

ILRI

Livestock:
a pathway out of poverty

MEDIUM-TERM PLAN
2006–2008

INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

ILRI Medium-Term Plan 2006–2008

Livestock: a pathway out of poverty

Vision

A world made better for poor people in developing countries by improving agricultural systems in which livestock are important.

Mission

ILRI works at the crossroads of livestock and poverty, bringing high quality science and capacity building to bear on poverty reduction and sustainable development.

Mandate

To measurably and sustainably improve the livelihoods of resource-poor livestock keepers, make animal products more affordable and accessible for the poor and conserve natural resources in developing countries through partnerships and alliances for innovative livestock research, training and information exchange.

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Dear Friends,

ILRI'S MEDIUM-TERM PLAN—2006–2008

We wish to share with you ILRI's Medium-Term Plan (MTP) for 2006–2008. This has been submitted to the Science Council and comments received have been incorporated into the current document.

An important planning and management instrument for ILRI, the MTP enables us to translate the ILRI Strategy into activities with measurable results and outcomes. It is a dynamic document which is updated every year, assisting us to measure progress as we fulfil our commitments to our stakeholders.

Thank you for your continued support.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'CS', with a long horizontal stroke extending to the right.

Carlos Seré
Director General

Foreword

Africa and agriculture, including agricultural research, continue to feature on the international agenda as evidenced by the declarations of the Blair Commission for Africa, NEPAD and the ongoing discussions related to the G8 meetings. Of significant interest is the cancellation of debt for the poorest nations as well as the pledge by several OECD countries to double the aid to Africa.

The reform of the CGIAR system has also picked up significant momentum. The Science Council system-wide priority setting, the new performance indicators, new guidelines for Medium-Term Plans (MTP), and the report of the Sub-Saharan Africa task forces are all elements shaping the future of the CGIAR. Some elements of this evolving CGIAR are clearer than others, but there definitely is a significant momentum for change.

ILRI's management and board are actively engaged in this change process. ILRI has been requested to spearhead the development of a regional MTP that will co-ordinate the work of the CGIAR with that of national and sub-regional institutions within Eastern and Southern Africa.

This MTP covers ILRI's activities during a period in which we expect to consolidate a number of changes put in place by the institute in the recent past. We expect to undertake a major refurbishment of the laboratory infrastructure as we implement the NEPAD ILRI Biosciences eastern and central Africa (BecA). This initiative will create a shared platform for African researchers to undertake cutting edge bioscience research alongside ILRI staff. We have led a research consortium which has made significant progress in developing a prototype subunit vaccine against a protozoan disease to the stage of proof of concept. If successful, it will be developed into a commercial product with the private sector. Building on the lessons of this work we are expanding the scope of our vaccine work to other challenges. We have embarked in research on innovation systems in the livestock sector. Early results of this endeavour should help us and our partners become more effective in ensuring our research is clearly leading to development outputs.

This year, we concluded a long-standing research programme into smallholder dairy policies for effective policy awareness and deliberation in both Kenya and Tanzania. The approach used highlights the productive way in which national institutions and ILRI can work together to produce national and international public goods through effective partnerships. We expect that this work will significantly shape future policies of these countries, to make them more pro-poor. We will work at sharing the lessons with other countries.

The ILRI-IFPRI programme on market access is expected to make significant progress in helping developing countries tackle the challenging issue of dealing with animal health and sanitary measures, which are increasingly affecting these countries' capacity to engage in regional and international trade in livestock and its products. In our effort to do business differently we have also established a joint ILRI-CAAS Animal Genetic and Forages laboratory in Beijing, China. First research activities were launched early this year and should significantly expand in the period 2006–08.

As part of the overall strategy for managing science quality, the Science Advisory Panel, which was established last year, officially began work in January 2005, and for the first time, this MTP benefited significantly from their professional input, for which we are grateful.

ILRI's core competence is its capacity to bring a broad range of disciplines, from social sciences to biological sciences, to effectively address complex livestock-poverty related issues.

We seek to produce globally useful knowledge on the basis of concrete studies in specific contexts, using our capacity to extrapolate broadly useful lessons from these. Through our work on learning and innovation, we expect to foster the more effective use of ILRI's and partners' research—to influence actions and functions of development institutions, the R&D activity of NARS and the investment decisions of development agencies. Overall, our major aim is to help the poor to compete in markets, and ease the transition towards new systems and new ways of utilising livestock development to create wealth for the poor.

We consider ourselves a small organisation seeking a global impact on poverty through livestock research and knowledge management. Working effectively through partnerships to leverage our knowledge and resources is and will continue to be key to our success.

Carlos Seré

Overview

ILRI's stated mandate is to reduce poverty and enhance sustainable development through livestock-related research. ILRI is determined to ensure that its research effectively contributes towards meeting the Millennium Development Goals (MDG), particularly for poverty and hunger alleviation. Along with our research and development partners, ILRI is keenly aware of the need to enhance the relevance and impact of its research in a rapidly changing global context.

ILRI's strategy is grounded on two premises: the Livestock Revolution and the multiple roles of livestock in the livelihood strategies of poor people. The Livestock Revolution encapsulates the fact that as developing country populations grow, become more urban and experience economic growth, their food consumption patterns increasingly shift to high-value and processed foods such as animal products, oils, fruits and vegetables. This demand growth creates a unique opportunity for the growth of the livestock sector. ILRI's goal is to maximise the value of this development opportunity as a tool to reduce poverty by enhancing the participation of poor people in dynamic livestock value chains, thereby providing them with increased incomes. While global change and market forces present many opportunities, they also pose threats for poor livestock producers. Increasing length of food chains, growing concerns about food safety and economies of scale in intensive production systems are threatening the participation of poor livestock keepers in these increasingly complex markets. Public research on technologies, institutions and policies can create more pro-poor options. Vertical integration of smallholder livestock keepers, for example, may allow small-scale producers to remain in high-value market chains, but it also raises issues of empowerment for the poor that research on

pro-poor cases can learn from to improve results elsewhere.

Structural change related to rapidly growing demand for livestock products is leading to the development of large-scale production units, which can better address food safety concerns of urban markets. If developed with the appropriate policies to eliminate negative food safety impacts, these developments can have pro-poor impacts under certain conditions, particularly when related to employment of poor people in activities along the value chain. The magnitude of these poverty alleviation impacts is dependent on the forward and backward linkages of such livestock enterprises, as well as the propensity of those employed in these enterprises to spend their new livestock incomes on consumer items and services typically produced by the poor.

The opportunities for using livestock as a tool for poverty reduction particularly hinge on rapid growth in demand for livestock products. In many parts of the developing world, poor livestock keepers do not have these opportunities. Nevertheless livestock frequently are a key component of poor peoples' livelihood strategies, with livestock assets providing services such as transport, traction for land preparation and a source of manure for soils depleted of organic material. ILRI's strategy recognises that quite distinct tools are required to reduce poverty under such circumstances. Careful analysis is required to understand the constraints and opportunities under these conditions. Frequently, very marginal environments put a ceiling on potential productivity increases. Here, public livestock research and development can reduce vulnerability in a number of ways, such as provision of vaccines, early warning systems and livestock management strategies to mitigate the effects of natural and man-made disasters. In many marginal settings livestock

will be only one of diverse options needed to escape poverty.

In better-endowed regions with poor access to markets, mixed farming systems are predominant. Productivity increases, for example, through better utilisation of crop residues in ruminant production, introduction of fodder species and adapted livestock genotypes are potential entry points. The success of such productivity-increasing interventions is generally linked to reducing market constraints.

Livestock play an increasing role in peri-urban systems. These systems are driven by growth of urban demand and inefficiency of market chains linking more remote producers to these markets. These systems frequently also provide income opportunities for landless poor, who provide fodder, collect waste to feed to animals and engage in distribution and marketing of outputs of such informal systems. The externalities associated with these systems, however, present formidable public health issues and environmental challenges.

ILRI research recognises the importance of animal products for poor consumers, for whom targeted research that raises productivity, improves food safety and lowers marketing costs in the sectors serving poor consumers can increase their access to lower cost and more reliable supplies of safe animal-source foods. In many cases these consumers spend a significant share of their disposable income on animal products, which provide an important source of minerals and micronutrients to their diets. Access to small amounts of these nutrients has been shown to benefit the physical and cognitive development of children, as well as mitigating the effects of diseases such as HIV/AIDS.

Given the above context for livestock as a tool to address poverty, ILRI has adopted a

‘pathways out of poverty’ framework, based on the sustainable livelihoods approach. In this approach, it is recognised that poor households face a range of external threats that influence their livelihoods. The challenge for these households is to manage their limited asset base through a set of livelihood strategies conditioned by processes and structures, both internal to the households and in the external environment, to generate desired outcomes that usually include higher income and reduced vulnerability. The three pathways through which ILRI seeks to improve the contribution of livestock in poor households are:

- securing the assets of the poor
- improving the productivity of their livestock systems
- improving their market opportunities

Through these pathways, ILRI seeks to take advantage of the potentials for livestock and livestock-related research to ensure uptake of improved technologies, policies and institutions that will contribute to improving the well-being of the poor.

ILRI's role

ILRI sees its role evolving as an institution engaged in livestock knowledge production and management for poverty alleviation and sustainable development in developing countries. Many other institutions are also addressing these issues: they include national agricultural research systems (NARS) and sub-regional organisations (SROs), research and analysis units within government departments, ARIs and universities, NGOs and private firms and consultants. ILRI is developing productive partnerships with all of these types of institutions and other key actors. In these partnerships, ILRI's unique niche is at the crossroads of global livestock research and social objectives such as poverty alleviation.

As a CGIAR centre, ILRI has a comparative advantage in focusing on those issues of widespread and critical relevance where insights can be transferred and synergies achieved across countries, regions and different kinds of organisations. While ARIs, universities, NGOs and private consultants may also be engaged in the production of international public goods, the reality of their modes of operation and funding rarely permits maintaining scientific commitment on an institutional basis to solve specific long-term problems in developing countries, and then ensuring uptake of innovations. Furthermore, few institutions in developing countries are as well-placed to achieve effective long-term coordination between the rigorous hypothesis-testing of hard livestock-related science and the pragmatic experimentation of action-research in the field.

ILRI achieves its comparative advantage through a form of organisation and governance that overcomes many of the constraints imposed on other types of institutions in the livestock knowledge generation and management area. With offices in East and West Africa, South and Southeast Asia, China and Central America, and projects in North Africa and the Near East, ILRI has a truly global footprint. Yet its internal form of organisation is not regional but thematic. ILRI's agenda and way of operating is heavily influenced through long-term host country, regional and global agreements with NARS and SROs, and with specialised livestock-relevant institutions in the development sphere such as the World Animal Health Organization (OIE) and the Animal Production and Health Division of FAO. It also partners to a great extent with sister CGIAR centres, both directly and through the System-wide Livestock Programme. Coherence across needs and opportunities is achieved not only by ILRI's staff and management, but also by an internationally appointed and cross-

disciplinary Board of Trustees representing stakeholders with both research and development perspectives. At the same time, science quality has been addressed strategically through the constitution of a Science Advisory Panel, made up of a team of specialised scientists of high repute.

The resulting institutional form allows ILRI to provide:

- A flexible framework that can address evolving needs and concerns through new partnerships, including with public- and private-sector entities;
- A long-term clearing-house for livestock knowledge and research in its relation to technical, social and economic objectives.
- An institutional memory and accessible database on livestock issues and answers in developing countries.
- A diagnostic capacity with respect to livestock knowledge that draws on insights from around the world and across disciplines.
- A means to integrate in a problem-solving format insights across disciplines as diverse as upstream microbiology, genetics, veterinary epidemiology, economics, nutrition and innovation systems science.
- An approach to associating in the same activities both the rigor of scientific hypothesis-testing and the impact-oriented approaches of action-research in the field.
- An international research character which allows ILRI to tackle research on key global livestock issues such as market access and emerging diseases.
- A commitment to foster knowledge uptake, diffusion and capacity-building in developing countries.
- A mode of governance that facilitates openness, accessibility and accountability to developing countries.

ILRI's operational strategy

ILRI's operational strategy is derived through recognising its unique and crucial niche and its mission for poverty alleviation. It provides an understanding of global livestock research issues into the broader research and development agenda.

ILRI recognises that there are many key actors that must be influenced if the demand-led growth of the livestock sector is to benefit the poor. This influence relies on producing research outputs demanded by and relevant to clients and on partnerships with key actors in the system. To do this, ILRI's research must anticipate future changes, be demand-driven and accessible to livestock research and development actors and be delivered in a timely fashion, given the dynamic changes in many livestock systems.

ILRI has developed a range of innovative institutional partnership arrangements. These partnerships are demand-driven and outcome-oriented. They include traditional collaborations with NARES, CGIAR centres, advanced research institutes and international organisations (e.g. OIE, FAO) as well as novel arrangements with civil societies, producer organisations, NGOs and private sector partners. In all its collaboration efforts, ILRI seeks to influence and add value to the agenda of others to increase its impact. This may be by influencing the agendas of key livestock research and development actors or by including livestock issues in the agendas of other sectors, such as health and water. In the livestock sector, private companies are playing an increasing role in dairy and poultry markets in developing countries. ILRI is seeking to expand its collaborations with private agribusinesses and progressive NGOs to add value to its already strong traditional links with NARS, ARI and CG research partners. Innovation systems approaches are used in guiding the identification of appropriate partnerships and in supporting analyses of new ways of doing

business that are responsive to changing opportunities and favour pro-poor outcomes.

Some examples that highlight the collaborations that ILRI is engaged in include:

- Establishment of a joint programme with IFPRI to merge insights from broad economic policy thinking with specialised knowledge of livestock science and to achieve synergies through better inclusion of ILRI's livestock work into a broader CGIAR emphasis on improving smallholder livelihoods through diversification into high-value agriculture more generally.
- Emphasis on application of advanced biosciences to 'orphan' problems, expanding the scope of the work by establishing with others a shared Biosciences facility for eastern and central Africa. This will enlarge the capacity of African partners to address their biosciences research needs and will allow ILRI to share its expertise more widely than in the past.
- Establishment of a range of strategic partnerships to address the challenges. This includes partnerships with other CGIAR centres on the Addis Ababa campus to provide a platform for integrated natural resource management (INRM), innovation systems and capacity building. Centres involved presently include CIAT, ICRAF, IFPRI (including its ISNAR program), IWMI, CIMMYT, and ICIPE. Similar partnerships in other parts of the world include ICRISAT and IITA, among others.
- A special relationship with the Animal Production and Health (AGA) division of the Food and Agriculture Organization of the United Nations (FAO).
- A private-public partnership involving a large pharmaceutical company and several advanced research institutes to develop a new East Coast fever vaccine.
- The establishment of a joint laboratory for animal and forage genetic resources

characterisation with the Chinese Academy of Agricultural Sciences (CAAS), Beijing.

To underpin its collaborations and increase their responsiveness and effectiveness, ILRI is changing and adapting its collaboration strategy, culture and process. Given our strong conviction that pro-poor impacts can only be maximised by influencing others, ILRI is supporting innovations at all levels, from individual livestock keepers to national and international decision makers. Within ILRI's mandate, the key principle it applies to partnerships is that partners and their roles should be determined by what best maximises pro-poor outcomes and impacts.

Collaboration highlights: 2004 actual and 2005 estimates

In 2004, ILRI began the implementation of two novel partnership innovations. The first was the Biosciences eastern and central Africa (BecA), implemented with the New Partnership for Africa's Development (NEPAD). BecA is a joint venture of national, regional and international organisations that will conduct cutting-edge bioscience research for priority agricultural problems in eastern and central Africa. ILRI hosts the BecA research hub and secretariat. In 2004, the BecA secretariat was established and agreements for the establishment of BecA and its operations were developed and approved by the regional steering committee. The design of research facilities and the development of the research programme also began in 2004 and are progressing in 2005.

The second research partnership launched in 2004 was the *Improving productivity and market success (IPMS) of Ethiopian farmers* project. As noted in the last MTP, ILRI is coordinating this research for development project on behalf of the Ethiopian government with many CGIAR, international and Ethiopian research partners. The research focuses on technological and institutional innovations to improve access to markets for

the poor along the agri-food chain and to new strategies for the generation and sharing agricultural knowledge among a variety of actors. The project design was completed in 2004 and project activities commenced in 2005.

The management and flow of agricultural knowledge is crucial to the CGIAR and ILRI is playing its role in fostering mechanisms for the better sharing of knowledge and joint learning between key stakeholders. In sub-Saharan Africa, IFPRI is coordinating a Strategic Analysis and Knowledge Support System (SAKSS) on behalf of USAID. ILRI is coordinating the development of the East and Central Africa SAKSS node for Association for the Strengthening of Agricultural Research in Eastern and Central Africa (ASARECA). The regional node is part of a continent-wide initiative identified as a cross-cutting pillar in the Comprehensive Africa Agricultural Development Programme (CAADP) of NEPAD. A regional planning workshop was held in October 2004 in Entebbe, Uganda and the development of the node is being initiated in 2005.

ILRI also supports the secretariat of the ASARECA Animal Agriculture Research Network (A-AARNET). In 2004, A-AARNET conducted a priority setting and five-year implementation planning process as part of the overall ASARECA priority setting agenda. Implementation will occur over the next four years through EU financial support.

Beyond ASARECA, ILRI supports the activities of regional and sub-regional agricultural research organisations including the Conseil Ouest et Centrale Africain pour la Recherche et le Développement Agricole (CORAF), the Forum for Agricultural Research in Africa (FARA), and the Asia-Pacific Association of Agricultural Research Institution (APAARI).

Linkages with the private sector and NGOs are becoming increasingly important to ILRI's

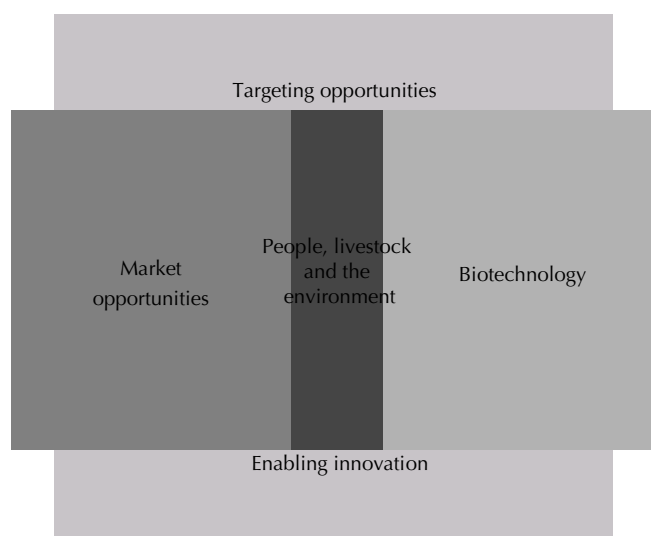
strategy of influencing key livestock actors and in the delivery of products from ILRI's research. As seen earlier, NGOs have become important partners in ILRI's dairy research in East Africa and in the delivery of fodder innovations in India and Nigeria. Regarding the private sector, ILRI has assisted DFID-UK, as endorsed by the inter-agency livestock donor group, to establish the Global Alliance for Livestock Vaccines (GALV), a public-private partnership for the development of livestock vaccines and diagnostics. GALV will be similar to a number of public-private ventures for human drug and vaccine development. GALV was registered as a company and an interim Board meeting was held in early 2005. It is expected that GALV will commence full operations in 2007, funding the development and commercialisation of livestock vaccines for diseases of priority to the poor where both public and private sector investment and expertise are required. ILRI expects to participate in selected GALV projects with other public and private sector partners.

Organisation of Research

The organisation of ILRI's research programme (see Fig 1) into 5 Themes (referred to as Projects in the CGIAR Medium-Term Plan terminology)¹ reflects its focus on livestock research for poverty alleviation. At its heart are three research Projects that have been developed with clear poverty alleviation objectives. The *Market Opportunities* Project focuses on research to find opportunities for the poor to benefit—through increased competitiveness, better

institutional arrangements and policies and improved quality and safety performance—from the increased consumer demand for livestock and livestock products. The *Biotechnology* Project conducts research using new bioscience tools to develop technologies for enhancing the health and performance of livestock. Target technologies and approaches, particularly vaccines, disease resistance and genetics, all focus on securing livestock assets and improving their productivity. The *People, Livestock and the Environment* Project, takes a more systemic approach to securing livestock assets and improving their productivity by assessing how livestock production can be improved to both improve livelihoods of the poor and enhance broader environmental sustainability, biodiversity and human health goals.

Figure 1. Organisation of ILRI's research program



Supporting these three Projects are two cross-cutting research Projects. The first of these, *Targeting Research and Development*, seeks to understand the future changes in livestock systems to better target efforts to alleviate poverty. It explicitly looks at the broad evolution of livestock systems; how

¹ In this MTP the following hierarchy of 'projects' is adopted; Project (with a capital P) is one of the 5 ILRI research Themes (the Systemwide Livestock Programme is presented as ILRI Project 6); an operating project is a group of related research activities within a Theme leading to common outputs in a defined time frame; a project (with a small p) is a defined donor-funded or partner-based research activity.

technologies, policies and institutions influence these changes and specifically at the implications of these interventions within the changing livestock context for the poor. The second cross-cutting project is *Enabling Innovation*. This programme was developed in recognition of the fact that livestock research and develop are integral parts of complex systems, linked to crop production, having long market chains and multiple actors of different types. An innovation systems approach is taken to more effectively address the complexity of such systems in supporting better research design and to enhance output–outcome–impact linkages.

