economic factors. This emphasis on systems research is by its nature ecoregional, and involves an increased interaction with NARS.

Linked to this reorientation towards end-user benefit is an increased emphasis on economic and social research, as well as work on natural resource management. The development of indicators of ecosystem sustainability is proposed, together with the concept of Integrated Health Management

A progressive program of involvement with the strong national institutions and relevant CG centres in Asia is proposed. This should lead to the redeployment of some resources to Asia, though it should be done in a way which preserves the commitment to the urgent development needs of Africa. Deployment of additional resources in Latin America and WANA is not

proposed initially, though a strengthening and integration of livestock research in those regions, based on CIAT and ICARDA, is proposed.

Economies of effort and resources, and a new synergy, are expected from the integration of the activities of ILRAD and ILCA. Consistent with new core priorities some projects will be terminated. Restricted core and complementary research consistent with ILRI's mandate will be demand driven in response to donor perspectives.

The breadth of the program will require not only a broad scientific cooperation but also a broad cooperation in its funding. Funds already allocated to core budgets would continue to be managed by the centres, while part of the funds proposed by TAC to start inter-centre cooperation (USD 4 million) would be allocated on a competitive basis. A special group(LPG) will represent stakeholders and oversee the system-wide program.

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Position papers on specific items were prepared by members of the task force. These were on Asian requirements (Devendra), Pastoral Systems (Sidahmed), Nutrition & Feed Resources (Leng), Systems and Latin American requirements (Sere). These papers are available.

Appendix

Table A1: Distribution of Livestock by Region and Production System (LDC Total for Cattle is 879 million, and for Sheep & Goats is 1097 million)

System	Cattle (% of LDC total)					Sheep and goats (% of LDC total)				
	SSA	Asia	LAC	WANA	Total	SSA	Asia	LAC	WANA	Total
LGT Livestock grassland tropical highland systems	1.0	0.0	2.6	0.0	3.6	0.6	0.0	1.8	0.0	2.4
LGH Livestock grassland humid/subhumid tropics systems	1.5	0.3	3.1	0.0	4.9	0.7	1.8	2.8	0.0	5.3
LGA Livestock grassland arid/semi-arid tropics/subtropics systems	3.0	0.0	0.1	0.1	3.2	5.2	0.0	0.1	1.6	6.9
MRI Mixed farming rainfed temperate/tropical highlands systems	3.7	0.0	1.9	0.1	5.7	4.1	0.0	0.5	0.6	5.2
MRH Mixed farming rainfed humid/subhumid tropics systems	4.4	9.3	21.5	0.0	35.2	6.3	10.8	3.2	0.0	20.3
MRA Mixed farming rainfed arid/semi-arid tropics/subtropics systems	5.4	10.2	2.6	2.1	20.3	8.0	10.1	0.9	11.1	30.1
MIH Mixed farming irrigated humid/subhumid tropics systems	0.0	11.9	1.6	0.0	13.5	0.0	13.3	0.7	0.0	14.0
MIA Mixed farming irrigated arid/semi-arid tropics/subtropics systems	0.0	10.2	1.9	1.5	13.6	0.0	10.1	0.7	5.1	15.8
Total	19.0	41.9	35.3	3.8	100.0	24.8	46.1	10.7	18.4	100.0

Figure A1: Land use, value of crops and livestock output, and population by agro-ecological zone

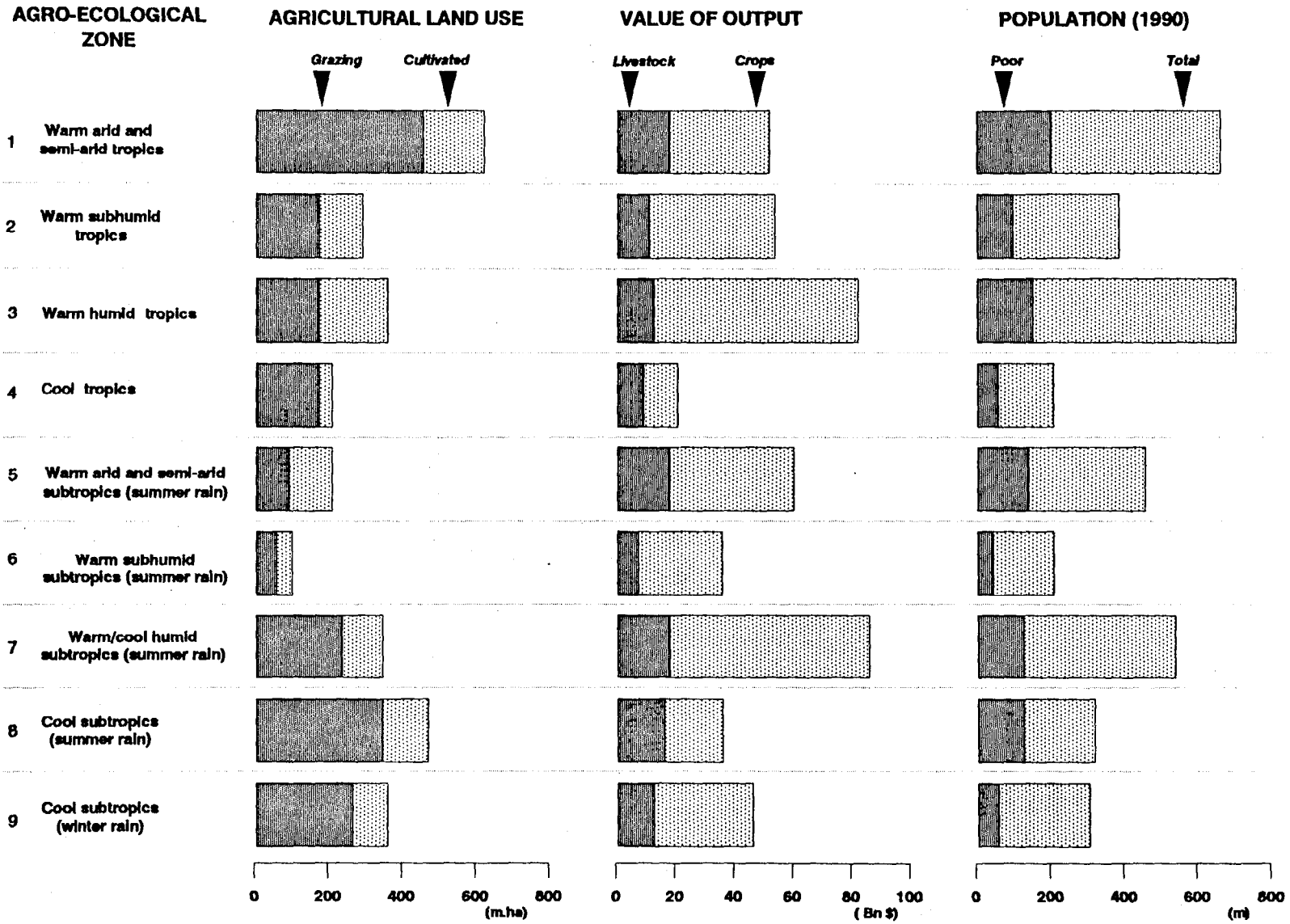


Figure A2: Volume of meat, milk and egg production by agro-ecological zone

AGRO-ECOLOGICAL ZONE