Beyond these 5 research Projects, ILRI has designed its other research activities to actively engage and influence other actors in the broader agricultural research for development web. Our objective is to get livestock issues integrated into broader research for development areas to maximise benefits for the poor. The System-wide livestock programme (ILRI Project 6) focuses on influencing the crop breeding and seed systems programs of crop centres to improve both the human food and animal feed value of staple crops. With a relatively modest input into identifying genetic traits for improving livestock nutrition and their tradeoffs with other traits, ILRI is able to strategically influence a huge and successful component of the overall CGIAR research portfolio. ILRI's involvement in other system-wide programs and challenge programs is based on a similar strategy. Through its involvement in the Water for Food Challenge Program, ILRI has been able to influence broader thinking on the importance of livestock in landscape and local level water use and efficiency and has effectively integrated these considerations into the methods, tools and actions of the other partners. Likewise our involvement in sub-Saharan Africa Challenge Program and CAPRI allows us to bring a livestock for poverty perspective into broader integrated

agricultural research for development and collective action and property rights agendas.

For the five research projects funding ranges from USD 3–11 million per annum, with Biotechnology and its associated laboratory support being the most costly. Within each Project, research is arranged in 3–5 operating projects. Operating projects encompass a group of time-bound research activities targeted at a specific output. In total, there are 17 operating projects, each focusing on one specific output, within the 5 ILRI Projects. Budgets for operating projects range from approximately USD 500,000 to USD 4 million.

Over the past two years, the structure and function of the research programme have continued to evolve. More detailed research plans for Projects and their constituent operating projects have been developed. A summary of these is presented below.

Targeting research and development opportunities (Project 1):

This Project investigates how livestock systems evolve to anticipate where, when and how livestock-related policy and technological interventions can best be targeted to alleviate poverty, sustain rural livelihoods and protect the environment. Research outputs for the operating projects in this Project are:

- **Livestock system evolution:** Activities include identification of drivers of change and their impact on livestock systems in the future; assessment of scenarios of alternative livestock system futures from different livestock development pathways and drivers of change; and analyses of these changes on households and communities across different regions.
- **Poverty, livelihoods and livestock:** ILRI is developing databases and analyses of where significant groups of poor livestock keepers are located. It is also seeking to better understand the relationships

between poverty, livelihoods and development strategies, the role of livestock in poverty processes and dynamics, and vulnerability, risk management and livelihood options.

- **Pro-poor options for livestock keepers:** Major activities focus on targeting livestock interventions and identifying their niches and contribution to the livelihoods of poor livestock keepers; targeting systems in which ILRI and partners have the greatest potential for maximising the opportunities for poverty reduction; *ex-ante* and *ex-post* impact assessment of interventions promoted by ILRI and its partners; and development of priority-setting frameworks for ILRI and/or its partners.

Enabling innovation (Project 2):

Under ILRI's new strategy, priority is being given to efforts to gain a clear understanding of the mechanisms that make research more effective and efficient, knowledge more contagious, processes more inclusive and outcomes more in favour of livestock-dependent poor people. Research and capacity strengthening activities are organised in three operating projects:

- **Innovation systems:** Ideas need to travel from the provider or the innovator to potential users and *vice versa*. Study of past, present and emerging innovation systems will disclose innovation processes and mechanisms that facilitate suitable knowledge exchange, the influence of research approaches on innovation and impact, the measurement and determinants of innovation (indicators and inducers), and how information within livestock knowledge systems is generated, acquired, used and circulated.
- **Research delivery pathways:** This 'action research' operating project consists of a variety of studies in which clients and other actors are directly involved in the identification of constraints and

opportunities and the development and testing of methodological, technical and institutional solutions. The case studies focus on the comparison of particular technologies, management strategies and delivery systems in different policy, institutional, socio-economic and bio-physical settings.

- **Innovative partnerships:** Activities conducted under this operating project evaluate the strengths and weaknesses of different types of partnerships in the identification of research needs, research implementation, dissemination and iteration, and the acquisition of funds. In addition, they provide an increased understanding of the institutional and organisational changes that empower different research and development partnerships. Such lessons drive and facilitate institutional change and capacity building and are a conduit for the promotion of innovative processes that transform the way in which ILRI and its partners go about their business.

Improving market opportunities—Joint ILRI–IFPRI programme (Project 3):

Livestock products have long been a pathway for income generation by the poor. Rapidly growing and changing livestock markets in the developing world provide real opportunities—but also significant threats—to participation of the poor, due to the increasing integration of national and world markets, the changing nature of food demand in cities, and a changing regulatory environment. In view of the importance of these trends, ILRI and IFPRI have joined forces through Project 3 to address three principal knowledge gaps for reinforcing the opportunities for sustainable poverty alleviation through livestock while mitigating the threats. The three pillars are also the main output and operating sub-units of the Project.

- **Smallholder competitiveness in changing markets:** Although research has shown that many smallholder livestock products

remain competitive with output from large-scale farms and with imports, it has also demonstrated major differences across small farms. There is considerable scope for helping the poor who might otherwise be left behind to join a market-driven pathway to improving their livelihoods through livestock, hence a focus on *smallholder competitiveness*.

A mix of technical, institutional, and policy options are evaluated with respect to their contribution to making smallholder livestock producers more competitive as markets integrate. The initial focus has been on smallholder dairy systems of Africa and Asia. Increasing emphasis will be given to poultry and pig systems in Asia and Africa, and to the role of private-sector solutions for incorporation of smallholders, such as contract farming.

- **Changing demand and market institutions:** However even the most competitive small farms may not be viable if wholesalers will not buy from them. In response to changing demand for food safety, quality, and uniformity, market chains in many parts of the developing world are becoming more concentrated and demanding. Study of these processes can be targeted to the design of better marketing institutions to allow smallholders to meet new requirements, hence a focus on *changing demand*.

This focuses on the driving forces of change in the market channels traditionally supplied by the poor, including changes in demand for increased safety, uniformity, and higher levels of processing. It considers private sector responses to the new market opportunities, the impact of changes in industrial organisation back through the supply chain to procurement from small-scale producers, and means for helping the latter respond.

- **Animal health and food safety for trade:**

Beyond primarily national issues, major global procedures for control of animal disease set up in the 1950s are under challenge from changes in the global distribution of livestock production and consumption and from significant changes in technological options for disease control. The costs of compliance with standards developed for the industrial world are often hard for small-scale operators in developing countries to meet. Through case studies, research can demonstrate the high costs of compliance with traditionally accepted norms and evaluate options for equivalent ways of reducing risk of disease transmission that are more appropriate to the resource endowments of developing countries, hence a focus on *animal health for trade*.

In addition to assessing costs of compliance with standards in a developing country context, this research will examine issues of equivalence of standards and options for assisting small-scale producers in meeting standards. Risk analysis from veterinary epidemiology will be combined with analysis of the costs and benefits of different options, including the implications for both direct and indirect impacts on the incomes of the poor.

Biotechnology (Project 4):

Research in this Project aims to develop and apply technologies that will allow poor livestock keepers to secure their livestock assets through the development and application of biotechnology. Specific applications of biotechnology include better understanding of the diversity and enhanced utilisation of indigenous animal genetic resources, and reducing disease and environmental risks through vaccines. Research activities are organised in three operating projects:

- **Improving disease control:** The main focus is on developing vaccines and diagnostics for high-priority animal

diseases of the poor to help secure their livestock assets by reducing the impact of disease. ILRI focuses on immunological evaluation of antigens and laboratory and field testing of prototype vaccines. It links with public-sector partners who conduct large-scale genomic screening, with private-sector partners in the development and delivery of vaccine products and diagnostic kits and with NARS for field testing, regulatory approval, quality control and product delivery.

- **Delivery of genetic change:** This operating project focuses on biotechnological applications to secure livestock assets through enhanced adaptive fitness and wider use of more productive and better adapted livestock. The main research activities include: identification and use of genes or genomic regions controlling resistance to diseases and other stresses and those implicated in product quality; and design of genetic improvement programmes appropriate for smallholder livestock systems.
- **Animal genetic resources:** Livestock species in many areas of the developing world have evolved critical adaptive traits such as disease resistance. There is increasing demand for improved understanding and conservation of genetic diversity in indigenous livestock. Molecular markers are combined with phenotypic data to characterise priority livestock species globally. In collaboration with partners from national agricultural research and extensions systems (NARES), this information as well as livestock systems and market information, is used to guide *in-situ* conservation programmes. Capacity building is integrated into all projects. Key research activities include: assessment of the distribution and variability of global livestock populations; identification of unique livestock gene pools; development of tools for molecular characterisation and

economic analysis, including valuation, of animal genetic resources (AnGR); and development of databases and decision-support tools for *in situ* conservation, including sustainable use.

People, livestock and the environment (Project 5):

Livestock provide an important entry point into protecting or improving agriculture, environmental sustainability and human health and nutrition. This research project focuses on enhancing the role of livestock in contributing to the sustainable livelihoods of poor households, in particular the natural resource and human health assets. The approach hones in on five major areas of opportunity and, recognising that livestock are always part of a system within each of these areas, concentrates on major hotspots in terms of agricultural system and geographic region. This is intended to facilitate the development and use of integrated, holistic options germane to the needs of end users and the wider range of stakeholders in these existing and emerging systems across the world. Research activities are organised in five operating projects. Two of the operating projects have a systems approach addressing areas of integrated natural resource management:

- **Sustaining water (and nutrient) productivity:** This activity contributes to increased productivity and sustainability of pastoral, crop–livestock and peri-urban production systems through improved strategies for water management emanating from increased understanding of livestock–water productivity issues and opportunities; and overcoming limitations of other scarce resources.
- **Sustaining lands and livelihoods:** Through this operating project, ILRI seeks to improve ecosystem resilience and services through the provision of livestock-based options for enhanced land-use management for the poor in marginal lands. Main activities include:

identification of management and policy options for sustainable land use by poor livestock keepers in marginal lands; improved understanding and communication of the implications of livestock and land management in relation to conflict; and capacity strengthening of target institutions and individuals to develop, test and support better strategies and options for sustainable land use and management.

Three operating projects undertake research on more specific components of livestock systems that contribute to health, food, feed and soil fertility issues:

- **Role of livestock in human health and nutrition:** The research examines the role of livestock-related research in securing the poor household's critical human capital assets through improved health and nutrition. Priorities for research include better understanding of the links between animal-source foods, livestock keeping and child nutritional status in poor households, the impact of zoonotic diseases and their control, and designing food safety options appropriate for informal markets for livestock products.
- **Mitigating feed scarcity:** With agricultural intensification, achieving greater efficiencies and synergies between crop and livestock enterprises is critical. A major constraint to livestock production in crop–livestock systems is feed scarcity. Farmers rely on a variety of approaches to feed their livestock. One key strategy is to feed livestock crop residues. In collaboration with crop breeders, the operating project targets the improvement of key crop species in crop–livestock systems in improving their human food and livestock feed value. Beyond providing technical options, broader systems approaches including the policy, institutional and market demand issues to promote feed system innovations for wider dissemination are addressed.

- **Forage diversity:** Research on forage diversity aims to improve utilisation of indigenous forage resources through studies on characterisation, conservation, dissemination and adoption of forage genetic resources. ILRI together with CIAT and ICARDA maintain the international forage germplasm collection. This collection is a global public good held in trust under the auspices of FAO. ILRI maintains, develops, targets and distributes forage germplasm and related information.

Programme discussion: 2004 actual and 2005 estimates

ILRI revised its strategy in late 2002 and restructured its research programme in 2003. Thus, this 2004 and 2005 programme discussion represents the first two years of implementing the new strategy in the new research programme structure. Relative to ILRI's 2005–07 MTP, there has been additional progress in realigning and focusing on-going research projects into the new strategy and structure. Careful consideration has been given to balancing ILRI's research focus on livestock public goods and its need to interact with research and development partners to achieve pro-poor outcomes and impacts. For example, in its targeting research (Project 1), ILRI has made considerable contributions to methods for poverty mapping and assessing land use and land change in past years. Enhancing the capacity of national and regional planning departments to take over these activities is well underway, allowing ILRI to meaningfully contribute by focusing its efforts on the application of these methods to assessing livestock-sector options for addressing broader poverty alleviation and land sustainability strategies.

In a similar manner, ILRI's enabling innovation research has of necessity started developing research strategies and methods

relevant to the livestock system and institutional innovations. These will be increasingly applied with partners to key livestock research and development issues, such as what institutional structures and linkages support improved smallholder access to high-value livestock markets or what research partnerships and institutional arrangements are required for vaccine and diagnostic test development.

ILRI's other Projects, in livestock markets (Project 3), biotechnology (Project 4) and people, livestock and the environment (Project 5) have had more emphasis on re-aligning their previous research portfolios to better focus on ILRI's new strategy and the CGIAR priorities and strategies, now being finalised. Details are provided in the project narrative sections.

An aspect of research management being actively investigated is to improve the cross-Project linkages and synergies. For example, Project (Theme) 1 is playing an increasing role in supporting research targeting and Project (Theme) 2 in supporting research process and partnership innovations for other ILRI Projects. Cross-theme linkages are fostered by regular meetings (8–10 per year) of the ILRI Management Committee, which includes all Project (Theme) Directors. The Annual Planning Meetings (APM) provides an avenue for invaluable interactive sessions that enhance cross-thematic project development. Individual Theme Directors also have an institutional responsibility for reviewing project proposals from other Projects.

ILRI is continuing to expand the geographical focus of its research activities and outputs from its traditional concentration in East Africa into South Asia and other regions of sub-Saharan Africa. ILRI established a regional office in Delhi and through that office, plus its teams posted at Patancheru, Los Banos and Beijing, is developing new

projects with partners in Asia, particularly South Asia.

The following is a selection of programme highlights in 2004 (actual) and 2005 (estimates) for the five ILRI Projects. Programme highlights for the System-wide Livestock Programme (Project 6), managed by ILRI, are described under the section on System-wide and Eco-regional programmes.

Project (Theme) 1: Targeting research and development opportunities

In 2004, considerable effort was placed on realigning existing research activities into a more coherent Project strategy. A new area of emphasis was on the analysis of trends and prediction of alternative future scenarios of livestock systems in the developing world and strengthening linkages with other ILRI Projects through joint planning and validation of outputs with field level data and case studies. Research on livestock-poverty issues saw the joint publication and application of methods and processes for poverty mapping and completion of cross-country analysis on the role of livestock in pathways out of poverty. In 2005, the poverty research evolved to consider the applications of poverty analysis by different livestock sector actors. If successful this research should contribute to improving the contribution of livestock sector plans to overall poverty reduction strategy processes. Likewise, tools for supporting livestock decision making developed over the past years are being applied with partners to learn lessons and share them across sites.

Livestock systems evolution: Accurate assessment of livestock population trends at global and sub-global levels is critical for any meaningful discussion of policies and strategies for using livestock as an instrument for poverty alleviation and sustainable management of the environment. In 2004, country-level FAO data on human and livestock populations and human dietary make-up was utilised to estimate livestock

populations across the developing world to 2030. The results highlighted important regional variability in species and growth projections that can inform differential targeting of livestock research and development investments and strategies (see below).

A new livestock research approach undertaken in 2004 was the evaluation of alternative future scenarios in a policy forum. The plan is to develop different future scenarios with national policy makers based on current and potential future trends in livestock systems evolution and to evaluate different policy options for meeting national poverty and development strategy objectives given these scenarios. The methodology was presented and tested at a policy workshop in Kenya involving key stakeholders from the government, research, and donors. Participants discussed alternative futures of crop–livestock systems in the Kenyan Highlands, and their impacts on livelihoods over the next 15 to 20 years using a business-as-usual base scenario and three alternative scenarios, for policy actions under the current Kenyan Economic Recovery Strategy Plan (ERSP). The practical testing of conceptual framework and modelling tools in this specific policy situation in Kenya has important lessons for other countries. Future plans are to test this framework and apply the lesson learnt in crop–livestock systems India.

Land use change is an important driver of livestock systems. Understanding the role that livestock plays in land use decisions at different scales is important in designing and implementing effective land use strategies that benefit poor people. Building on past research under the broader East African study on Land Use Change Impacts and Dynamics (LUCID) project in crops–livestock systems, two feedback workshops were held at case study sites to present and discuss research results on land use change dynamics with farmers. The highlights of the discussions with farmers have been presented in two

working papers. Four regional synthesis papers on the root causes of land use change and the linkages between land use changes, biodiversity loss and land degradation were also completed and are under peer review.

In 2005, a synthesis paper on land use and land degradation trajectories in livestock systems in East Africa will be completed. This synthesis will identify synergistic livestock–crop options and draw lessons for sustainable land use. These lessons will be presented and discussed at a policy workshop involving UNEP–GEF, and key partners from national and international organisations with sustainable land use agendas. Several research publications will be reviewed for final preparation and widespread dissemination to development partners. These include the study of livestock number projections and synthesis papers on land use dynamics in crop–livestock systems. Expert input involving policy advisers, government policy analysts, and staff from national research institutes and universities, is being used to help define and develop alternative scenarios describing alternative pathways of crop–livestock system evolution and the likely impact on government policy actions. Two policy workshops, one on alternative futures of crop–livestock systems and another on land use change, impacts and dynamics will be held to share research results with key stakeholders. A training workshop will be held to share data, tools, and methods and help build the capacity in modelling and scenario analysis of national research collaborators. A methodological guideline on identification of trends and linkages between land use change, biodiversity and land degradation will be completed and shared with national collaborators and key stakeholders from research and development agencies including the GEF, UNEP, FAO, and World Bank.

Enhancing the role of livestock in poverty interventions: Poverty maps are important tools that help policy and project interventions focus on the rural poor.

Technical backstopping was provided to the Uganda Bureau of Statistics for the development of poverty maps for Uganda in collaboration with the Rockefeller Foundation, World Bank, World Resources Institute, Africa Economic Research Consortium, and United Kingdom Department for International Development. The maps show spatially disaggregated poverty information for different poverty measures. A book 'Where are the Poor: Mapping Patterns of Well-Being in Uganda' was launched by the Government of Uganda. The book showed geographic variation in poverty distribution among and within regions, districts, counties and sub-counties in Uganda. The poverty mapping work in Uganda contributes to a multi-institutional effort among several CGIAR centres and partners in national, regional, and international organisations in developing sub-national poverty maps for Kenya, Uganda, Tanzania, Malawi and Mozambique. These maps are proving to be an important tool that is critical for geographic targeting of interventions in pro-poor poverty making and project interventions not only in rural productive sectors such as livestock and cropping but also in social sectors such as reaching poor people with health services.

Understanding the role of livestock in pathways out of poverty provides useful information for designing income diversification, growth, and social protection strategies in rural areas. The report from a study of the role of livestock in pathways out of poverty was completed and published as a joint FAO-Pro-Poor Livestock Policy Initiative (PPLPI) and ILRI Working Paper. This Working Paper has been posted for wider dissemination on both ILRI and FAO web sites. One policy brief prepared for decision makers was also completed and widely disseminated to policy makers, and stakeholders in development partner institutions. The results from the study were also presented to advisers and key

stakeholders in several workshops and seminars. FAO-PPLPI provided funding for an additional case study using the stages of growth approach in Peru.

A study conducted in partnership with the interagency initiative, Food Insecurity and Vulnerability Information and Mapping System, (FIVIMS) analyzed and mapped community livelihood assets in pastoral areas of Kenya. The study involved collaboration with NGOs, community and local policy makers in the analysis of participatory land use planning and mapping of community livelihood assets, and exploring actions reducing food insecurity and vulnerability. The spatial based method, data, and information on mapping livelihood assets contributes to FIVIMS as part of a global network of information systems and tool kits that are used to assemble, analyze, and disseminate data and information on food insecurity and vulnerability in other countries in the developing world.

An important activity in 2005 is to synthesise the results and policy lessons from the four country case studies (India, Kenya, Peru, and Uganda) on pathways out of poverty and the role of livestock will be completed as well as a methodological guide on the application of the Stages of Growth Approach for analysis of livestock-poverty issues. The synthesis report and methods guide will be presented and discussed at a major workshop that will be organised jointly with FAO/PPLPI. The workshop will aim to identify key lessons, analytical gaps, and priority policy, research and advocacy work to mainstream livestock issues in poverty reduction strategies. The analytical tools and techniques of poverty analysis, such as poverty mapping and spatial overlays with markets and other key drivers of livestock systems changes as well as the insights into pathways into and out of poverty are beginning to attract interests from other sectors, such as the health sector, that are interested customised to their specific institutions. Discussions have started with a number of development partners on how the

analytical tools and methods from the Targeting Project can be used for the design of pro-poor policies and projects in other sectors.

Targeting livestock based interventions:

Decision support tools help identify and evaluate alternative interventions that inform investment choices as well as policy and project design at the micro, meso and macro-levels. Broad-brush analyses help target priority research areas and geographical regions where to invest and implement projects, while meso and household-level analyses identify system niches for implementing feasible technologies or policies for poverty reduction. In 2004 work continued on refining three decision support tools for evaluating options at different spatial and temporal scales in livestock-based systems. These were: Integrated Modelling Platform for mixed Animal–Crops systems in the Tropics (IMPACT) a database and analysis tool that can be used for testing the impacts of interventions at the household level in crop–livestock systems; PRIMAS (Poverty Reduction Intervention Mapping in Agricultural Systems) a filtering tool that matches the characteristics of particular technological options with the spatial characteristics of particular target groups in the landscape, and EXTRAPOLATE (*EX-ante* Tool for RAnking POLicy ALternatives) a tool to assess the impact of policy measures on different target groups. Apart from that, a range of spatial analyses were performed overlaying a range of poverty indicators with livestock systems, agronomic potential, population and market access data for informing the selection of sites for implementing projects by diverse clients ranging from the donor community to sub-regional organisations and NARS.

Feed resources are recognised to be an important constraint to the productivity of mixed crop–livestock systems throughout the tropics. This is one area of research where cross-centre linkages have been exploited

very effectively with other CGIAR centres and NARS. In 2004, the System Wide Livestock Programme provided funds for the development of a framework to assess the impacts of feed resource interventions on crop–livestock systems. This work was designed to provide answers to three basic questions: Which data are required for *ex-ante* impact assessment? How do we collect the data? How can the data be integrated to assess different impacts of feed resources? An international workshop was organised to discuss and develop a generic framework that could be used to assess the potential impact of all feed resource work. The major output from the project will form the basis for a coherent and cohesive SLP-lead research and development plan on feed resources in the coming years. Development and implementation of the impact assessment framework will continue in 2005.

A major focus in 2005 is on the application of decision support tools for assessment of alternative livestock based interventions in sub-Saharan Africa (SSA) and Asia. PRIMAS-EXTRAPOLATE will be applied in the analysis of smallholder dairy and small stock issues in Uganda and India. By the end of 2005, it is expected that the tool will have been thoroughly tested in new situations, spatial data and policy information collated, local counterparts trained in its use, and results utilised by local and national policy makers. In 2005, the focus will shift to the application of the feed resources framework to help set crop improvement priorities. Within the context of the System-wide Livestock Programme, it is expected that the feed resources framework will assist with better selection and targeting of new and existing feed resource options that will have a beneficial impact on smallholders' livelihoods, groups of beneficiaries, and hence help identify policies and projects that are pro-poor.

Project (Theme) 2: Enabling innovation

Innovations research is a new area for ILRI arising from the need to assist ILRI and its partners be more responsive to the changing demand-led livestock research and development context. In 2004, efforts focused on developing partnerships with innovation system research groups and alliances. These will allow, in 2005 and subsequently, for best practices to be adapted and applied to innovations in systems, institutions and partnerships to enhance the pace of livestock research, and their scaling up and out. Research under this theme is organised into the following three areas which are closely integrated.

Innovation systems: In 2004, efforts focused on exploring ways of building capacity to do this type of research either through engaging new staff with appropriate skills or seeking funding that facilitated strong links with innovation experts in other organisations.

During 2005 long-term relationships with the United Nations University for New Technology (UNU-INTECH) and the ISNAR Division of IFPRI were developed. Memoranda of Understanding (MoU) are being finalised to formalise the arrangements. The MoU with UNU-INTECH is aimed at exploiting the complementary research and capacity development skills in the organisations to further their respective missions. The focus of this relationship will be collaboration in the creation and operation of a regional agricultural innovation research and capacity development facility in SSA and South Asia. The vision and rationale for the hub stems from the joint interest of UNU-INTECH and ILRI in the innovation systems concept as a way of addressing the question of how science, technology and knowledge can be used more effectively and equitably for sustainable development. At the same time, ILRI and ISNAR/IFPRI will implement a joint programme of activities on Agricultural Innovation Systems in SSA which will form a

major part of the hub. These activities will address critical research issues to strengthen the capacity of agricultural innovation systems in developing countries, in the context of poverty reduction, globalisation and rapid structural changes in the agricultural sector. Collaboration with UNU-INTECH staff has already led to the development of methodologies and tools for the analysis and 'typing' of innovation systems, different partnership mechanisms, and actor linkages for testing.

Another activity starting in 2005 seeks to identify and institutionalise innovative research and development approaches that lead to pro-poor policy outcomes. A series of case studies focusing on specific areas of policy change, and in some cases specific projects including in their objectives impacts at policy level, will be carried out in Eastern Africa. A major focus will be on identifying how policymakers source information that contributes to the policy process as well as the roles of research *vis-à-vis* non-research actors, and on communications between them. The case studies will provide a framework for the organisations involved to learn and adopt new ways of working to achieve their goals.

The project also facilitated a Centre Commissioned External Review (CCER) of ILRI's Capacity Strengthening (CaSt) Unit and concluded that additional reflection was required on i) how ILRI can best support and/or deliver CaSt activities in support of the policy, institutional and technological innovations it wishes to facilitate and on ii) the role, context and direction of future ILRI CaSt activities. ILRI considers that its main comparative advantage with respect to its CaSt activities lies in the contextual analysis of the livestock sector's changing dynamics and cutting edge information, which reflect ILRI's research outputs to offer new options and insights into ways of making more effective use of livestock science and

technology for poverty reduction. Increasingly, ILRI believes that such CaSt should evolve from 'changing individuals' to 'changing institutions', thus increasingly shaping the nature and the focus of livestock research and development agendas.

Research delivery pathways: In 2004, a number of projects developed strategies to scale research findings up and out to broader communities. In South-East Asia, the focus was on strategies for the control of helminths in small-ruminants. In West Africa, strategies to support improved management of trypanocide resistance were tested, adapted, and adopted in study areas in a number of countries, and a strategy for scaling out formulated. The established evaluation protocols and their application in suspected resistance 'hotspots' have been documented in a number of reports and publications. At the same time, the capacity of NARS to evaluate trypanocide resistance hotspots was established in several West African countries. A number of publications document the monitoring of tsetse and trypanocide control practices in the study sites. In Kenya, farmer to farmer dissemination of technology and information was explored to learn lessons about the role of farmer social networks in spreading ideas.

Service delivery was addressed in the Ghibe Valley of Ethiopia, where participatory evaluation of public/private sector–community partnerships to establish service cooperatives for the delivery of sustainable animal health services was completed. The testing of livestock Farmer Field Schools (FFS) in Kenya was completed and strategies for out-scaling by national partners formulated. A number of publications on livestock FFS implementation, and monitoring and evaluation manuals were produced.

A collaborative agreement with the IPMS project was also reached to experiment with a variety of best practice mechanisms and

processes for the promotion of agricultural innovation, pro-poor innovation capacity and knowledge sharing in its pilot learning sites. Testing and documentation of lessons learnt continues in 2005.

Although a number of projects used some methodologies and approaches that conform to the principles of the innovation system concept, such as action research, few fully embraced the concept. In 2005, new projects are being developed together with other themes in which an innovation system approach is applied with the objective of achieving research and development outcomes. Close linkages with the innovation systems team allows concepts and institutional innovation to be tested in on-going research activities, while the results from that team are used to adapt research approaches across the institute and with partners.

Innovative partnerships: In 2004, different types of partnership were tested, developed and evaluated. Multi-partnership activities were created, using the FFS methodology as an entry point, with NGO's, public sector, development agencies, national and international research institutions. These partnerships were developed to test different roles of this extension approach. New ASARECA Animal Agriculture Research Network (A-AARNET) network structure and priorities were adopted under the ASARECA strategy in 2004 to improve partnership mechanisms for livestock research and development. In the Philippines, China and Thailand, several reports and publications of the Crop–Animal Systems Research Network (CASREN) documented the mainstreaming of innovative research approaches and methodologies and the positive impact of the outcomes of this research on the livelihoods of families in livestock production systems. A novel partnership in which ILRI made a major contribution to the management of a major livestock NGO—Veterinaires sans

Frontieres Belgium—(VSF-B) in East Africa allowed exploration of the operational mechanisms of NGOs leading to development of partnerships in which joint activities combining research and development goals are carried out.

A key result in 2005 is the establishment of a partnership network to facilitate the scaling up and out of the livestock FFS in Uganda, Tanzania, Kenya, Central America and Asia. At the same time the project is carrying out an assessment of its livestock FFS activities in Kenya that encompasses both the learning and production objectives of the FFS approach and its specific role in the application of new knowledge and practices. A series of activities have also been undertaken in collaboration with other projects to evaluate how partnerships can extend the role and impact of ILRI research. As an example, this output brokered a partnership between an NGO consortium and Project (Theme) 1 staff to define the potential role of research in emergency interventions.

Project (Theme) 3: Improving market opportunities

While many of the elements of the Project 3 portfolio was present from previous years, there was much reflection in 2004 on how to organise the research to better influence key actors in livestock market chains to benefit the poor. The thematic research portfolio is now clearly defined and in 2005 progress is being made in integrating livestock into broader research efforts in high-value agriculture market chains and in defining research questions into appropriate norms and standards for livestock product quality and safety. In 2004, ILRI research greatly influenced pro-poor dairy policy in East Africa. In 2005 this research is being expanded with partners in South Asia.

The prioritisation, organisation, reporting of research under Project 3 falls under three pillars:

Smallholder competitiveness in changing markets: Prior even to the establishment of the ILRI–IFPRI Joint Program on Livestock Market Opportunities (Project 3) in September 2003, collaborative markets research involving ILRI, IFPRI, FAO and national collaborators focused on the need to understand what was driving the rapid scaling-up in the size of individual livestock farms in developing countries where livestock product consumption is growing rapidly. This research began to be reported in 2004 for case studies in Bangladesh, Brazil, India, Kenya, the Philippines, and Thailand. It was shown that in fact smallholders are often more efficient users of farm resources for securing profits from livestock than are larger-scale producers, provided that family labour is not costed at market rates and provided that the main markets continue to accept the undifferentiated and variable qualities of products typically supplied by smallholders.

The main problem facing smallholders looking to the future is that markets are changing, with increased demand for food safety and predictable quality. Market chains are also becoming longer, larger, and more anonymous. Under these conditions, continued survival of smallholders producing primarily for urban markets over time will require forms of collective action at the farm level such as raw milk dairy coops and contract farming schemes for pigs and poultry that both brands output in a way to build market trust and reputation in anonymous supply chains, while cutting the overhead costs of securing and distributing quality inputs, knowledge and credit to small farmers in a way to keep them competitive.

Work in 2005 is thus focused on the initiation of a series of case studies of

contract farming of poultry products, dairy and pigs in several Asian countries, and on smallholder dairy promotion in the poorer regions of South Asia. The end objective is over time to build a 'knowledge bank' of what works well and why, what has not worked as well and why, and what new innovations are most promising for achieving reliable delivery and acceptance of smallholder products.

Changing demand and market institutions:

Urban consumers in many places of the developing world now pay more for (safe) bottled water per litre than they do for milk. It is becoming increasingly apparent that the demand for safe animal source foods is high concern that people will pay for in the growing cities of the developing world. One conclusion is that even the most efficient smallholder producer may not be able to sell his or her products if buyers do not trust the safety of the output, and that trust is hard for anonymous small-scale sellers to achieve.

ILRI research in 2004 continued to focus on three aspects of these issues. First, an overview survey showed that much of the smallholder dairy cooperative development seen in recent years in East Africa involved selling raw milk, and pasteurisation brings in scale issues in processing that will put many existing coops and their suppliers out of business. Second, surveys of raw milk marketing channels in various parts of East Africa showed that traditional practices of boiling and using the milk the same day as produced are both universally followed and relatively safe, although problems of contamination of milk begin to arise as traditional market channels become longer and larger. Third, it was demonstrated that enforcing pasteurisation of milk under East African conditions would almost double the price of milk to poor urban consumers presently consuming boiled raw milk in tea. These points were demonstrated forcefully in important policy workshops in Kenya in

2004, and demonstrably led to a change in amendments to the Kenyan Dairy Act to better accommodate the interests of poor milk producers and consumers (the concerned Project 3 and Project 2 researchers won the 2004 CGIAR Outstanding Communications Award for this work).

Continuing research in 2005 focuses on ways to make traditional raw milk channels safer under changing circumstances, and do so in ways that both poor producers and consumers continue to benefit. Project staff are collaborating with ASARECA and East African institutions in launching a major regional study of milk marketing food safety. Other work is also being planned in Eastern India, and should commence in the second half of 2005.

Animal health and food safety for trade:

The world of animal disease control and its impact on market access is changing rapidly in developing countries under globalisation. With institutional innovations such as the SPS agreement in 1995 and the introduction of zonation within countries for disease-free certification, the stakes in effective disease control in developing countries suddenly rose as the possibility of export was added to what had been relatively less attractive domestic markets in many cases. Related research at ILRI in 2004 focused on the costs, benefits and issues in compliance with changing SPS regulations for meat animal exports in developing countries. In-depth work in Ethiopia suggested the positive returns to investments in compliance measures for reducing the danger of transmission of Rift Valley Fever in exports to Saudi Arabia.

More broadly, in 2004 and continuing in to 2005, Project 3 conducted a multi-country global scoping study with FAO support on the impact of SPS barriers on market access for developing country livestock. A key set of

issues emerging from this work centre around the concept of equivalence of standards. Developing countries are having difficulty in being effectively involved in standard-setting or gaining recognition for reasonable compliance with procedures offering substantively equivalent degrees of safety. Equivalence issues are multi-faceted, including issues in disease reporting systems and data analysis, certification procedures, animal identification and traceability.

The lessons learned from this work are being synthesised in 2005, with the intention to launch several follow up case studies with respect to exports for Africa to the Middle East, particularly those associated with live small ruminant exports. Countries currently identified for this work are Sudan, Ethiopia, Syria, Jordan and Tunisia.

Project 4: Biotechnology

Research into livestock biotechnology was relatively little affected by ILRI's structural realignment. Important progress was made in 2004 on the development of an experimental ECF vaccine, on the identification of genetic quantitative trait loci for trypanosome tolerance in cattle and helminth resistance in sheep, and on genetic characterisation of small ruminants and chickens in Africa and Asia.

In 2005, vaccine trials on an experimental ECF vaccine are being conducted. ILRI is also investigating with partners, opportunities for applying vaccine development strategies used in ECF to other priority vaccines and diagnostics. Progress on this will depend on success in resource mobilisation. In genetics, emphasis in 2005 is shifting to the application of molecular tools to practical livestock breeding and animal genetic conservation and use questions.

Improving disease control:

Substantial progress was made in this area during 2004. Work towards a schizont based ECF vaccine has advanced with the

identification and evaluation of vaccine candidates in cattle under laboratory conditions in partnership with consortium members including the private sector. Two papers presenting results of the *Theileria* genome sequence research have been accepted for publication in *Science*.

In parallel, back-stopping of regional tick-borne disease control programmes has been expanded. Four diagnostic kits developed by ILRI and partners were transferred (under an agreement) to a private sector company (SVANOVA Biotech) for commercial production and distribution. Work on contagious bovine pleuro-pneumonia (CBPP) has generated information on disease dichotomy in the young and adult cattle and provided a platform for optimising an immune screening system for identification of diagnostic and vaccine candidate antigens. Preliminary trials of a salivary gland candidate vaccine antigen showed significant reduction in levels of tick infestation, demonstrating technical feasibility for developing a vaccine that may provide protection against ticks.

In 2005, ECF schizont vaccine trials to demonstrate induction of protective killer T cell responses in a significant proportion of vaccinated cattle are well underway. Activities toward the development of a second generation anti-tick vaccine using a novel antigen delivery system (mimotope-virosomes) in cattle have been initiated while comparative studies on mechanisms of host immunity against CBPP in young and adult cattle are being undertaken to underpin the optimisation of a vaccine and diagnostic candidate antigen identification system. An anti-trypanosome antibody detection ELISA test is undergoing further validation using experimental sera.

New research activities being initiated in 2005 include:

- the identification of candidate vaccine antigens from *Theileria annulata* using the same approach applied for *Theileria parva*;
- Immunological assessment of *Mycobacterium bovis* in vaccinated cattle;
- evaluation of two CBPP vaccines (a modified formulation and a new mutagenised version) under laboratory and field conditions in Kenya and Tanzania;
- development of ELISA-based tests for diagnosis of African Swine fever.

Delivery of genetic change:

In 2004, broad-scale mapping of genes controlling helminthosis resistance in sheep was nearly completed with 80% of the genome covered and the chromosomal region with the gene controlling helminthosis resistance was identified. Progress was also made towards identification of genes responsible for trypanotolerance. A total of 36,000 expressed sequence tags generated from trypanosome-infected N'Dama and Boran cattle were submitted to the global Ensembl/NCBI trace repository, clustered and annotated and are now being used to prepare a next generation bovine expression analysis microarray.

In 2005, the genome wide scanning of the sheep genome will be completed leading to the identification of QTL chromosomal regions for helminth resistance. On the cattle side, the gene content of bovine trypanotolerance QTL will be fully identified and the process of examining these as candidate genes for trypanosomosis resistance or susceptibility will begin through the analysis of gene expression data. Already preliminary cluster analyses have shown differential gene expression responses related to resistance or susceptibility and infection status. This information, together with

sophisticated data mining in collaboration with Liverpool and Manchester Universities, is generating new insights into the disease process and is facilitating prioritisation of candidate genes. Work on the understanding of indigenous selection criteria and genetic diversity in the African Longhorn Ankole cattle has been started in Uganda and will be expanded to Tanzania, Rwanda, Burundi and Tanzania in collaboration with Austrian collaborators (BOKU University), and NARS in the respective countries.

Animal genetic resources:

Animal genetic resources work continues to focus principally on characterisation, including inventory/documentation; activities to support *in situ* conservation are only just being initiated. In 2004, the functionality and scope of DAGRIS (Domestic Animal Genetic Resources Information System) database was expanded with the development of descriptors and data entry structure for poultry and subsequent entry of 127 breeds/ecotypes /strains indigenous to Africa and Asia. A second version of DAGRIS was released on CD-ROM and placed on the web (<http://dagris.ilri.cgiar.org/dagris>).

In 2004, two molecular genetic diversity studies were completed. A survey of the genetic diversity of the Yak populations of Central Asia and the Himalayan region led to the first comprehensive analysis of the distribution of the genetic diversity of this unique livestock species over nearly its entire geographic distribution. At the country level, a detailed survey of the genetic diversity of Ethiopian goat populations was finalised and showed that most of the genetic variation is found within rather than between these goat breeds with four out of 11 breeds representing the complete set of national goat types studied carrying 75 % of the goat diversity found in the country.

In 2005, data from livestock breeds / populations of Africa and Asia will continue to be collected/collated, validated and entered into DAGRIS. Development of breed descriptors for pigs will be undertaken and protocols will be included in geo-referenced data. Links between DAGRIS and FAO's DAD-IS will be established.

Molecular assessment of diversity in 2005 includes the following projects:

- ongoing assessment of diversity in mitochondrial DNA sequences in chicken will continue leading to a better understanding of the origin of chicken diversity in Africa and Asia, with possible inclusion of indigenous South American chicken samples;
- a new initiative will be started on the characterisation of polymorphism at the level of candidate genes for disease resistance in chickens, the starting point of which will be the screening of indigenous populations from different centres of origin;
- laboratory analysis of autosomal microsatellite markers of West and East African goat populations will be finalised to better understand the distribution of genetic diversity within and between African goat populations.

The development of a GEF–UNEP project “Development and application of decision support tools to conserve and sustainably use genetic diversity in indigenous livestock and wild relatives”, started at the end of 2003 with the initiation of the design (PDF-B) phase. The full project proposal of this 5-year project is expected to be submitted to GEF at the end of 2005 or in early 2006. This activity will address, for the first time, the issue of priority breeds for conservation and utilisation in diversity hotspot countries (Pakistan, Sri Lanka, Bangladesh, Vietnam).

New policy-related initiatives on AnGR conservation and sustainable use are being developed. These include:

- research on exchange, access and benefit sharing of AnGR which aims to develop scenarios to explore how climate change, globalisation, and developments in biotechnology may influence the choice of regulatory options for AnGR conservation and sustainable use;
- a state-of-the-art review and an annotated bibliography of agricultural (crop and livestock) genetic resources valuation work;
- participation in the Genetic Policy Resources Initiative (GRPI) including support for a forthcoming workshop aimed at defining the ‘Role of Economics in Genetic Resources Policy’.

On capacity building, tailor-made training in AnGR will be conducted in South Asia and training materials from that region included in Version 2 of the TRAINING Resource. A CD-ROM version of this resource will be released and distributed for wider use by teachers and researchers for the promotion of the study, utilisation and conservation of indigenous animal genetic resources.

Project 5: People, livestock and the environment

In 2004, there was considerable realignment in strategies for livestock–environment and feeding systems research. Livestock–water issues were given more importance. In 2005, there are plans to extend lessons learned from successful research in pastoral systems of East Africa to West Africa and to expand the application of feed values into the breeding of dual purpose crops beyond sorghum, millet and cowpea to pigeon pea, maize and rice. Research into the importance of livestock practices on human health and nutrition began in 2004 and a number of key partnerships are being further developed in 2005. ILRI's role in this research will be to provide the livestock and developing country

perspectives in collaboration with health and nutrition experts.

Sustaining water (and nutrient) productivity:

A major output from ILRI's research on livestock–water productivity in 2004 was the development of a conceptual framework for assessing livestock–water productivity. As well as submitting the description of this framework and related hypotheses to a peer-reviewed journal, the tool is, in 2005 being developed to enable its practical application in relation to integrating livestock in agricultural water research and management.

The research led by ILRI in the context of the *Comprehensive assessment of water management in agriculture*, has included significant engagement with national institutions in Ethiopia. In 2004, five master's theses were completed, contributing to improved understanding of how investments in community-based irrigation systems could be better designed and managed to increase the efficiency of water utilisation and accommodate the livestock keepers who are and will be users of the systems. ILRI's role in this assessment has resulted in the scientists being invited to contribute the livestock perspective to a major synthesis on the impacts of investments in agricultural water which is being developed in 2005.

ILRI's contribution (Projects 1 and 5) to the livestock component of an IWMI-led report on *Agricultural and water investment opportunities in sub-Saharan Africa* was completed in 2004. This study was presented to investment agencies in 2005 and this has led to new recognition of the importance of livestock in water productivity and opportunities to contribute in this respect to policy issues emanating from the report.

Sustaining lands and livelihoods:

ILRI produced several synthesis of its research at global, regional and local levels. At global level, a number of chapters in

books and reports on livestock–environment issues were produced in 2004 and 2005. These included contributions on ecology, livestock and land-use policy issues globally, a synthesis of East African pastoral and grasslands issues for FAO, and a chapter on food and ecosystems (livestock and the environment) for the Millennium Ecosystem Assessment in 2004 and 2005.

ILRI has been documenting lessons learned from its several years of research into the links between livestock, land degradation, livelihoods, and use of biodiversity for East Africa. In 2004 and 2005, a total of 40 working papers, journal articles and book chapters were produced and disseminated. Highlights of these reports include information on ways that the poor can benefit from direct ecosystem service payment programmes, synergies and competition between livestock and wildlife, and detailed analysis of the forces driving changes in pastoral livelihoods. This information is now being discussed and disseminated to communities and policy makers to strengthen their decision making capacity.

A synthesis of ILRI research activities in the Fagara region of Niger was produced in 2004, providing for the first time, details of characterisation methodologies that can be widely applicable to other Sahelian zones in West Africa. These methodologies are being further applied in 2005 in the context of the new phase of the Desert Margins Program, for which ILRI is a collaborator.

Role of livestock in human health and nutrition:

In the context of new research to study the interactions of livestock and human health, two reports were published in 2004, documenting the human health impacts associated with peri-urban livestock production. Research results about livestock related health risks fed into the Urban Harvest-led efforts in Kampala, Uganda and led to revision of municipal by-laws to better

support urban agriculture, including livestock.

In order to better understand the context, and identify key roles for ILRI, and other stakeholders, a review of the literature, on the linkages between livestock keeping and nutritional well-being, conducted in collaboration with IFPRI and Cornell University, US is being developed in 2005 for a formal publication and as a platform leading to new initiatives to investigate this research area;

A number of zoonotic diseases that are well controlled in richer populations have considerable impact on poor populations. ILRI is focusing on cysticercosis/Taeniosis, a disease of pigs and people associated with poor hygiene. Evidence from previous research was synthesised as part of an international workshop at the Rockefeller Foundation's Conference Centre in Bellagio, Italy held in 2004. A consensus was reached and an international action plan for implementing a Global Campaign for Combating Cysticercosis was formulated by key international stakeholders including ILRI, WHO and FAO. A more specific action in 2005, was the widespread dissemination of a poster by South African collaborators to improve awareness of Cysticercosis transmission and prevention.

Mitigating feed scarcity:

In order to support crop breeders in their food-feed crop breeding programmes, ILRI is developing and validating the use of Near-Infrared Spectroscopy (NIRS) equations, as an indicator of nutritional value for specific crops. In 2004, NIRS equations were developed and validated for screening the stover quality of sorghum and pearl millet cultivars. The National Research Centre for Sorghum in India, immediately applied to the approach developed by ILRI to screen sorghum cultivars for stover and to include this parameter in release criteria. Similar

approaches are being pursued for other key crops in 2005.

The project agenda in 2005 is moving towards looking at feeding as part of a broader crop-livestock systems approach. In 2005, an innovative joint appointment between ILRI and KVL-Denmark has facilitated the initiation of research and proposal development in the context of intensifying crop-livestock systems with national partners in Ghana and Burkina Faso. In another region, systems research, focusing on feeding strategies for pigs is being developed in collaboration with key partners in NE India, and with the addition of new skills in pig nutrition through a visiting scientist.

Forage diversity:

In the context of global public goods funding for CG centres, during 2004, operations in ILRI's forage genebank were upgraded in line with international standards. Practical implementation of these measures with genebank material will continue in 2005.

A new forage image collection and database with user search facility was developed with partners in 2004 and is under evaluation for launching in mid 2005.

During 2004, development of approaches to enhance the use and impact of forages in crop-livestock systems in Nigeria and India has included an increased focus on diversifying and strengthening partnerships and use of tools such as actor linkage matrices to promote these. This has benefited from close interaction with Project 2 in bringing innovation systems perspectives to this project. This aspect was further strengthened in 2005, when a review of the project on fodder innovations resulted in key recommendations to enable partners to scale up and out feed innovation strategies. From mid-2005, this project will be coordinated by Project 2 with inputs from Project 5.

Project 6: The System-wide Livestock Programme (SLP)

The SLP was established to build upon the expertise and investments of the CGIAR centres on food crops, natural resource management and policy/institutional analysis. It leverages existing CGIAR system resources to address the global research needs of small-scale crop–livestock in a coherent and integrated manner. The members of the SLP include CIAT, CIP, CIMMYT, ICARDA, ICRAF, ICRISAT, IITA, IFPRI, ILRI, IRRI, IWMI and their partners.

Over the years, the SLP has worked in the broad area of crop–livestock integration, bringing together expertise from the partner Centres. A number of results from this work were completed in 2004:

- A typology of crop–livestock systems was developed for South Asia (India Sri Lanka, Nepal) and West Africa. Rice–livestock systems in the rain fed lowlands of south-east Asia (Cambodia, Indonesia, Philippines, Thailand and Vietnam) were characterised. The contribution of livestock and the drivers of evolution in these systems and opportunities for system improvements were identified;
- The drivers of intensification and adoption of productivity enhancing technologies were identified in a trans-regional analysis of crop–livestock systems in Asia, sub-Saharan Africa and Latin America;
- Models to represent the key interactions in mixed farming systems were validated and made available to researchers in countries of Asia and Latin America;
- A synthesis of the scale factors that affect the competitiveness of smallholders was performed.

In 2004, the SLP almost exclusively focused its research on feed resources, particularly on identifying and breeding for feed traits that can be integrated into existing crop breeding

and seed systems, both public and private. To support this new focus, a series of seed grants were provided in 2004 to consortia of SLP partners to develop larger feed resource research proposals in different crop–livestock contexts during 2005. Seed grants for improving sweet potato, sorghum, rice, pigeon pea and grass pea as food feed crops were funded. Related to these, a new collaboration between ILRI and CIMMYT to improve the breeding and scaling out of dual purpose maize in eastern Africa began in mid-2005. In addition, one seed grant to assess the influence of livestock on water use in crop–livestock systems was funded. To draw lessons across different systems, research was funded on developing a framework for assessing, *ex-ante*, the impact of feed interventions.

In 2002, SLP members combined to develop research proposals for assessing feed innovation systems. A major project in this area was funded in 2003. During 2004, the demand and drivers of adoption of fodder technologies were assessed in India and Nigeria and institutional alliances were established to evaluate the processes involved in effective dissemination and uptake of fodder in key pilot sites through participatory testing of fodder innovations. This project was reviewed in 2005 and a number of recommendations made to build on project results to enhance the capacity of institutions in both countries to scale up and scale out successful feed innovations.

Highlights of the 2006 Project Portfolio

A keenly anticipated highlight expected in 2006 is major works on the construction and refurbishment of bioscience laboratory facilities at the ILRI Nairobi campus as part of the BecA hub development. This will be a major milestone in the joint plans of NEPAD, ILRI their partners to enhance bioscience research for agriculture and livestock in Africa. Another major highlight in 2006 will

be the 2nd EPMR of ILRI. It is anticipated that an initial visit will happen in the first half of the year and the main review in the second half.

In line with the development of the BecA hub, ILRI anticipates increasing its emphasis on strategic livestock biotechnology research for vaccine and diagnostic test development and genetic improvement. For Projects 1, 2 and 3 we anticipate greater collaboration with partners on cross-cutting and cross-sector poverty alleviation research. In these collaborations, ILRI will contribute livestock specific expertise and support research methodologies important for analysis of poverty alleviation and cross-sectoral lesson learning. For all projects and particularly Projects 1 and 5, we see continued expansion and cross-regional analysis of livestock system evolution. This will be in line with the continued gradual expansion of ILRI's geographic focus from East Africa to Asia and other regions of sub-Saharan Africa.

Following the recommendations of the sub-Saharan Africa task force, ILRI is coordinating the development of the regional east and southern Africa MTP, which is due for submission in 2006.

Project 1: Targeting research and development opportunities

Livestock systems evolution: Changing demand patterns, urbanisation, and globalisation are major drivers of structural change in the livestock sector in developing countries. Understanding how livestock systems may evolve in response to these drivers of change is crucial for effective priority setting, targeting of interventions, and strategy formulation. A study will be conducted in collaboration with FAO to examine the key trends in livestock systems and opportunities for using livestock in reducing hunger and poverty, improving rural livelihoods, and facilitating sustainable management of natural resources. This study

will use data and information from SSA, South Asia, and South East Asia to examine alternative scenarios of livestock sector development to 2030 and develop policy relevant options. The analysis will involve literature reviews, trend analysis, narratives, and quantitative modelling. The output from the study will include insights into plausible futures of livestock sector development in these regions, drivers associated with alternative trajectories, priorities for updating quantitative and modelling work. This study will enhance understanding of how livestock systems are changing now and in the future in various sub-regions where livestock production and demand is predicted to increase. The information will help ILRI and its development partners formulate more effective strategies and identify technology, policy, and institutional options to address predicted increases in demand for livestock products in ways that benefit poor people and the environment. The results from this study will be discussed extensively with policy advisers, major development partners, and donors.

Future work in land use change and its implications for livestock keepers and others living in livestock based systems focuses on the interaction between climate change and land use. The Climate–Land Interaction Project (CLIP) is conducting research to determine the impact of land use change on the regional climate of East Africa, and the impact of current and projected climate change on land use and livelihoods of households in different crop–livestock and rangeland systems. It will involve a suite of modelling and other activities, including developing a regional climate model for East Africa, conducting land use and land cover change projections for the region, and crop– and rangeland climate modelling. Michigan State University is the lead institution, while ILRI is leading the East African activities of the research. Other aspects of the research are being conducted by research institutions

in the USA and UK. Results and feedback from simulation modelling of impacts on net primary productivity in crop and livestock based systems will be used to identify hotspots where current land use systems are most vulnerable to climate change. This will help identify how households in different areas may respond by adjusting livelihood strategies and land use. The study is expected to generate information, methods, and analysis that would enhance understanding and contribute to scientific knowledge on interactions and feedbacks between climate and land use and land cover, and modelling complex system. The results will also be used to inform policy processes in climate change by indicating possible impacts of climate variability upon livelihood systems and land use. These will have critical implications for agricultural research and policy, conservation and land use planning in the region. The lessons drawn from the regional analysis and country case studies will be used to inform a similar project in China.

Enhancing the role of livestock in poverty interventions:

In 2006 there will be increased emphasis of livestock-poverty understanding to generate policy relevant information that can be used by key livestock sector decision makers in policy dialogue. A study will examine the spatial determinants of the prevalence of poverty for small – spatially defined populations in livestock based systems in Kenya. It builds on ILRI's past work on poverty maps, attempting to establish an analytical link between people and their local environments, i.e. between the tabular economic data (poverty incidence at the location level) and GIS based environmental data. Key livestock decision makers, policy advisers and government policy analysts, key users of this information, will be engaged throughout the study to get feedback from the study results. The research findings will be presented and discussed at a policy workshop involving key clients and stakeholders. It is expected that the results

from this study can be used to improve targeting of anti-poverty programs by identifying more location specific policy options, including livestock based options that can be incorporated into poverty reduction strategies.

The effort to demonstrate the use of poverty tools for other sector applications will be increased. Using the livestock sector as a case study, Project 1 will demonstrate the use of poverty tools such as poverty maps for informing poverty interventions. It will share data and information as well as experiences with applications of tools and analytical approaches in design of specific pro-poor livestock interventions with policy analysts from the health sector in selected countries East Africa so that they can enhance pro-poor policy making and project design in their own sectors. The lessons learnt from this experience will be shared and applied in other countries to foster cross-sectoral interventions in national poverty strategy processes in other developing countries.

A study on poverty and environmental links will extend Project 1's past work on poverty maps to examine the links between poverty and ecosystems services. Research questions addressed in this study include where are the poor? Which areas provide which amount of ecosystem services? How does the location of poverty compare to the distribution of ecosystem services? Who has access to resources, who benefits, who bears the cost? Ecosystems services considered in the study include the benefits poor people derive from provisioning, regulating, cultural, and supporting services in crop, livestock and wildlife systems. The data and information from the study will be used to identify pro-poor options from ecosystems services. It is expected that these results will contribute to mainstreaming environmental issues in poverty reduction strategies. The methodology linking spatial analysis of poverty and ecosystem services will enhance

the capacity of national collaborators to better address poverty–environment links in policy, project, and programme interventions in other developing countries.

Targeting livestock based interventions: A desk study will be conducted to develop methods, tools, and techniques that can be used to assess the socio-economic and environmental impacts of Tsetse & Trypanosomiasis interventions. The methodological guidelines will support decision making processes for monitoring and assessing environmental and social economic impacts as well as mitigating negative impacts of Tsetse & Trypanosomiasis interventions. A literature review will be conducted to synthesise information on methodologies for assessing environmental and socio-economic impacts and indicators that are used to measure impact. A methods manual will introduce concepts of impact analysis, present a conceptual framework for assessing socio-economic and environmental impacts, and identify data requirements and appropriate tools and techniques for different types of impact analysis. The methods manual is targeted at practitioners implementing tsetse & trypanosomiasis control activities under the Pan-African TseTse and Trypanosomiasis Eradication Campaign (PATTEC). Programme participants provided inputs into the study design at a stakeholders' workshop. The guideline will be presented and discussed at a number of meetings involving key stakeholders working on tsetse & trypanosomiasis control, policy advisers, and donors in sub-Saharan Africa.

To support decision making on priorities and resource allocation decisions on animal health constraints facing poor people, a study utilising spatial analysis and country case studies from East, West and Southern Africa, will be conducted to provide better information about the relative importance of individual livestock diseases and syndromes

in terms of their impact on the poor in sub-Saharan Africa. This will be achieved by refining the methodology reported in an earlier Perry et al. (2002) and using a similar consultative approach, but with enhanced quantitative detail, to assemble the necessary data for its implementation. The study will involve macro level analysis of livestock production systems characterisation using GIS techniques. This spatially based livestock system characterisation will provide the basis for selection of case study sites where meso and micro level analyses will be undertaken. The analysis will generate an updated ranking of disease priorities, awareness about how disease affect the poor differentially and how it can be measured and streamlined, rapid methods for relevant data collection at different levels using different information sources. The results from the analyses will be documented and disseminated through papers, research briefs, and policy workshops involving policy advisers, researchers, and donors. The outputs from the study are expected to influence research priorities on poverty–animal health links as well as donor funding to support research on the priority animal diseases affecting livestock assets of poor people.

Project 2: Enabling innovation

Innovation systems: In 2006 full staff complement will be in place, the hub will be fully operational and activities of the joint programmes will be consolidated with active programmes involving numerous other partners. A learning-based monitoring and evaluation (action research, action learning, process monitoring) methodology will be under going testing in sub-Saharan Africa and Asia with the objective of enhancing the capacity within organisations, projects and communities for interactive learning and the sharing of livestock-related knowledge.

Research delivery pathways: Activities in a number of different projects across themes will be experimenting with a variety of best

practice mechanisms and processes for the promotion of livestock innovation and pro-poor innovation capacity to mainstream innovation systems and participatory approaches within ILRI and among partners. Cross-cutting analysis of research results in countries including Ethiopia, India and Nigeria, will allow generic lessons to be drawn.

Innovative partnerships: In 2006, research activities to understand mechanisms that enhance participation of public–private sector will build on results in earlier work to produce a set of guiding partnership principles for livestock-related policy research in collaboration with the activities mentioned under *innovation systems* for 2006 above, thus ensuring that knowledge generated through livestock-related policy research leads to pro-poor policy change.

Project 3: Improving market opportunities

The planned portfolio for 2006 has not changed significantly from that given in last year's MTP, although a clearer funding picture has enabled greater precision with respect to the location of the country cases to be studied, and a more proactive stance towards output 2. The main targets by planned output follow.

Smallholder competitiveness in changing markets

- Benefits from and barriers to smallholder participation in contract farming of poultry and pigs or dairy in South Asia and Southeast Asia documented, and compared (targeted cases: India, Philippines, Thailand, Vietnam);

Work in mid 2005 is starting in India and Vietnam, and will form a corpus of case studies along with prior work in the Philippines and Thailand to produce the output target listed in 2006.

- Current smallholder dairy production technologies and best practices for

increased smallholder competitiveness and participation in markets identified and documented in SSA and South Asia.

Work in 2006 in SSA will mainly be to promote even better NARS ownership and scaling-up of results from previous work in East Africa. The work should be extended in 2006 to poor regions of Eastern India as planned, with the possibility of further work throughout poor South Asia depending on success of external proposals. Attempts are also being made in 2005 to develop new activities in this regard in West Africa, with still uncertain prospects as of writing.

Changing demand and market institutions

- Develop improved framework for applying quantitative risk analysis of milk safety in selected African cases;

This work is on track to commence in late 2005, as planned.

- The changing nature of urban demand assessed for animal source foods in at least two country cases, and price premia paid for food safety and quality documented.

This specific output target for 2006, reported from the 2005–2007 MTP, has only recently gotten under way due to delays in securing sufficient funding to create a new position for a person with expertise in this area.

Recruiting is under way as of spring 2005. Collaborations to carry out this work are also being developed in India, Vietnam, and (tentatively) Cambodia. Disappointingly, proposals to external donors to fund this work in West Africa failed in late 2004.

Animal health and food safety for trade

- Characterisation and scoping analysis of small ruminant health delivery systems and market access in the Near East—North Africa;

This work is on track as planned.

- Policy domains identified and documented for regulatory and institutional change in developing countries that will help meet

SPS concerns, while minimising negative impacts on small-scale producers. This work is on track as planned.

Project 4: Biotechnology

Improving disease control

- Proof-of-concept for the development of a schizont ECF vaccine and induction of killer T cell responses that associate with protection against a lethal challenge in a significant proportion of cattle will be assessed in the final phase of the ECF vaccine development project. Subsequently, if successful, the product development phase will be initiated by developing protocols for simultaneous evaluation of the vaccine under laboratory and field conditions for a number of parameters required for licensing;
- The development of a rapid ELISA test for detection of antibodies against trypanosome infections will be assessed using laboratory experimental sera. Results from this analysis will help initiate the evaluation of this test in a number of laboratories with sera from several field sites to provide data for the transfer of this technology to a private company for distribution;

Delivery of genetic change

- *T. congolense*-specific gene expression studies in the mouse and cattle: For the first time, we will have detailed description of the host processes that follow infection. These will be used to identify the processes by which the already-identified QTL exert their effect. The opportunities to compare mouse, cow, resistant and susceptible, make this a uniquely powerful approach;
- Pilot field study of trypanotolerance QTL completed: N'Dama x Boran backcross animals under field challenge provide information on the effect of the QTL in this particular production system. The experimental herd could also provide the nucleus for future expansion of the cross

for deployment or further studies. Data on farmers' perceptions of these animals and their possible value will be collected during this study

Animal genetic resources

- Centres of origin and genetic diversity for African and Asian chicken will be identified and distribution of diversity in African goats will be mapped: On the basis of mitochondrial DNA sequences in chicken and analysis of autosomal microsatellite loci in goats, it is expected that the centres or regions of high diversity for these two species in Africa and Asia (chicken) or in East and West Africa (goat) will be identified. This information will guide decisions on conservation and utilisation of these indigenous genetic resources at national and/or regional levels;
- Scope of DAGRIS will be expanded in Asia with inclusion of chicken population information: The inclusion of chicken information into DAGRIS is a particularly challenging exercise as chicken populations of the developing world remain poorly described and information provided often refers to ecotypes rather than well defined breeds.

Project 5: People, livestock and the environment

Sustaining water (and nutrient)

productivity: This activity contributes to increased productivity and sustainability of pastoral, crop–livestock and peri-urban production systems through understanding and providing options for better livestock–water management and works closely with IWMI, in particular in the context of the CPWF. In this context, highlights for 2006 include completion of livestock–water productivity domains for key systems in SSA and further progress with a framework to enable local evaluation of livestock water productivity, which will be ready for

testing through case studies in the Nile Basin.

- ***Sustaining lands and livelihoods:*** The focus of this operating project remains to improve ecosystem resilience and services through the provision of livestock-based options for enhanced land-use management, with an increased focus on research to ease the transition for poor livestock keepers facing dynamic system changes. Research to improve our understanding of changing livestock based systems in East and West Africa will include an assessment of the changes in pastoral livelihoods and ecosystem services. In addition, studies in East Africa will analyse the trade-offs and benefits from natural resource conservation strategies for poor livestock keepers in changing pastoral environments
- ***Role of livestock in human health and nutrition:*** As a fairly new research area, the focus of this operating project has not changed significantly since the previous MTP. A key output in 2006 will include the development of an appropriate research framework together with methods for assessing health risks associated with urban livestock activities which will be tested and documented in several African urban areas (in collaboration with Project 3). In order to mitigate the potentially detrimental effects of livestock diseases on the poor, an assessment of the relative importance of individual livestock diseases and syndromes will be implemented (in collaboration with Project 1).
- ***Mitigating feed scarcity:*** This operating project, which previously focused mainly on food–feed crops is moving more towards a systems focus. With agricultural intensification, achieving greater efficiencies and synergies between crop and livestock enterprises is critical. Key outputs in 2006 relate to the food–feed crop agenda and include identification of approaches and criteria for food–feed crop selection for cowpea, groundnut, pigeon

pea, maize, sorghum, pearl millet and rice in crop livestock systems in SSA and Asia. Through partnerships with crop breeders, improved food–feed crop genotypes of key crops in Asia/SSA will be available.

- ***Forage diversity:*** Work started in 2004 on the strengthening of the management of the genebank, will continue into 2006. Major improvements in data management and plant health procedures will be in place. These will allow ILRI to meet international standards under the International Treaty on Plant Genetic Resources for Food and Agriculture.

Project 6: The System-wide Livestock Programme (SLP)

The major emphasis on 2006 will be to continue research on feeding strategies based on a variety of food–feed crops in different crop–livestock systems across the globe. Building on the review of feed innovations research in 2005, research will focus on scaling out and scaling up institutional and systems innovations identified by development partners. Depending on funding approval, this work will be expanded from Nigeria and India to include systems in Ethiopia, Syria and Vietnam.

In 2006, the SLP plans to refine its feeding strategy agenda in two ways. The first is to assess the tradeoffs between feeding crop residues and conserving them to enhance soil fertility through methods such as conservation agriculture. This is a major sustainability issue in different crop–livestock system contexts and the SLP partners plan to initiate research into the tradeoffs between these options in two contrasting systems. Another major feeding issue, given the rapid expansion in demand for poultry and pigs, is to assess options for the use of grains as feeds. The SLP plans to initiate a desk study to look at trends of grain feeding in crop–livestock production systems in developing countries and their impacts on poor livestock producers and feed suppliers.

System-wide and ecoregional programmes (SW/ERP)

The CGIAR has established a number of system-wide and eco-regional projects to improve the effectiveness of Centres in tackling key cross-cutting issues. ILRI coordinates one system-wide programme, the System-wide Livestock Programme (SLP) and participates in 7 others (see Box 1 below). ILRI's participation in these programmes is determined by the opportunities for livestock research to add value to the objectives of the programme. Livestock research could add value to some of the system-wide and eco-regional programmes that ILRI does not participate in, but in those cases the capacity, particularly of human resources, to respond to all such requests is limited.

The System-wide Livestock Programme (SLP)

Details of the global activities of the SLP are presented separately, as ILRI project 6. Each participating Centre in the SLP also highlights its contribution to SLP in its Centre MTP. Below are the highlights of ILRI's contribution to the SLP.

As a convener of the Systemwide Livestock Programme (SLP), ILRI hosts and provides logistic and administrative support to the Programme' Coordination office, chairs the Livestock Programme Group and ensures that the required expertise in livestock is available for projects led by other centres.

The part played by ILRI's livestock research in SLP is in 3 major areas. The first is in coordinating research on major drivers of change in crop-livestock systems. ILRI has coordinated two major SLP projects, one on the trans-regional analysis of crop-livestock systems that is being finalised in 2005 and the second on a framework for assessing *ex-ante* impacts of feed innovations in mixed crop-livestock farms. Both of these projects are reported under ILRI Project (Theme) 1. In 2006, there are plans to expand the

framework for assessing *ex-ante* feeding impacts work to consider interactions of feeding crop residues versus retaining them for soil fertility enhancement such as in conservation farming.

The second major area is providing livestock nutritional expertise so that important feed traits can be incorporated into the germplasm breeding and dissemination programmes of CGIAR Centres working on plants used as livestock feeds. The major thrust has been on establishing methods and indicators for feed value of important crops so that these can be incorporated into crop breeding and seed systems. This research is reported under the mitigating feed scarcity output in ILRI Project (Theme) 5. For ILRI, this is a very strategic and high impact research area, since the improved dual-crops identified can be bred and disseminated through the well-established breeding and seed-system programmes of CGIAR crop Centres and their public and private partners.

The third area in which ILRI contributes to SLP is in coordinating research on innovative partnerships and strategies for livestock feeding. Initial work has been conducted with public, private and NGO partners in India and Nigeria and is expected to expand in 2006, depending on funding, to Ethiopia, Syria and Vietnam. This is reported under Projects (Themes) 2 and 5.

Other SWP and ERPs

As noted, ILRI contributes to 7 other system-wide initiatives based on their livestock research input requirements and ILRI's capacity to contribute (see Box 1).

ILRI's collaboration with the Collective Action and Property Rights Initiative (CAPRI) has focussed on collective action for pastoral and health issues that have been or are being completed. In 2004, an ILRI senior scientist joined the CAPRI Executive Committee and

will be assisting in the development of the new CAPRI strategy.

ILRI's Project 2 is collaborating with the Participatory Research and Gender Analysis (PRGA) programme to investigate ways and means of initiating institutional changes within ILRI that would mainstream gender analysis, participatory approaches, and action research. A series of workshops was initiated in early 2005 to develop a plan for an assessment of the use of participatory and gender methods within ILRI.

Box 1. ILRI's participation in CGIAR system-wide and eco-regional programmes

Collective Action and Property Rights (CAPRI), led by IFPRI

Participatory Research and Gender Analysis (PRGA), led by CIAT

Deserts Margin Programme (DMP), led by ICRISAT

Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC), led by CIMMYT

Strategic Initiative on Urban and Peri-urban Agriculture (Urban Harvest), led by CIP

System-wide Genetic Resources Programme (SGRP), led by IPGRI

System-wide Initiative on Malaria in Agriculture (SIMA), led by IWMI

System-wide Livestock Programme (SLP), led by ILRI

ILRI is an active participant in the Desert Margins Programme (DMP) and has one livestock scientist directly involved in and funded by DMP. Among the specific ILRI contributions to DMP are in monitoring and evaluating indigenous vegetation and livestock management practices for arresting land degradation and for conservation of biodiversity, and the identification of socio-economic constraints to the adoption of improved livestock management practices with NARS, NGOs and farmer groups. ILRI

also supports capacity strengthening in the DMP member countries to undertake land degradation and biodiversity conservation research and to apply best bet technologies and practices.

Beginning in 2005, ILRI began working with members of the Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC) to describe and understand crop-livestock interactions in the rice-wheat systems of the Indo-Gangetic Plains. The research takes a systems perspective for the evaluation of the contributions of crops, livestock and their interactions to the livelihoods of resource-poor families and to identifying the drivers of change in these rice-wheat-livestock systems. The research will propose policy options and institutional and technical interventions to improve livelihoods and the management of the natural resources of the Indo-Gangetic Plains.

ILRI's collaboration with Urban Harvest has led to a number of achievements:

- a project has been completed on nutrient cycling of organic waste and livestock manure for enhancing agricultural productivity in urban and peri-urban Nairobi;
- ILRI and Urban Harvest jointly sponsored a major stakeholder workshop on Kenyan urban and peri-urban agriculture policy;
- ILRI made contributions to the Urban Harvest programme through a study on gender and urban livestock funded by IDRC;

Urban Harvest and ILRI are seeking to develop collaborative activities related to: 1) nutritional and health benefits and risks associated with urban livestock activities, including those specific to households affected by HIV/AIDS, 2) livestock waste recycling and water quality issues in urban agricultural ecosystems, and 3) building on the first phase of health risk studies to develop and apply a participatory risk analysis framework for assessing health risks associated with urban livestock activities and

designing appropriate mitigation strategies and policies.

ILRI is working closely with other Centres as part of the System-wide Genetic Resources Programme (SGRP) in the areas of forage and livestock genetic resources and is applying the common CGIAR Centre policy instruments and guidelines on genetic resources, biotechnology and intellectual property rights developed through the programme. ILRI is involved in the system-wide upgrading of genebanks and is also leading a specific activity on assessing availability and use of low-technology options for seed drying and storage in SSA. ILRI is also a major contributor to a study on economic valuation of crop and livestock biodiversity.

ILRI's support to the System-wide Initiative on Malaria in Agriculture (SIMA) focuses on a project in Uganda that seeks to investigate the role of livestock and the use of pour-on insecticides on cattle in malaria prevalence in herders in areas in transition from pastoralism to agro-pastoralism. Other ILRI livestock health inputs into SIMA will depend on the identification of additional human and financial resources.

Challenge programmes (CP)

The Water and Food CP

Since the last MTP, the ILRI-led proposal, *'Increasing water-use efficiency for food production through better livestock management—the Nile River Basin'* was approved with US\$ 970,000 of committed funding coming from the Challenge Programme on Water for Food (CPWF). In March 2004, ILRI hosted the first planning meeting in Addis Ababa that included stakeholders from Sudan, Ethiopia and Uganda. ILRI also received a small grant from the CPWF through IIRI to prepare a background paper outlining a conceptual framework for assessing livestock–water productivity. ILRI has made an important

contribution to the CPWF in bringing livestock–water issues to the fore and the CPWF has provided a broader water perspective into ILRI's livestock–environment systems research.

The sub-Saharan Africa (SSA) CP

ILRI played an important role in supporting FARA and the SROs in the development of the revised sub-Saharan Africa Challenge Programme proposal. This proposal was accepted by the Science Council in September 2005, and endorsed and funded by the CGIAR membership at AGM in Mexico. ILRI provides livestock expertise in support of all three sub-regional pilot learning teams and has participated in the workshops to plan and implement activities in these sites. ILRI is also a member of the consortium for the facilitation and mentoring group.

Centre financial health indicators

ILRI expects to grow moderately over the 2006–2008 period (see the table below). A decline in unrestricted revenue in 2006 is expected due to the end of the three-year Canada Fund for Africa contribution to the CGAIR. Revenue and expenditure are forecast to grow again in 2007 and 2008 as commitments to Africa from the 2005 G8 summit and pledges of increasing aid to Africa by most OECD countries are expected to lead to increased funding to the CGIAR centres. Some of this funding may be as core contributions from donors for the new CGIAR System Priorities to be approved later in 2005. Much of the restricted funding in 2005 and 2006 is supporting two large projects (IPMS and BecA). In the medium-term we expect to grow the portfolio broadly with a range of smaller and larger projects. In funding proposals, we will seek to increase the share of staff costs covered by projects. We are also seeking new ways of partnering and sharing staff to contain overall staffing costs.

Key Financial Indicators			
Year	ILRI Research Agenda	Liquidity	Adequacy of reserves
	\$ million	days	days
2004	31.71	207	209
2005	35.10	174	190
2006	34.15	165	201
2007	35.58		
2008	37.50		
CGIAR Recommended range		90–120	75–90

ILRI has accumulated a healthy level of reserves in recent years. These will be used to allow the institute to consolidate its strategic research in the field of vaccine development, as funding for East Coast fever research comes to an end and new diseases are tackled. Additional reserves will be allocated for matching funding of the BecA platform to enhance the capacity of the Nairobi campus to undertake cutting edge biosciences research as well as to fund staffing changes to better position the ILRI team to respond to the evolving livestock research agenda. We expect to stay within the World Bank recommended liquidity and adequacy of reserves ranges throughout this period.

Project (Theme) 1: Targeting Opportunities

Project Narrative

Project description

The Targeting Opportunities Project provides strategic guidance and direction to ILRI's programme planning and research, as well as influencing the livestock R&D agenda in developing countries. Research activities focus on assessing trends and opportunities in livestock systems to guide future research directions and evaluation of policy, technical and institutional interventions to ensure the effectiveness of ILRI and partner activities. Its approach to this is through three interlinked sub-themes:

- **Livestock systems evolution:** This research examines how and why livestock systems are changing over time in specific policy contexts in relation to spatial and non-spatial drivers of change. It focuses on emerging trends and drivers of livestock system changes, including changing demand consumption and trade patterns, land use change, water-livestock dynamics, and climate change. Research in this sub-theme involves the development of alternative future scenarios of livestock sector development and assessment of related consequences for the well being of poor people dependent on livestock systems and the environment.
- **Enhancing the role of livestock in poverty interventions:** Policy, institutional, and technical options are identified, evaluated, and discussed with a view to mainstream livestock issues in poverty reduction efforts at the project, program, and country level. The research builds on past efforts in global mapping of poverty and livestock systems and sub-national poverty mapping. Current research focuses on poverty dynamics and vulnerability as they pertain to livestock keepers in Africa, South Asia and Latin America and on the lessons learned from cross country case studies examining the role livestock play in poverty reduction. This work will continue in Africa and Asia but with greater emphasis on integrating quantitative, qualitative, and spatial analysis and policy dialogue. Increasing emphasis will also be given to identifying sustainable pro-poor options for livestock keepers through cross-thematic studies on Animal Genetic Resources (AnGR) and poverty as well as poverty-environment linkages.
- **Targeting livestock based interventions:** Decision support tools are being developed and applied at sub-national, national and regional level to identify and evaluate livestock based investment options, including delineation of spatial domains to target interventions. The core of this research is framed by geographic context at macro, meso, and micro levels, providing answers to questions such as in which systems should we work, what interventions and investment priorities can we identify for these systems, what are the impacts of alternative interventions on livelihoods and the environment? It integrates socio-economic, geographic, and bio-physical data and analysis to set priorities and guide current and future investment choices for their poverty impacts.

Rationale

The links between poverty and livestock are varied and context specific. Research managers, scientists and their partners therefore need to enhance their understanding of the role of livestock in emerging trends, alternative futures, and poverty processes in rapidly changing situations to formulate effective policies, priorities and strategies for using livestock as an instrument for reducing poverty whilst mitigating negative environmental impacts.

Project 1 provides an analytical basis for addressing present and future livestock development challenges, particularly as they relate to using livestock as an effective instrument for sustainably reducing poverty. Although the multiple roles of livestock in rural livelihoods and pathways out of poverty have long been recognised, the dynamic implications of these roles in reducing poverty have not been fully appreciated. This Project examines the broader roles livestock can play in building and sustaining economically viable livelihoods. Understanding trends and assessing alternative futures of livestock sector development provides

a basis for setting priorities and guiding current and future decision making, including building capacity to respond to these changing environments and managing transitions in dynamic systems. Work on understanding poverty process and livelihood strategies serves as a basis for improving the pro-poor focus of policy and project design as they relate to livestock. An important thrust is to identify and integrate livestock-issues into national development strategy processes that comprehensively address poverty such as Poverty Reduction Strategy Papers (PRSP). The development and application of decision-support tools provides analytical approaches that inform the choice, design, and implementation of targeted livestock-based technology, policy, and institutional interventions. The focus is on *ex-ante* analysis but builds on lessons learnt from *ex-post* analysis to inform future choices.

Specific objectives

- Analyze drivers of livestock systems evolution to formulate more effective technology, policy, and institutional interventions addressing present and future livestock development challenges, and improving the prospects for using livestock as an instrument for reducing poverty and sustainably managing the environment.
- Understand poverty processes and livelihood strategies of livestock keepers and poor people dependent on the livestock sector, with a view to identifying targeted options that promote livestock in the design and formulation of poverty reduction interventions and strategies
- Develop and apply decision-support tools to identify options and opportunities for livestock-based research and assess potential impacts and trade-offs of policy, technology, and institutional options on the livelihoods of smallholder livestock keepers, other poor people dependent on the livestock sector, and the environment.

The project will strengthen its core competence in policy research, particularly in the development and application of scientific tools and analytical approaches to make its outputs more policy relevant for poverty reduction efforts. It will enhance its involvement in current policy dialogue and forge broader alliances with key stakeholders in governments, non-governmental agencies, development agencies, and private sector to ensure that the information and knowledge generated from its analytical work feeds into action research, policy analysis, and advocacy that raise the profile of livestock issues in national and international development agenda, .

Links to CGIAR System Priorities (SP)

The outputs from Project 1 are linked to several CGIAR System Priorities. The outputs on trends and future scenarios of livestock systems development contributes to science and technology policies and institutions under SP5. The enhanced understanding of poverty processes and pathways into and out of poverty as they relate to livestock keepers contributes to the development of interventions concerned with rural poverty dynamics in SP5. The enhanced understanding of poverty and its application to identification and evaluation of livestock-based technology, policy, and institutional options is linked to income diversification and growth strategies under SP3. The outputs identifying pro-poor outcomes from utilisation of AnGR will contribute to sharpening the poverty focus of animal genetic conservation and utilisation under SP1.

Output implementation strategy

The strategy for implementing Project outputs emphasises three related strands. First, analysis to enhance understanding of dynamic livestock systems in specific policy environments; second, using this understanding to identify pro-poor options for livestock keepers and other poor people dependent on livestock systems; and third, drawing lessons to influence decision making on priorities, policies, and strategies for using livestock as an instrument for reducing poverty. Output 1 provides insights into how we can understand and characterise trends and future scenarios of livestock systems to help identify opportunities for poor people. The focus is therefore on responding to changing environments and managing transitions in different policy and institutional contexts. It develops conceptual and analytical framework of how livestock systems are evolving and uses tools such as Geographic Information Systems (GIS) and overlay of spatially referenced data and applies spatial models to enhance understanding of key drivers of

change at sub-national, national, regional and global levels. This information is used to define context and develop country typologies based on their underlying characteristics. Scenarios of alternative futures are developed using qualitative narratives and quantitative modelling work to identify interventions and development strategies that provide alternative pathways under different policy and institutional situations. These pathways are explored in country case studies to develop, test, and validate hypotheses, conceptual frameworks, and decision support tools to identify and assess the best mix of technical, policy, and institutional options for achieving poverty and environmental objectives in different situations. These case studies generate lessons that are widely disseminated to policy makers and other key decision makers, who can influence the livestock development agenda,

Output 2 focuses on generating empirical evidence to enhance understanding of poverty processes including poverty dynamics as it relates to livestock keepers. It develops and applies conceptual and analytical framework to understand the multiple role of livestock in livelihood strategies and pathways out of poverty and applies tools such as poverty maps to identify poor people, including poor livestock keepers and where they live. These tools help in the identification of case study sites and definition of household typologies. Case studies are carried out to test hypotheses on poverty determinants, pathways into and out of poverty and examine the role livestock can play in growth, diversification, and vulnerability strategies. Information from country case studies is synthesised to draw lessons on livestock-poverty links that can be applied in other country situations. The information and lessons from this output are used to inform and help sharpen the poverty focus in other ILRI Themes as well as feed into policy dialogue with national, regional and international partners. Delivery of outputs emphasises collaborative work with other ILRI Themes, national partners from client countries such as National Bureaus of Statistics; Planning Ministries, and Departments of Livestock, other development partners including international organisations such as World Resources Institute (WRI), FAO and World Bank

Output 3 focuses on the development and application of tools and analytical approaches for identifying, targeting, and assessing livestock based interventions to enhance their impact on poverty reduction whilst mitigating negative environmental impacts. This output provides insights into questions such as where should we work, on what interventions, and how do we scale up promising interventions to maximise their poverty impacts. It uses GIS tools and databases to identify and characterise development domains, defined as geographic areas exhibiting similar underlying conditions or resource endowments. Development domains provide an analytical approach to assess development constraints and opportunities, investment and livelihood options, potential for technology adoption, and extrapolation of research results to other sites with similar characteristics. Development domains also provide a basis for identification of hotspots and pilot sites that represent specific policy contexts for more detailed analyses. Case studies are carried out in context specific situations to develop and test analytical tools and decision support systems that help screen policy and technical options, assess impacts, and facilitate discussions between different stakeholder groups. Outputs focus on opportunities and livelihoods enterprises in specific development domains. Intervention options are tested using field data in other ILRI Themes as well as with development partners in the NARS and NGO community. Output 3 also focus on assessment of socio-economic and environmental impacts and trade-offs involving economic, environment, equity and social objectives. Such assessments provide an analytical basis for identifying technical, policy and institutional options that are used to inform choices, policy and project design, and sequencing of livestock based interventions. Together with key stakeholders and development partners, outputs focus on what works and what does not work as the basis for identifying promising options that can be scaled up in development interventions to maximise poverty impacts

Strategy for output–outcome logic

The strategy from output to outcome focuses on the clients and stakeholders the Project is aiming to influence and the mechanism that are used to influence their agenda. Project outputs are therefore targeted at other ILRI themes, researchers in national, regional and international research organisations, policy

advisers, policy makers, development agencies, and donors. An important thrust is engagement in early dialogue with key stakeholders to help guide research outputs towards generating policy relevant information in a timely manner. In delivering output 1, key stakeholders at the national level are involved in problem diagnosis and development of baseline and alternative future scenarios for livestock sector development. Continuous dialogue with key regional and international partners such as sub-regional organisations and multi-lateral development organisations such as FAO, World Bank, OIE, and IFAD increases the likelihood that the objectives of the analyses are consistent with regional and global priorities. Early dialogue helps to ensure that research efforts are aligned with national, regional, and international development strategy process, providing buy in and inputs from key stakeholders who need the results to influence investment priorities and resource allocation decisions. At the institute level, the analysis and information is shared with other ILRI Themes and used in cross-thematic interactions and planning processes.

Output 2 aims to target policy makers, development agencies and researchers to influence policy and project design as well as to share methods, data, and information with researchers to strengthen national policy research capacity in poverty analysis in relation to livestock issues. At the national level the focus is to identify and work with key livestock decision makers at high levels in the government structure. Focused analytical work that will be carried out to provide policy inputs that can be used to design pro-poor livestock initiatives, increase advocacy, and inform resource allocation decisions. A major thrust of this effort is to support national policy analysts through technical assistance and training to develop expertise in the application of poverty tools and techniques that focus on livestock-poverty issues. By engaging with a broad range of stakeholders we will facilitate dialogue between livestock decision makers and other decision makers in Ministries of Planning, Finance, and National Bureaus of Statistics to help raise the profile of livestock in national poverty strategies. Lessons from cross-country syntheses will be disseminated to key stakeholders through a wide range of publication products, workshops, seminars, conferences targeting major development partners such as FAO, World Bank, African Livestock (Alive) Platform, IFAD and African Union.

Targeted livestock based interventions and synthesis of cross-country case study experiences will be used to provide documented examples of how decision support tools can be used to identify pro-poor livestock interventions. Promising options will be tested out in pilot interventions through direct engagement with NARS, NGOs, and other development partners. National analysts will be trained in the application of decision-support tools to strengthen their capacity to identify and evaluate pro-poor livestock interventions. Information and lessons learned will be shared with national researchers to help facilitate scaling up of promising interventions.

External conditions

The context in which the Project needs to provide policy relevant analysis and foresight is changing rapidly. The international development agenda already has the Inter-Academy report on science and technology, the UN Millennium Project Report, the International Assessment on Agricultural Science and Technology for Development, G8, UN MDG summit, and WTO trade talks. Progress in meeting MDG goals in Eastern, South Eastern and Southern Asia and the bleak prospects of reaching these goals in much of sub-Saharan Africa are posing additional opportunities and challenges for using livestock as an instrument for reducing poverty. Additional challenges arise from climate change and emerging livestock diseases such as BSE and avian flu. Thus, the livestock development agenda is changing rapidly in very dynamic contexts. Although there is a general recognition that *ex-ante* analyses and foresight is important, it is becoming increasingly difficult to anticipate change and contribute effectively with policy relevant research in an uncertain and unpredictable environment.

Project 1 is forging new partnerships to deal with these complex policy processes and emerging developments in order to align its agenda with broader discussion on poverty and sustainable development.

Given our staffing and resource situation, we will engage actively with other institutions such as the World Bank and United Nations agencies that are providing leadership on conceptual and analytical issues as well as advocacy relating to poverty and MDGs. Within these broad coalitions, we will focus our efforts on the livestock sector, particularly on the development and application of tools and analytical approaches that can be used to understand, identify and evaluate technical, policy, and institutional options, and draw lessons that can be applied elsewhere. The sector specific information as well as tools and analytical approaches that have wider applicability in other sectors will provide important policy inputs into an international agenda that is concerned with reducing hunger and poverty in the developing world.

Collaborators

Other CG centres

ICRAF, CIMMYT, IWMI, IFPRI, CIAT, IITA, ICRISAT

SWPS/ERPs, CPs

Systemwide Livestock Initiative
Sub-Saharan Africa Challenge Program

NARS (including NGOs and Private Sector)

Ministry of Agriculture, **Bolivia**; National Agricultural Research Institute, **Gambia**; Savanna Agricultural Research Institute – SARI, University of Ghana, **Ghana**; Poverty Analysis unit, Government of Andhra Pradesh, BAIF – Bharatiya Agro Industries Foundation, **India**; Ministries of Planning and National Development, Ministry of Agriculture and Livestock, Central Bureau Statistics, Ministry of Environment, University of Nairobi, Kenya Agricultural Research Institute – KARI, Tegemeo Institute, Department of Remote Sensing and Surveys – DRSRS, ALRMP-Arid Lands Program/Office of the President, **Kenya**; Institute d'Economie Rurale du Mali, **Mali**; Ministries of Planning and Agriculture, Poverty Analysis – Peru, CARE **Peru**; Institute Senegalaise de Recherche Agricoles, **Senegal**; Ministry of Livestock, University of Dar es Salaam, National Bureau of Statistics, **Tanzania**; Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Finance, Planning and Economic Development, Ministry of Environment, Uganda Bureau Statistics, Makerere University, Metrological Department—Government of Uganda, Coordinating office for Control of Trypanosomiasis in Uganda, **Uganda**;

ARIs

Universite Catholique de Louvain – UCL, **Belgium**; Universite de Bordeaux, **France**; University of Edinburgh, Sterling Thorne Associates, University of Reading, University of East Anglia, Overseas Development Institute, **United Kingdom**; World Resources Institute, International Consortium for Agricultural Systems Applications (ICASA), University of Florida, Michigan State University, Cornell University, University of Hawaii, University of Georgia, Duke University, **USA**;

Regional organisations

AU, FARA, ASARECA, CORAF, SADC, FEWSNET, ACTS, COMESA, ECOWAS, CONDESAN,

International organisations

FAO, World Bank, OIE, UNEP, IFAD, UNDP.

Project 1: Targeting Research and Development Opportunities

	Outputs	Intended User	Outcome	Impact
(ILRI Project 1) Output 1	Understanding of trends and alternative futures of livestock sector development used to set priorities and influence resource allocation decisions that enhance the prospects for using livestock as an instrument for poverty reduction (5years)	ILRI, CGIAR and NARS researchers; policy advisers; development agencies	Increased priority of livestock issues in agendas and investment decision of donors and development agencies	Information and knowledge generated used to set the livestock development agenda and increase investment in livestock R&D in Sub-Saharan Africa, South Asia, and South East Asia
Output targets 2006	Hypotheses tested about the importance of factor opportunity cost (land and labour) and market access as the key drivers behind the intensification of crop-ruminant systems in Asia, Latin America, and Sub-Saharan Africa;	CGIAR Systemwide Livestock Program; NARS researchers; policy analysts; policy advisers; development agencies	Enhanced understanding of the main drivers of intensification in crop-ruminant systems used to identify and formulate targeted interventions	Improved crop-livestock based options used in the development and formulation of research, policy, and management interventions in Columbia, India, Kenya, Niger, Nigeria, and Sri Lanka
	Scenarios of alternative development paths of crop livestock systems to 2020 in Kenya developed and lessons drawn for setting priorities and guiding investment choices in developing countries	CGIAR and NARS researchers; policy advisers; development agencies (IFAD, World Bank)	Policy makers and researchers have better understanding on options for interventions in crop-livestock systems in Kenya	More effective policy and technical interventions used to inform policy directions and foster debate on policy reform in crop livestock systems in developing countries
	Hypotheses on the role of livestock in improving land use decisions tested in Kenya, Uganda, and Tanzania and lessons drawn for developing countries	CGIAR and NARS researchers; Policy advisers, development agencies (UNEP-GEF; World Bank; FAO)	Enhanced understanding of livestock-land use issues used to identify synergistic crop-livestock interventions for sustainable land management	Improved livestock management practices used to inform and support decision making on livestock-land use issues in east Africa and lessons drawn for developing countries
	Scenarios and maps of climate change and vulnerability in livestock systems developed for identifying hotspots and new research areas on climate change and development in Sub-Saharan Africa	CGIAR and researchers; development agencies (UNEP, DFID)	Livestock issues better integrated into a broader research agenda on climate change and development	Enhanced understanding of climate change and vulnerability in livestock systems used to develop effective adaptation strategies in developing countries.
Output targets 2007	Scenarios of alternative futures of livestock sector development to 2030 in developing countries developed and documented for setting future livestock priorities and formulating strategies	ILRI, CGIAR and NARS researchers, development agencies (FAO, World Bank)	Livestock issues have a high profile in the agenda and investment decisions of donors and development agencies	Improved understanding of future scenarios used to set priorities and formulate more effective strategies that improve the prospects for using livestock as an instrument for reducing poverty in the developing world
	Enhanced understanding of drivers of land use change, land degradation, and biodiversity at landscape level used to identify improved livestock based land	CGIAR and NARS researchers; Policy advisers, development agencies	Researchers and policy makers have changed perspectives of livestock-land use issues	Synergistic livestock and crop management practices and technology options used in the design of sustainable land management

	Outputs	Intended User	Outcome	Impact
	use options in crop–livestock systems in Kenya, Uganda, and Tanzania and lessons drawn for developing countries	(UNEP-GEF; World Bank; FAO)		interventions in Kenya, Uganda, and Tanzania and lessons learnt for improvement and scaling up in developing countries
Output targets 2008	Climate change – land use interactions and its implications for vulnerability and poverty analyzed and documented in East Africa	CGIAR researchers; policy advisers, development agencies (UNEP, DFID)	Increased stock of knowledge on climate change and land use to inform research and policy decisions	Enhanced understanding of climate land use interactions and its implications used to inform adaptation strategies to climate change in East Africa
(ILRI Project 1) Output 2	Methods and tools for enhancing the role of livestock in poverty reduction efforts developed, tested, and used in the design of policy, project and strategy formulation (5 years)	ILRI, Development Agencies (FAO, World Bank, IFAD)	Livestock options used to inform the design and formulation of pro-poor policy, project, programme interventions and strategy	Livestock issues more effectively integrated in pro-poor policy and project design and strategy formulation
Output targets 2006	Lessons on the role of livestock in pathways out of poverty identified and documented, for identification of effective poverty reduction strategies in developing countries	CGIAR and NARS researchers; Policy Advisers and development agencies (country governments; World Bank; FAO, IFAD)	Improved understanding of livestock-policy issues used to develop new research approaches and identify pro-poor policy options at national, regional and international levels	Livestock-poverty analyses used to sharpen the poverty focus of ILRI Themes; and used to mainstream livestock issues in poverty reduction strategies in Kenya, Uganda, India, and Peru and lessons learnt scaled out in developing countries
	Databases on poverty, poverty maps, and analyses of poverty–environment links developed and shared with researchers in East Africa and lessons drawn for enhanced research targeting in developing countries	CGIAR and NARS researchers; policy advisers, Bureaus of Statistics; development agencies (FAO, World Bank, DFID).	Researchers in NARS increase their capacity, including new issues and approaches in livestock-poverty analysis	Improved data, information, and methods used for research targeting in developing countries
	A framework to reduce vulnerability and manage risks through use of livestock developed and tested with partners in developing countries	ILRI, Development agencies (World Bank)	Enhanced understanding of the role livestock in reducing vulnerability used to identify risk management options and strategies	Livestock based risk management and strategies for reducing vulnerability used to design effective social protection programs in developing countries
Output target 2007	Policy options identified from determinants of poverty and poverty–livestock–environment links used to identify opportunities for increased income and employment in East Africa	CGIAR and NARS researchers; policy advisers; Bureaus of Statistics; development agencies (FAO, World Bank, DFID).	Enhanced understanding of livestock issues used to inform poverty interventions and strategies in Kenya, Uganda, and other	Results of the determinants of poverty and the role of livestock in sustainable livelihood strategies used to inform policy, project design and strategy formulation in developing countries

	Outputs	Intended User	Outcome	Impact
	and lessons drawn for developing countries		developing countries	
	Maps showing the spatial relationships between poverty and ecosystems services in crop–livestock systems in Kenya developed and used for identifying income generation opportunities and lessons drawn for developing countries	CGIAR and NARS researchers; Government policy advisers; National Environmental Management Authority	NARS, policy makers, and development agencies have improved tools to better understand poverty–environment links	Information generated from mapping of poverty and environmental services used to stimulate debate on poverty–environment issues and mainstream environment issues in poverty reduction strategies in developing countries
	Tools to accurately forecast the needs of populations vulnerable to drought identified and used for targeting interventions in agro-pastoral areas in East Africa and recommendations for improvement and scaling up identified.	Development agencies (World Bank)	Risk management tools used to target risk management options and strategies in livestock systems in developing countries	Livestock based risk management and strategies for reducing vulnerability used to design effective social protection programs in developing countries
Output target 2008	Maps integrating farming systems characteristics, poverty, and genomes of livestock species used to inform conservation and utilisation projects in Guinea, Gambia, Mali and Senegal	ILRI Biotechnology Theme; Development agencies (GEF, AfDB; FAO)	Researchers and development agencies understand the links between animal genetic resources and poverty in different policy contexts	Enhanced understanding of animal genetic resources–poverty links used to inform pro-poor interventions in AfDB and GEF animal genetic resource conservation and utilisation projects in West Africa and methods scaled up in developing countries
(ILRI Project 1) Output 3	Analytical framework and tools for identifying, and assessing impacts of livestock based interventions developed and used for targeting investment choices and maximising poverty reduction outcomes (5 years)	ILRI, CGIAR and NARS researchers; development agencies	Enhanced utilisation of analytical approaches and tools improved the effectiveness of resource allocation and investment decisions by research institutions and development agencies	Improved targeting of interventions and enhanced understanding of impacts used to set priorities and guide investment choices
Output targets 2006	A framework to assess <i>ex-ante</i> the impact of feed resources in smallholder mixed farming systems developed and tested with collaborating CG centres and their research partners in developing countries	CGIAR and NARS researchers; development agencies (FAO)	Understanding of impacts and trade-offs in feed resources research enhances resource allocation decisions in crop improvement research	Enhanced understanding of synergies and trade-offs in feed resources used to set priorities for feed resources research at least 2 CG centres in developing countries
	Pro poor options for crop livestock systems identified and documented for learning lessons and scaling up promising innovations in livestock systems in	CGIAR and NARS researchers, SRO networks (ASARECA, CORAF); development agencies	Stock of knowledge on crop–livestock options for reducing poverty enhanced	Improved options for interventions in crop–livestock system used in the design of project interventions by at least 2 development agencies.

	Outputs	Intended User	Outcome	Impact
	developing countries	(FAO, World Bank, IFAD)		
	Maps depicting spatial distribution of poverty-livestock-land degradation in sub-Saharan Africa developed and used for identifying hotspots and set research priorities	CGIAR and NARS researchers, development agencies (FAO; UNEP, UNDP)	NARS, policy makers, and development agencies have improved tools to better understand poverty-environment links	Maps and information generated used for more effective targeting of options for improving land use in at least one country each in East, West and Southern Africa
	Policy and technology options for enhanced livelihoods in dairy sub-sector in India and small stock sub sector in Uganda identified and documented and lessons drawn for identifying effective poverty reduction strategies in developing countries	ILRI, policy analysts; policy advisers, development agencies (FAO, IFAD)	Policy analysts have increased capacity to apply PRIMAS EXTRAPOLATE to support decision making in the livestock sub sector	Pro-poor livestock options used for more effective design of livestock policies and projects in developing countries
	Context specific investment priorities and entry points identified and used for guiding investment choices in the sub-Saharan Africa Challenge Programs	CGIAR and NARS researchers; SRO Networks (ASARECA, CORAF, SADC), FARA	Decision makers in the Sub-Saharan Africa Challenge Programme have information and knowledge to make strategic investment decisions.	Priority investment options and strategic entry points used to target pro-poor investments and agricultural growth in Sub-Saharan Africa
Output targets 2007	Pro-poor options for trypanosomiasis control identified and documented for targeting interventions in Uganda and recommendations provided for scaling up in Sub-Saharan Africa	Policy analysts, policy advisers, development partners (IFAD, AfDB, PAATEC, PAAT)	Policy analysts and GIS technicians have enhanced capacity in the use of PRIMAS EXTRAPOLATE	Policy options used to inform investment choices and strategies for trypanosomiasis control in Sub-Saharan Africa
	Improved approaches for monitoring and evaluating the socio-economic and environmental impacts from tsetse and trypanosomiasis interventions identified and used for setting priorities and guiding investment decisions in PATTEC study countries in Sub-Saharan Africa.	CGIAR and NARS researchers; veterinary departments; policy analysts, project implementation partners in study countries; development partners (AfDB, UNDP, GEF)	Researchers and policy analysts are exposed to a range of approaches for assessing socio-economic and environmental impacts from tsetse and trypanosomiasis interventions	Enhanced capacity to assess socio-economic and environmental impacts used to design, monitor, and evaluate tsetse and trypanosomiasis control options in PATTEC study countries
Output target 2008	Priority animal health constraints to poverty alleviation in sub-Saharan Africa identified and documented and lessons learnt for guiding research into high poverty impact areas in developing countries.	CGIAR and NARS researchers; development agencies (DFID, FAO)	Researchers in NARS and international organisations have better information to target animal health issues as they relate to poor people	Enhanced understand of priority livestock diseases of poor people used to set priorities and increase research resources for animal health research in developing countries

Project (Theme) 2: Enabling Innovation

Project Narrative

Project description

This project is based on the growing realisation that traditional research and technology-led development approaches have not had the expected social and economic impacts, and may no longer be appropriate in a world of rapidly changing technological perspectives and development contexts. Such analysis not only suggests that research is just one input to a dynamic system of knowledge production and use, but also has significance for the type of institutional and organisational capabilities that need to be in place to effectively support such systems. In seeking to respond to these issues, the project takes a fresh look at the question of how livestock research and development leads to poverty reduction. It does this through the identification and synthesis of lessons from on-going and new projects about the type of institutional settings and partner groupings necessary to drive pro-poor livestock innovation. It uses the contemporary concept of the innovation systems framework. This framework, while recognising that the scientific and technical knowledge bases in ILRI's project 3, 4 and 5 are fundamental within effective livestock innovation systems, reveals that the capacity to innovate is determined by the way different research and development actors link and interact. Furthermore, that a large element of this capacity relates to the nature of institutional settings (rules, norms, standards and routines) and how this influences knowledge sharing and learning within both research and development communities. A key capability of an effective innovation system is its ability to evolve and adapt in concert with changing circumstances. These circumstances maybe the opportunities presented by new livestock technologies; changing development imperatives and agendas of stakeholders; the challenges of evolving pest and disease problems; or competitive pressures particularly in international commodity markets. This project thus seeks to gain a clear understanding of the mechanisms that make research more effective and efficient, knowledge more contagious, processes more inclusive and outcomes more in favour of livestock-dependent poor people.

Rationale

In many developing countries the rate of social, technological, institutional and environmental change is accelerating with major impacts on the poor and their development prospects. Besides the opportunities that arise from the associated demands for livestock products in such dynamic livestock systems, poor people are also facing threats from the resulting transformation of the livestock sector. Unfortunately, neither traditional knowledge nor traditional research systems have kept pace with these needs and changes. Although systematic approaches for generating and disseminating livestock technologies from research through extension have worked well for certain clients and in certain settings, this linear paradigm has failed to respond effectively to the complex, diverse and dynamic needs of livestock-dependent poor people.

The Project thus bases itself on three fundamental premises: i) that demand growth in the livestock sector offers a unique opportunity for the rural poor to escape poverty, ii) that to be relevant and responsive to these needs, livestock research and research organisation need to become less isolated, more interconnected and embedded within the innovation systems of livestock-dependent poor people, and iii) that learning-orientated monitoring and evaluation of research impacts on poor rural communities will identify more effective ways of employing livestock research for development, thus enabling significant value addition to broad development coalitions. If poverty reduction potential of dynamic livestock markets is to be exploited, livestock producers in the poorest countries need to constantly innovate to compete, cope and prosper. Response capacity needs to be enhanced in ways that both allow producers to innovate and at the same time safe guards the livelihoods of poor people linked with the sector. This is not simply a question of ensuring that production and processing technology is made available through adequate livestock

research, extension and other support services. Response capacity includes the social and institutional arrangements to mobilise different sorts of knowledge in ways that create novelty on a continuous basis, thus ensuring that livestock science and technology are used more effectively for development.

Specific objectives

The specific objectives of project 2 are:

- to understand the innovation system approach in different institutional and policy contexts that improve livestock knowledge production and use processes;
- to elucidate the generic principles, using a learning-by-doing approach, that enhance livestock-related innovation and innovation capacity in ways that promote equitable wealth creation and sustainable development, and;
- to identify and experiment with new patterns of livestock R&D partnership, within the evolving roles of public, private and civil society sectors, to enhance the use of different types of pro-poor livestock knowledge.

These objectives will aid ILRI and its partners to ensure that livestock research can be more responsive and adaptive to new options and insights.

The activities under this project should be seen as a natural progression, building on and strengthening past approaches through the application and scientific underpinning of learning and action research, science and policy studies, management science and institutional economics to systems analysis. This project is also not about ILRI trying to occupy institutional space beyond its mandate and comparative advantage, but rather about the types of organisational mechanisms and institutional arrangements that strengthen the capacity of other actors in the development process to use livestock science, technology and other types of livestock information for equitable wealth creation and sustainable development.

Links to CGIAR systems research priorities

The Enabling Innovation project falls under priority area 5, *Improving policies and facilitating institutional innovation and capacity to support sustainable reduction of poverty and hunger*, but has cross-cutting linkages to all other priority areas as it deals with questions related to how to enhance the impact of knowledge interventions, including those associated with scientific research, on poor farming communities in the developing world. Specifically, livestock knowledge generation, acquisition and use, and the policies and institutions that control such processes links to systems priorities 5b *Science and technology policies and institutions* and 5c, *Enhancing innovations and governance in institutions for effective market chains and agricultural systems that benefit the poor*. The promotion of livestock related innovation and pro-poor innovation capacity is clearly related to system priorities 5a, *Global change, world food situation and the role of agricultural research and development in achieving the MDGs* and 5c. Lastly, research in project 2 on the evolution of institutional and organisational arrangements to empower research and development partnerships is most clearly related to system priorities 5a and 5c.

Output implementation strategy

Since this type of work and capacity remains largely a new departure for ILRI, the project has also been focusing attention on the building of capacity within the organisation through the links with the CGIAR ILAC and PR&GA initiatives and the organisation of a number of training courses on the application of the innovation systems approach to livestock research. Similarly, project 2 is complementing its own capacity through the initiation of a joint programme with IFPRI/ISNAR and the establishment of an Innovation Systems Research Hub in Addis Ababa, Ethiopia and Hyderabad, India with the UNU-INTECH to address critical research issues related to the strengthening of the

capacity of agricultural innovation systems in sub-Saharan Africa and South Asia, in the context of poverty reduction, globalisation and rapid structural changes in the livestock sector.

Output 1: This output area focuses on analysis of livestock innovation systems which address the needs of the poor in developing countries in Africa and Asia. The objective is to understand livestock innovation processes including the institutional and policy contexts that shape these processes. This would lead to an increased understanding of the knowledge bases and institutional contexts involved with new livestock-related (bio)technology and how changing social and economic environments affect the way in which such knowledge is applied for development. At the same time it will develop and implement a series of workshops and mentoring activities to introduce innovation systems approaches and their applications to ILRI and its partners with a view to internalising these new perspectives in the organisations involved. A common understanding is essential if ILRI and partners are to design projects from a broader perspective and to interact with a wide range of actors to experiment with new mechanisms and processes. Development of learning based monitoring and evaluation tools that can be used to develop process lessons and to characterise innovation capacity will also contribute to activities in output areas 2 and 3.

Output 2: Although the innovation systems approach has been applied extensively in industry and more recently in agriculture, there has been less attention paid to its application in the livestock sector. Staff in this output area will take a 'learning-by-doing' case study approach to experimenting with ways to build innovation capacity in a variety of contexts. The first step will be to build a conceptual framework which will be used across case studies. This framework will facilitate analysis and enable establishment of generic principles for enhancing livestock related innovation and innovation capacity with potential to promote equitable wealth creation and sustainable development. In 2006 case studies addressing feeding strategies will be initiated and in 2007-8 strategies and mechanisms to institutionalise these principles at National level will be developed and tested. At the same time activities experimenting with innovative research and development approaches that lead to policy change in the dairy sector will continue, in close collaboration with Project 3 staff and partners. These activities will build on a retrospective analysis of earlier activities by ILRI and its partners as well as other partner groupings to identify principles and processes.

Output 3: This output area is focused on the linkages and interactivity that are at the heart of innovation processes. A set of guidelines will be developed based on a series of studies including a) analysis of existing partnerships with ILRI and other organisations, including an evaluation of views of ILRI as a partner, using formal questionnaires combined with workshop activities and b) a set of case studies to evaluate partnerships and processes leading to pro-poor policy change, which will also contribute to output area 2. These partnership guidelines will lead to learning-by-doing case studies exploring innovative partnerships and funding mechanisms with development organisations and the role of the research partner in supporting development activities. Case studies will also evaluate the evolving roles and responsibilities of public, private and civil society sectors in the delivery of livestock services including extension in Africa and S Asia. The staff working in output area 3 include the team managing the ASARECA A-AARNET (Animal Agriculture Research Network) providing a laboratory for learning lessons about factors leading to successful partnerships. A review of the partnerships in AARNET in E Africa will complement a review of networks in SE Asia. The review in SE Asia will lead to an activity experimenting with novel learning networks involving consortia of researchers and development actors from the public and private sector. Funding is also being sought for a study to analyse attitudes and behaviours of innovation system actors that contribute to an enabling environment for effective farmer focused, pro-poor research and development.

Output–outcome–impact logic

Output 1: Increased understanding of how and with whom best to implement pro-poor livestock-related research including policy research could significantly enhance the use of the outputs generated through such research by decision-makers. Increased capacity within organisations, projects and communities to use M&E to enhance learning and livestock knowledge sharing would promote insights on how best to deploy available resources in livestock R&D. Such sharing of successes and failures in livestock innovation systems research and development would increase the awareness among the research, including other ILRI projects, development and donor communities of the guiding principles for doing ‘business unusual’ that could enhance the contribution of livestock R&D projects to poverty reduction. This in turn would provide increased understanding of the nature of livestock related innovation capacity, the policy and institutional developments required to build such capacity and the pathways and linkages that facilitate stakeholders’ access to knowledge and enhance its impact on the poor.

Output 2: Understanding livestock innovation systems is a first step towards a new paradigm in the design of livestock R&D. Activities in output area 2 will lead to sets of guiding principles allowing researchers to develop new ways of interacting with a broader range of actors and to work with partners to institutionalise these approaches. Mainstreaming of these approaches will lead to changes in behaviour of R&D partners that result in improved social and economic impact, since new ways of working are key to using livestock science, technology and other types of knowledge more effectively for development. The use of qualitative and quantitative indicators to evaluate innovation in livestock R&D on its poverty reduction potential will result in the more efficient allocation of available resources and contribute to the pathways, linkages and processes that enhance innovation capacity within livestock R&D organisations. Livestock R&D services that are flexible, relevant and responsive to the needs of poor people in dynamic agricultural systems are more likely to contribute to a wider capability to innovate, and will offer new options and insights to broad development coalitions to using livestock science and technology for pro-poor outcomes.

Output 3: An improved understanding of the types of services and partners groupings that enhance the capacity of livestock-dependent poor people to respond to changing circumstances would stimulate the continued experimentation by diverse livestock R&D actors to deliver an evolving range of services to livestock-dependent poor people. The broad dissemination of such lessons would contribute to the awareness among the research, development and donor communities about the types of institutional settings and partner groupings that drive pro-poor innovation. Lasting relationships between diverse groups of livestock R&D actors would facilitate the demand for, and supply of new knowledge and technology. Insights into the nature of livestock-related innovation capacity and the policy and institutional developments required to build this capacity will be gained through, for example: the evaluation of farmer field school activities and their specific role in the application of new knowledge and practices and; the mainstreaming of lessons learned from public/private sector-community partnerships for the delivery of livestock services. Such insights create an institutional environment that is conducive to the flow of knowledge, learning, collaboration, experimentation and implementation of innovations.

External conditions

In many developing countries the rate of social, technological, institutional and environmental change is accelerating with major impacts on the poor and their development prospects. Besides the

opportunities that arise from the associated demands for livestock products, poor people are also facing threats from the resulting transformation of the livestock sector. To respond effectively to these changing circumstances local communities need to innovate at historically unprecedented rates. Unfortunately, traditional knowledge systems have not kept pace with these rapid changes, and although systematic approaches for generating and disseminating technologies from research through extension have worked well for certain clients and in certain settings, this linear paradigm has failed to respond effectively to the complex, diverse and dynamic needs of livestock-dependent poor people. Many donors now feel that although much CGIAR activities generate good scientific knowledge, the conversion of this knowledge into poverty reduction is weak. In addition, donors do no longer accept the traditional excuse that technology transfer is the responsibility of other organisations outside the CGIAR system. These criticisms have been accompanied by a concomitant reduction in core contribution, forcing scientist to seek ever more 'restricted' funding sources with resultant pressure on management to handle an increasingly complex set of scenarios. The *Innovation Systems* concept has been suggested as one approach to consider in this context.

Major collaborators

CGIAR Centres

IFPRI; IRRI; CIAT; CIP; ICRAF; ICRISAT.

SWPs

PRGA; Urban Harvest; SLP.

ERPs

AHI; CONDESAN.

CPs

Sub-Saharan Africa.

NARS/CSOs

Aga Khan Foundation, **Afghanistan**; Belgian Survival Fund, Veterinaires sans Frontieres, **Belgium**; Direction Provinciale des Ressources Animales, INPHB, Programme National de la Gestión de la Terroir, Service de Lutte contre la Trypanosomiase Animale et les Vecteurs, **Burkina Faso**; Houphouet Boigny, Institut National Polytechnique, Service de Lutte contre la Trypanosomiase Animale et les Vecteurs, **Cote d'Ivoire**; Scanagri, **Denmark**; Agri-Systems, EARO, PROFIEET, MoARD, **Ethiopia**; Freie Universitat Berlin, University of Hannover, **Germany**; Institut de Recherche Agronomique, **Guinea**; Department of Veterinary Services, KARI, MoA, COOPI, Hygro-Tech, **Kenya**; Centre Regional de la Recherche Agricole Sikasso, Institut d'Economie Rurale, Laboratoire Central Veterinaire, Unite Centrale de lutte Contre les Mouches tse-tse et les Trypanosomoses Animales, **Mali**; Wageningen University, PROLINNOVA, **the Netherlands**; CRISP, BAIF, ANTHRA, **India**; Ahmadu Bello University, Department of Livestock and Pest Control Services, Federal Ministry of Agriculture and Rural Development, Metti Allah, NVRI, PACE, University of Ibadan, University of Maiduguri, University of Nigeria, Vom Plateau State Associations, National Livestock Projects Division, Smallholder Livestock, University of Agriculture, Veterinary Services Department, **Nigeria**; CBRM, **Pakistan**; ASB, Bureau of Agricultural Research, **The Philippines**; ITTBDCP, Ministry of Water and Livestock Development, Sokoine University of Agriculture, Veterinary Investigation Centre, **Tanzania**; LIRI, Makerere University, Ministry of Agriculture, Animal Industry and Fisheries, **Uganda**; University College London, University of Warwick, Wrenmedia, **United Kingdom**; Land O'Lakes, **United States of America**.

ARIs

CIRDES, **Burkina Faso**; CAAS, SASA, **China**; ICIPE, **Kenya**; PCARRD, **Philippines**; NRI, ODI, **United Kingdom**.

International organisations

DANIDA, **Denmark**; BMZ, **Germany**; FAO, IFAD, **Italy**; UNU-INTECH, **the Netherlands**; AsDB, **Philippines**; DFID, **United Kingdom**, World Bank, Rockefeller Foundation, USAID, CARE, **United States of America**,

Regional and ecoregional partners:

AU, **Ethiopia**; ITC, **the Gambia**; FARA, **Ghana**; A-AARNET, AU/IBAR, ACTS, **Kenya**; CORAF, **Senegal**; ASARECA, ECAPAPA, FITCA, **Uganda**.

Project 2: Enabling Innovation

	Outputs	Intended users	Outcome	Impact
<i>(ILRI project 2) Output 1</i>	Concepts and principles of livestock systems capacity to deliver pro-poor innovation under different policy and institutional contexts developed (5 – 7 years)	NARS, ARI and CG livestock researchers	Greater capacity to adapt innovations systems approaches to the design and implementation of livestock research	Enhanced contribution of livestock research and development projects to poverty reduction
Output targets 2006	A conceptual framework for applying the innovation systems approach to priority livestock research and development problems.	NARS, ARI and CG livestock researchers; Livestock Development Specialists	More relevant design of livestock research projects by researchers; better use of livestock knowledge in livestock development programs	Enhanced contribution of livestock research and development projects to poverty reduction
Output targets 2007	System, tools and methods for learning-based monitoring and evaluation for pro-poor livestock research and development interventions developed	NARS, ARI, CG researchers, livestock development and investor communities	Increased capacity within organisations, projects and communities to use M&E to enhance learning and livestock knowledge sharing	Faster and better learning for pro-poor livestock development
Output targets 2008	A synthesis of innovation systems principles from studies of livestock innovation made available	NARS, ARI and CG livestock researchers; Livestock Development Specialists	More relevant design of livestock research projects by researchers; better use of livestock knowledge in livestock development programs	Enhanced contribution of livestock research and development projects to poverty reduction
	Guidelines and practices for the conduct of experiments within livestock innovation systems developed and tested	NARS, ARI, CG livestock researchers; Livestock development specialists	Better design and conduct of livestock research projects by researchers with outputs that are more relevant and better used in livestock development programs	Enhanced contribution of livestock research and development projects to poverty reduction
	A synthesis of innovation systems principles that enhance the ways in which knowledge from livestock-related (bio-)technology research is generated and applied in different social, economic and regulatory contexts	NARS, ARI, CG researchers, SROs, ROs, private sector, development and donor community	Application of principles and approaches to better plan, implement and deliver livestock (bio) technology research	More rational and effective application of biotechnology research for livestock development

	Outputs	Intended users	Outcome	Impact
<i>(ILRI project 2) Output 2</i>	Concepts and principles of innovation systems approaches evaluated in priority livestock research and development contexts (5-7 years)	NARS, ARI and CG livestock researchers; Livestock Development Specialists	More relevant design of livestock research projects by researchers; better use of livestock knowledge in livestock development programs	Enhanced contribution of livestock research and development projects to poverty reduction
Output targets 2006	A critical mass of ILRI researchers and partners have obtained confidence and competence in putting innovation systems approaches into practice	NARS, ARI, CG livestock researchers	Researchers have increased capacity to design and operationalise innovation systems approaches that includes critical actors, linkages and issues	Increased relevance of research to livestock research and development efforts
	Action research case studies using an innovation systems approach applied to feeding strategies implemented	NARS, ARI, CG researchers, private sector, development and donor community (India, Nigeria, Vietnam, Syria and Ethiopia)	Better design and implementation of feeding strategy research; Better use of livestock knowledge in feeding development activities.	Research based evidence informs policy makers
	Recommendations on approaches that support the development of pro-poor dairy development policies and regulations developed	Livestock researchers; livestock development specialists and policy makers	Livestock development personnel and policy makers develop dairy policies and regulations that are pro-poor	Improved incomes and livelihoods of poor dairy producers, market agents, salaried workers and consumers
Outputs targets 2007	Recommendations on innovation system approaches that support the application of technological, institutional and policy options to improve market success for the poor developed and discussed with partners (Africa and Asia)	NARS, ARI and CG livestock researchers; Public and Private sector Livestock Specialists	Livestock development actors implement technologies, institutional changes and policies that improve the market success of the poor	Improved incomes and livelihoods of poor livestock keepers, market agents, salaried workers and consumers
	Summary of lessons learned in feeding systems innovation approaches completed	Partner livestock and crop researchers and development specialists (India, Nigeria, Vietnam, Syria and Ethiopia)	Partner organisations adopt key lessons and improve their performance to further improve their adaptive performance	Improved and more adaptive livestock feeding systems for poor livestock producers
	Synthesis of lessons learned in the application of learning-based monitoring and evaluation systems prepared	NARS, ARIs, CG researchers, private sector, development and donor community	Learning-based monitoring and evaluation systems applied by livestock researchers and development	Enhanced contribution of livestock research and development projects to poverty reduction

	Outputs	Intended users	Outcome	Impact
			specialists and lead to faster learning and adjustment of programs and activities	
(ILRI project 2) Output 3	Principles, guidelines and practices for networks and partnerships, using innovation systems approaches developed and implemented (5-7 years)	NARS, ARI, CG livestock researchers, livestock specialists in the public and private sectors, NGOs and civil society organisations	Changes in capacities and behaviours of livestock institutions to work in networks and partnerships that enhance the development and use of livestock knowledge for poverty alleviation	Improved relevance and performance of livestock research to alleviate poverty through livestock development
Output targets 2006	Guiding principles for partnerships implemented by ILRI and partners in priority livestock research for development projects assessed	NARS, ARI, CG livestock researchers in selected research projects chosen for range of activities and international relevance	Changes in the manner in which partnerships are established and implemented	Knowledge generated through livestock-related research is more effective in addressing the needs of livestock dependant poor people
	Impact assessment of livestock Farmer Field School Approach completed	Farmer organisations, extension specialists, livestock development specialists and livestock researchers	Improvements in performance of organisations using the farmer field school approach and the scaling up and out of lessons to other groups	Better use of knowledge and sharing of lessons for improving the impact of livestock interventions on poverty alleviation
Outputs targets 2007	Different arrangements for applying innovation system approaches to public, private and civil society partnerships for improving market success of poor livestock keepers compared	NARS, ARI, CG researchers, private sector, development and donor community	Enhanced understanding of the types of services and partners groupings that increase the capacity of livestock-dependent poor people to respond to changing circumstances	Capacity of livestock R&D actors to experiment and learn in providing an evolving range of services to livestock-dependent poor people
	Syntheses of lessons from on-going projects about the types of partner groupings required to drive pro-poor livestock innovation capacity	NARS, ARI, CG researchers, SROs, ROs, private sector, development and donor community	The research, development and donor communities are operating in institutional settings and partner groupings that drive pro-poor livestock innovation and response capacity	Lasting relationships between diverse groups of livestock R&D actors leading to a well articulated demand and supply of new knowledge and technology
Output target 2008	Principles, guidelines and practices for new patterns of networking and	NARS, ARI, CG researchers, SROs, ROs, private sector,	Networks enhance the adoption of innovation systems	Better use of knowledge and sharing of lessons for

	Outputs	Intended users	Outcome	Impact
	livestock knowledge sharing implemented in establishing livestock research for development networks in Africa and Asia	development and donor community	approaches to livestock research and development for knowledge generation, exchange and use	improving the impact of livestock interventions on poverty alleviation

Project (Theme) 3: Improving Market Opportunities

Project Narrative

Project description

ILRI and IFPRI have developed a joint programme to improve market opportunities within supply chains involving poor livestock keepers, the market intermediaries that serve them, and poor urban consumers of livestock products. ILRI's Project 3 is the main expression of the joint programme and the implementation of research on Pathway 3 out of poverty from *ILRI's Strategy to 2010*: 'Encouraging participation of the poor in livestock-related markets'. Following extensive consultation with stakeholders on several continents in 2003 and 2004, the Project was organised to have 3 areas of focus, spanning the range from production, procurement, processing and distribution, to final sale in local, national, regional and world export markets:

- **Smallholder competitiveness in changing markets:** A mix of technical, institutional, and policy options are evaluated with respect to their contribution to making smallholder livestock producers and those market agents that serve them more competitive as markets integrate. The initial focus has been on smallholder dairy systems of Africa and Asia. Increasing emphasis will be given to poultry and pig systems in Asia and Africa, and to the role of private-sector solutions for incorporation of smallholders, such as contract farming.
- **Changing demand and market institutions:** This focuses on the driving forces of change in the market channels traditionally supplied by the poor, including changes in demand for increased safety, uniformity, and higher levels of processing. It considers private sector responses to the new market opportunities, the impact of changes in industrial organisation back through the supply chain to procurement from small-scale producers, and means for helping the latter and small-scale market agents respond. It also assesses the impact of these changes on the price of livestock products to poor urban consumers and options for improving their access to low cost livestock-source foods that are safe.
- **Animal health and food safety for trade:** This seeks to identify animal disease control, health and standards certification methods, and commodity-based strategies to improve access to markets by poor producers, their organisations, and countries. In addition to assessing costs of compliance with sanitary and technical standards in a developing country context, this research will examine innovative options for assisting small-scale producers in meeting standards. Risk analysis from veterinary epidemiology will be combined with analysis of the costs and benefits of different options, including the implications for both direct and indirect impacts on the incomes of the poor.

Rationale

Livestock products have long been a pathway for income generation by the poor. Rapidly growing and changing livestock markets in the developing world provide real opportunities—but also significant threats—to participation of the poor, due to the increasing integration of national and world markets, the changing nature of food demand in cities, and a changing regulatory environment.

Increasing demand for livestock products in developing countries will be met by a variety of different agents through various processes. There is a need to assist these actors and processes to provide opportunities for the poor to become more involved as producers, market agents, employees, and consumers of cheaper and safer products. This will take active development efforts informed by relevant research.

Although research has shown that many smallholder livestock products remain competitive with output from large-scale farms and with imports, it has also demonstrated major differences across small farms. There is considerable scope for helping the poor who might otherwise be left behind to join a market-driven pathway to improving their livelihoods through livestock, hence a focus on *smallholder competitiveness*.

However even the most competitive small farms may not be viable if wholesalers will not buy from them. In response to changing demand for food safety, quality, and uniformity, market chains in many parts of the

developing world are becoming more concentrated and demanding. Study of these processes can be targeted to the design of better marketing institutions to allow smallholders to meet new requirements, hence a focus on *changing demand* structures that motivate the need for new institutions.

Beyond primarily national issues, major global procedures for control of animal disease set up in the 1950s are under challenge from changes in the global distribution of livestock production and consumption and from significant changes in technological options for disease control. The costs of compliance with standards developed for the industrial world are often hard for small-scale operators in developing countries to meet. Through case studies, research can demonstrate the high costs of compliance with traditionally accepted norms and evaluate the costs and benefits of alternative options for reducing risk of disease transmission, some of which may be more appropriate to particular developing country situations, hence a focus on *animal health for trade*.

Specific objectives

- Technical, institutional and policy options identified for increasing the ability of poor livestock producers to take better advantage of the changing demand opportunities and the structural context that they face.

The competitiveness of poor producers is targeted through improved technologies, institutions and policies that address changing agro-ecological and economic contexts. The focus is farm-level, action-oriented, and recognises the complex, multi-objective nature of poor farm households. The work typically involves smallholders and small-scale market agents in mixed crop–livestock systems and intensifying peri-urban systems.

- Technical, organisational, and policy options identified for more effective market access of poor producers and consumers of livestock products, given rising demand for uniformity, quality, increased convenience, and food safety.

The primary targets are institutional options for smallholder livestock producers and the supply chains that serve them to meet new requirements for market trust and reputation in the context of changing demand. A secondary target is to assess options for reducing the costs of safe livestock products for poor urban consumers harmed by higher prices of more formally marketed products. Work is at the level of market agents within supply chains.

- Impact on market access for countries, and for small-scale and poor producers of changing methods of animal disease control, and of health and standards certification methods assessed and options identified for them to comply with these changing standards and procedures.

This work draws attention to the high costs of compliance with existing SPS and other standards facing producers in developing countries who wish to sell into rapidly rising export markets. It also evaluates in selected cases the costs and benefits of alternative procedures for equivalent levels of animal disease control proposed for developing countries. While the proposals of others may be evaluated with respect to costs and benefits for a given level of risk, the work does not involve lab-based work on standards-setting, nor widespread comprehensive risk assessments of the type used for standard-setting. Work is at the level of supply chains, typically export-oriented, including within regional markets. The focus of partnership with lab-based organisations (such as ARIs) and standard-setting organisations (such as OIE and CODEX) will be to attempt to demonstrate interactions between the context and practical requirements of developing countries with the technical options available in different parts of the world.

Links to the new CGIAR Systems Priorities

Project 3 specifically targets CGIAR System Priority 3b (CGSP 3b) 'Income Increases from Livestock'. The project directly addresses the main concern of CGSP 3b that the rapid demand-led growth in livestock product consumption in developing countries presents opportunities, but that current policies, institutions, and structures unfairly favour large-scale livestock farming, and that poor livestock keepers may be driven out (CGIAR SP Sept. 2005, p. 46).

The three outputs of Project 3 address the six bullet items in CGSP 3b under the 'research on markets' component of Specific Goal 1 (CGIAR SP Sept. 2005 pp. 49–50): (a) understanding how changing demand (including for food safety) can displace smallholders (Project Output 2), (b) assessing the relative competitive position of smallholders (Project Output 1), (c) evaluation of different forms of collective action to overcome transaction costs (Project Outputs 1 and 2), (d) linking livestock development to changes in trade (in this case SPS agreements (Project Output 3), (e) coping with the impact of concentration of supply chains (such as supermarkets) on procurement from smallholders (Project Output 2), and (f) better linking rural production with expanding urban markets (Project Outputs 1 and 2).

In addition, the Project contributes to Specific Goal 2 to analyze the social impact of livestock development through research on how to minimise the exclusion of smallholders and how to increase income sources of women.

Finally, the Project directly addresses Specific Goals 1 and 2 of CGSP 5B, 'Making International and Domestic Markets Work for the Poor' (CGIAR SP Sept. 2005 pp. 74–75): (a) understanding the impact of changing consumer preferences on poor producers (Project Output 2); (b) understanding risk sources for improved SPS standards (Project Output 3); and (c) options to help smallholders to adjust to new demands for food safety and quality (Project Outputs 1 and 2).

Output implementation strategy

The strategy for implementing Output 1 (options identified for increasing the ability of poor livestock producers to expand viable livestock enterprises, or 'smallholder competitiveness') is based on three premises. First, the best chance for improved livelihoods of smallholders through livestock lies in those areas where demand is expanding and diversifying, which is implemented through work on promoting increased output and sales by small-scale dairy producers and smallholder producers of monogastric livestock products selling into urban markets or other growing markets. Second, promoting successful changes in smallholder farming requires a systems approach that considers the inter-relatedness of all farm-household activities and income sources, and the changing agro-ecological and economic context affecting incentives for smallholder producers. Third, success will require finding ways to mobilise the technical abilities and deep pockets of large private sector integrators and processors for the benefit of smallholder producers. Practically, this will be through forms of collective action such as coops or contract farming that allow smallholders to overcome imperfections in markets for information, credit, and other inputs and services, and become more attractive commercial partners, while also increasing their collective bargaining power. Success is likely to require increased use by smallholders of technologies that increase productivity through use of improved inputs and procedures, while making better use of undervalued family labour, a resource that often gives smallholders a competitive edge.

In view of these premises, work under Output 1 is at the farm-level, focuses on areas serving growing urban demand, focuses on the promotion of change in farming systems, and is built around the role of private sector or cooperative market institutions and service providers. Examples would be private sector or NGO contract farming schemes, public-private partnerships for livestock service provision, and cooperative livestock development. Strong and growing demand for specific traditional livestock products that are typically not well suited to industrial conditions, such as native chicken, may also produce opportunities in markets for which small-scale production systems may be uniquely suited. Partnerships are used to ensure

adequate technological input, particularly with other research Themes within ILRI and with the livestock-related work of CIAT and ICARDA.

The strategy for implementing Output 2 (options identified for more effective market access of poor producers and consumers of livestock products, given rising demand for uniformity, quality, increased convenience, and food safety) also starts from the premise that the Livestock Revolution is propelled by demand. However, it also focuses on the changing nature of demand for livestock products in end markets, how that influences market channels, and how that filters back to smallholder farmers. Thus it starts from the opposite end of the chain from farm-level work, the final consumer, and works backwards. Emerging market price premia in urban outlets for food safety and convenience are key indicators of these demand changes; thus in part this work will need to assess these trends and what the requirements are for product attributes to be remunerated in the market-place by these premia. Since many of the sought after attributes are hard to observe at the time of sale (such as safety, tenderness, etc.), market success is related to consumer confidence in the product and its specific supply chain. Thus the work also focuses on institutional options for product certification and grading in specific supply chains serving poor producers and consumers. Research will also need to assess the degree to which retail and processing operations for livestock products are becoming more concentrated, as in the case of widely observed supermarket chain development, and the implications of this for market access by smallholders and poor consumers, and what can be done to improve pro-poor outcomes. This work is highly complementary to work at other CGIAR centres with programs on improving market access for high-value food items, such as IFPRI and the World Fish Centre, and associated centres such as AVRDC, and also with work at ARIs such as Michigan State University; collaborative links are being forged in this area with these centres in order to capture synergies and achieve increased attention to livestock issues in non-livestock-specific fora. Outreach will also be extended to private sector retailers and processor groups.

The strategy for implementing Output 3 (options identified for countries, small-scale and poor producers to comply with changing animal disease control measures) is based on four premises. First, animal disease control measures constrain livestock exports from developing countries to levels far below what they would be otherwise (less than 10% of world production by value is traded, compared to 40% for fish). Second, the current set of global export standards, developed for the industrialised countries, is not particularly well adapted to developing country trade with respect to product definitions, types of risks considered and realistic methods of reducing risks. Third, the current world system of regulation of animal disease control is likely to change radically over the next 20 years with changes in technology and a shift in the large majority of livestock production consumption to the developing countries from the opposite situation 20 years ago. Fourth, while there are many legitimate actors in these debates with competences far beyond those of the CGIAR, there is a lack of hard empirical facts on the cost of compliance with current standards in developing countries and on the balance between risks on the one hand, and costs and benefits of different strategies for risk reduction under developing country conditions on the other. Work under Output 3 thus focuses on assessing the costs of compliance with norms in selected cases and where possible for alternative (proposed by others such as ARIs as equivalent) procedures for reducing risks to comparable levels, to generate evidence for the contentious debates sure to come in the near future. The work associates approaches of veterinary epidemiology and economics, and is particularly in need of strong partnerships with lab-based ARIs and standard-setting agencies.

Strategy for output–outcome logic

All work under Project 3 is market-oriented, meaning that it starts from emerging needs of producers in responding to changing market opportunities, and seeks institutional ways to leverage the resources of a wide variety of public and private actors in providing options for increased but more sustainable production and sales by the mass of small-scale producers, especially the poor and disadvantaged. The focus is on building national ownership for results, and engaging key decision-makers at policy and private investment levels early in the research, through national collaborators. The strategy for achieving facilitating policy changes is premised on the belief that successful policy outreach is best pursued by achieving buy-in from

trusted national policy analysts who will remain engaged in the countries concerned long after the Project staff has moved on. Work is thus highly collaborative and is expected to lead to a number of graduate theses and extended research visits to ILRI by senior research collaborators under Project 3 over the 2006–2008 period. Almost all written output is co-authored with national collaborators and virtually all sub-projects lead to restitution workshops.

The primary strategy for promoting outcomes from Output 1 (smallholder competitiveness) is to work in areas where demand for the end product is increasing, in systems and commodities (including traditional products) where smallholder systems are competitive, and where viable options for overcoming supply response constraints are much sought after by producers. The action-oriented and inter-Thematic systems approach of work under Output 1 allows a more realistic assessment of what those constraints are. The focus on institutional solutions in farm-market linkages through producer associations, coops and contract farming to overcome identified constraints recognises both the reality that increasingly integrated market players are likely to find it less risky and cheaper to transact with collectivities as opposed to individual small-scale farmers. It also recognises that access on a broad scale by poor producers to extension, credit, and the certified inputs necessary for quality outputs will in many places require mobilisation of private sector resources from integrators. The focus on technologies particularly suited to smallholder resources and the crop–livestock synergies of mixed farms, recognises the fact that sustainable commercialisation of livestock keeping by the rural poor in many areas both requires and promotes changes in prevailing farming systems. Finally, a key strategy for promoting outcomes from Output 1 is to integrate research into larger development projects, to allow direct opportunities for scaling up and impact through the efforts of development-oriented partners associated from the beginning of the research.

The primary strategy for promoting outcomes from Output 2 is again to focus work on areas where market needs are changing, but to assess the implications of this for poor producers and consumers through the impacts of these changes in demand on retailing and processing. The rise of supermarkets in developing countries has tended to be associated with increased consumer demand for food safety and convenience; both private and public sector decision-makers are responding to these rising demands. Yet formal sector solutions to the demand for food safety, such as pasteurisation or UHT processing, are not always the most pro-poor solutions, at least not in the immediate future, especially in relatively poorer and lower income countries such as in most of Africa. In the case of raw milk marketing in East Africa, for example, research has revealed that traditional systems are quite efficient and quite safe; traditionally consumers boil the milk before consumption the same day. However, as market chains become longer, more anonymous, and the amounts handled by each trader larger, food safety issues become more of a barrier. The solution advocated by some of enforcing pasteurisation of all milk sold in towns has been shown to eliminate poor consumers from the market because of much higher prices. There is some evidence that enforcing such regulations will make the small-scale raw milk cooperatives and NGO schemes currently serving poor producers unable to compete with large-scale private and public processors in urban areas. However, research shows that improved systems for handling raw milk at low cost, which is of great concern in the region to producer associations and NGO groups involved in rural development through dairy promotion, for example, can be developed that meet the demand of both poor consumers and provide an acceptable degree of food safety.

Building on ILRI's experience with milk safety issues, the strategy for producing outcomes from outputs for other commodities under Output 2 will be also be to assess changes in consumer demand for product attributes and associated consumer willingness-to-pay for these attributes (such as food safety). This permits an assessment of viable commercial strategies to tap into new market opportunities, and thus can be expected to be of interest to retailers and processors. This also directly responds to the expressed concerns of regulators who are acutely conscious of trade-offs between improved safety and raising politically-sensitive urban consumer prices of livestock products.

The primary strategy for promoting outcomes from Output 3 is to generate solid empirical evidence from a limited number of carefully selected case studies that serve as 'inconvenient, but indisputable facts' in highly

contentious international debates about the appropriateness of current standards and their impacts. Such facts established by rigorous inter-disciplinary work (veterinary epidemiology for risk assessment and economics for cost/benefit analysis, for example) are in truth few and far between in a domain where opposing and congruent commercial interests are ever-shifting. Advocacy claims in this area are often based on analysis that associates solid work in one discipline with back-of-the-envelope calculations in another that are nonetheless necessary for interpretation of the significance of the combined result. Consequently, these arguments are often easily discounted by opposing viewpoints. Inconvenient facts that are both hard to dispute and well-publicised, however, are taken up by the side they are favourable to, and then used by them in policy debates.

Since ILRI does not have the widespread resources to engage in work that sets standards and that mandate is fully occupied by others, the strategy is to focus on selected multi-disciplinary case studies that illustrate the sorts of problems that standard setters need to turn their attention to in developing countries, without impinging on their work. The strategy is to use ILRI's understanding of the developing country context in these areas and pro-poor bias to influence key technical and regulatory groups. Every effort is being made to develop and maintain partnerships with competent agencies in the SPS area, and in fact such agencies are an important target for the results of this work.

External conditions

Monogastric livestock product consumption in developing countries increased at about 5% per capita per annum for the last 30 years in developing countries; milk, fruits and vegetables, and beef grew at about 2 to 3 % and cereals by less than 1 %. These changes are driven by growth in population, income, and urbanisation. Longer, larger and more anonymous supply chains between farmers and consumers for perishables necessarily lead to increased demand for food safety. The rise in the share monogastrics means that purchased input supplies become more prominent in the total costs of production.

Two features of the response to this demand growth are the scaling-up of farm size in fast growing areas and the concentration of supply chains as they strive to meet changes in consumer demand. Such concentration is often manifested by the consolidation of specialised meat and dairy outlets, and by the rise of supermarkets in terms of urban market share handled. On the other hand, pro-poor NGOs are also noting the opportunities for poverty alleviation inherent in livestock production. Pro-poor interventions, whether public, NGO-led or private, need to focus on market-oriented institutional development and collective action, partnerships with the private sector such as contract farming, and the policy frameworks necessary to support these items.

Issues in animal health that affect trade are becoming increasingly prominent; major changes in the way the developed world accomplishes these functions are likely to occur as technological options develop and the core constituencies for livestock product trade in the industrialised world shift from producer interests to processors and retailers, as has already happened for fish, fruits and vegetables. Ensuing debates will undoubtedly be contentious, and mandate a solid core of hard facts to inform those concerned about the interests of the poor in developing countries.

Collaborators

Other CGIAR Centres:

CIAT, CIP, ICARDA, ICRAF, and IFPRI

SWPs/ERPs and CPs:

SLP

NARS (including NGOs and private sector):

Crawford Fund, **Australia**; Bangabandhu Sheikh Mujibur Rahman Agricultural University, Department of Livestock Services (Ministry of Fisheries and Livestock), **Bangladesh**; University of Ouagadougou, **Burkina Faso**; CEPEA, University of Sao Paulo, **Brazil**; CAC, CGG, CGUS, CORFOGA, SIDE, **Costa Rica**; Addis Ababa University, EARO, EDRI, Ministry of Agriculture, Animal and Fisheries Resources, Mekelle University, **Ethiopia**; ARI, Kwame Nkuruma University of Science and Technology, **Ghana**; ASOBRAHMAN, Ganadería y Alimentación, ICTA, Ministerio de Agricultura, **Guatemala**; DICTA, FENAGH, Secretaria de Agricultura y Ganadería, **Honduras**; CALPI, Government of Assam, ICAR, IIM-Ahmedabad, NDRI, **India**; Ministry of Agriculture, Jordanian University of Science and Technology, **Jordan**; ActionAid Kenya, Egerton, KARI, KEMRI, KDB, KIPPRA, MoLFD, MoARD, Ministry of Health, ITDG Kenya, IPAR, SITE, Tegemeo (Egerton University), University of Nairobi, **Kenya**; MEATCO, Namibia Meat Board, **Namibia**; FAGANIC, Ministerio Agropecuario y Florestal, IDR, **Nicaragua**; Pakistani NARS, **Pakistan**; Bureau of Animal Industries, Central Luzon State University, PCARRD, University of the Philippines, Los Banos, **Philippines**; SAMIC, South Africa Department of Animal Services, National Emergent Red Meat Producers Organization, The Red Meat Abattoir Association, **South Africa**; University of Peradeniya, **Sri Lanka**; Ministry of Animal Resources and Fisheries, University of Khartoum, **Sudan**; Ministry of Agriculture and Agrarian Reform, Damascus University, **Syria**; Sokoine University of Agriculture, **Tanzania**; Department of Livestock Development (Ministry of Agriculture and Co-operatives), Khon Kaen University, Thai Development Research Institute, **Thailand**; Ministry of Agriculture, Environment and Water Resources, **Tunisia**; Dairy Development Authority, NARO, Makerere University, **Uganda**; Department of Environment, Food and Rural Affairs, Natural Resources International, **United Kingdom**; Hanoi Agricultural Institute, Ministry of Agriculture and Rural Development, National Institute of Animal Husbandry, Vietnam Agricultural Sciences Institute, Department of Animal Health, **Vietnam**.

ARI partners:

IDRC, **Canada**; DIAS, **Denmark**; CIRAD-EMVT, **France**; FASID, GRIPS, **Japan**; Wageningen Agricultural University, **Netherlands**; DFID, Institute for Development Studies, Natural Resources Institute, University of Reading, **United Kingdom**; Cornell University, Purdue University, **USA**

Regional organisations:

AU-IBAR, ASARECA, ECAPAPA, CILSS, IICA, ITC, SEAFMD

International Organisations:

BMZ, CFC, DANIDA, European Commission, FAO, GTZ, IFAD, OIE, USAID, and World Bank

Project 3: Improving Market Opportunities

	Outputs	Intended User	Outcome	Impact
(ILRI Project 3) Output 1	Technical, institutional and policy options identified and promoted that increase the ability of poor livestock producers to take better advantage of the changing demand opportunities and structural context that they face (3–5 years)	Development practitioners and investors, private sector and collective livestock processors and integrators, producer associations, for the technical and institutional options. Policymakers and analysts for the policy options to facilitate the uptake of the technical and institutional options by the actors above.	Increased awareness of—and resources devoted to—increasing the market-orientation and competitiveness of smallholder livestock producers by policy-makers, private sector entities, and development agencies. Evidence demonstrating uptake of best practices for market-oriented smallholder livestock and dairy development by development organisations and NGOs	Increased productivity, incomes and sustainability of smallholder livestock producers targeted by this research
Output 1 Targets 2006	<p>Benefits from and barriers to smallholder participation in contract farming of poultry and pigs or dairy in South Asia and Southeast Asia analysed, documented, and compared (targeted cases: India, Philippines, Thailand, Vietnam)</p> <p>Current smallholder dairy production technologies and best practices for increased smallholder competitiveness and participation in markets analysed, identified and documented in SSA and S Asia from a cross-country scoping-study. Options explored for extending the Kenya model in depth to the Kivu Pilot Learning Site in Central Africa and to the poor parts of eastern India.</p>	<p>Policymakers, development investors, private sector and collective livestock processors and integrators, producer associations, for South and South East Asia</p> <p>Dairy related policymakers, development projects, practitioners and investors, producer associations, other ILRI Themes, CG researchers in CIAT and ICARDA dealing with ruminant livestock.</p> <p>NARS in Rwanda and NGOs and provincial officials in Eastern India</p>	<p>Increasing participation in target countries of smallholder livestock farmers in vertically coordinated schemes for livestock production and sales and evidence of uptake by contract farming schemes of options identified by the research to make vertical coordination more pro-poor</p> <p>Increased attention and resources devoted to investment in dairy best practices in target countries.</p>	<p>Improved incomes from livestock production of vertically coordinated small-scale livestock producers in targeted schemes</p> <p>Higher and less variable unit returns to smallholder dairy production in target areas</p>

	Outputs	Intended User	Outcome	Impact
	Markets for indigenous small ruminants and poultry in selected SSA countries assessed and options for improving the market-participation, competitiveness and livelihoods of farmers of these commodities evaluated.	Researchers (including ILRI Theme 1—Targeting, and Theme 4—Biotechnology), policymakers, development practitioners and investors, and producer associations working in marginal areas	Increased resources devoted by farmers and development schemes to enhancing the role of indigenous livestock in the farming systems and market baskets of target countries.	Improved incomes of the poor from increased sales of indigenous livestock products
Output 1 Targets 2007	<p>Benefits from and barriers to smallholder participation in contract farming of poultry and pigs or dairy in South Asia and Southeast Asia assessed and documented (targeted cases: Vietnam, Cambodia, Bangladesh)</p> <p>Promotion of best practices to facilitate the growth of smallholder dairy production in selected poorer areas of SSA (Kivu PLS) and South Asia (Eastern India)</p> <p>Current smallholder pig production technologies and best practices for increased smallholder competitiveness and participation in markets analysed, identified and documented in SE Asia (SW China, Vietnam and Cambodia)</p> <p>The role of indigenous livestock in enhancing competitiveness and sustainability of smallholder</p>	<p>Policymakers, development investors, private sector and collective livestock processors and integrators, producer associations, for South and South East Asia</p> <p>Dairy related policymakers, development projects, practitioners and investors, and producer associations</p> <p>Researchers (including ILRI (including ILRI Theme 1—Targeting, and Theme 4—Biotechnology), policymakers, development practitioners and investors, and producer associations working in pig systems in S and SE Asia.</p> <p>Policymakers, development projects, practitioners and investors, and producer</p>	<p>Increased participation in target countries of smallholder livestock farmers in vertically coordinated schemes for livestock production and sales</p> <p>Increased attention and resources devoted to investment in identified best practices for smallholder dairy in target countries.</p> <p>Increased awareness of potential best bet technologies in smallholder pig systems.</p> <p>Increased awareness and resources devoted to investment in appropriate promotion of</p>	<p>Improved incomes from livestock production of vertically coordinated small-scale livestock producers in targeted schemes</p> <p>Higher and less variable unit returns to smallholder dairy production in target areas</p> <p>Increased investment in smallholder pig systems development</p> <p>Higher and more reliable incomes to smallholder engaged in indigenous livestock production</p>

	Outputs	Intended User	Outcome	Impact
	producers evaluated in selected W African and South Asian countries	associations working in marginal areas	indigenous livestock in target countries.	
Output 1 Targets 2008	<p>Benefits from and barriers to smallholder participation in contract farming of poultry and pigs or dairy in selected countries of South Asia and Southeast Asia comprehensively documented and promoted.</p> <p>Strategies to enhance the competitiveness and sustainability of smallholder producers in selected countries of W Africa and South Asia through increased production and sale of indigenous cattle, small ruminants and poultry comprehensively evaluated in the context of market incentives.</p>	<p>Polymakers, development investors, small scale market agents, private sector dairy processors and retailers; producer associations</p> <p>Polymakers, development practitioners and investors, and producer associations working in marginal areas</p>	<p>Growth of market-oriented smallholder livestock production in targeted regions of South Asia using practices and strategies advocated</p> <p>Renewed interest by researchers and private sector for use of indigenous breeds within small farm production contexts</p>	<p>Decline in the rate of decrease in smallholder livestock producer market share in targeted countries</p> <p>Higher and more reliable incomes to smallholder engaged in indigenous livestock production</p>
(ILRI Project 3) Output 2	Technical, organisational, and policy options identified for more effective market institutions and servicing of small-scale, poor and disadvantaged producers and consumers, in the context of rising urban demand for reliable quality, increased convenience, and food safety of livestock products (3–5 years)	Polymakers and analysts, regulatory authorities, Development investors, public and private sector traders (wholesalers, processors and retailers) of livestock products, consumers, producer associations, researchers for the technical and organisational options. Polymakers and analysts, and regulatory authorities for the policy options to facilitate the uptake of the technical and organisational options by the actors above.	<p>Increased sales by smallholders and disadvantaged producers (poor and women) to urban formal sector outlets; awareness increased of technical, institutional, and policy options for increasing the amount of smallholder livestock product sales to urban outlets among polymakers, producer associations and development investors</p> <p>Increased recognition among market actors about options available beyond traditional formal sector responses from the</p>	<p>Improved livelihoods of small-scale producers and market-agents through greater participation than would otherwise be the case in supply chains serving high-end urban markets for livestock products</p> <p>Improved producer responsiveness to consumer demand for better food quality and safety reflected in premium prices received for better quality and safety, and lower prices for safe food to the urban poor</p>

	Outputs	Intended User	Outcome	Impact
			developed world to meet public and private sector food safety and quality requirements and regulations	
Output 2 Targets 2006	Develop improved framework for applying quantitative risk analysis of milk safety in selected African cases by 2006	Dairy marketing and processing agencies/enterprises, dairy cooperatives, dairy Boards and policy agencies in East Africa	Improved framework for milk market regulations in selected East African countries based on the application of quantitative risk analysis	Improved livelihoods of small-scale producers through greater participation than would otherwise be the case in high-end urban markets for dairy products
Output 2 Targets 2007	Key trends in changing demand attributes for milk in a sample of developing countries in East Africa and South Asia identified and documented Extent and significance of trends in emerging price premia in urban outlets for livestock product attributes such as safety and convenience decomposed and assessed in selected Asian and African cases.	Policymakers and analysts, development investors, public and private sector wholesalers, processors and retailers of livestock products, consumers, producer associations, researchers	Increased awareness among small-scale producers and market operators in project areas about potential for price premia for selected products with different attributes	Increase in the share of smallholder production going to higher priced markets in targeted countries leading to higher incomes
Output 2 Targets 2008	Policy and institutional options identified for improving food safety in raw milk marketing channels in a sample of countries in East Africa and South Asia Options identified in selected Asian cases for self-sustaining supply chain certification schemes that allow small-scale producers and marketing agents to benefit from emerging price differentials for credibly certified livestock products	Policymakers and analysts, regulatory authorities, development investors, public and private sector traders, wholesalers, processors and retailers of milk products, consumers, producer associations, researchers in East Africa and Southern Asia	Increased awareness among small-scale producers and market operators about quality and safety requirements in the market chain in target countries	Increased producer and market agent compliance with quality and safety requirements in stable urban high-value supply chains for raw milk products leading to higher incomes

	Outputs	Intended User	Outcome	Impact
(ILRI Project 3) Output 3	Impact on market access for countries, small-scale and poor producers of changing methods and regulations of animal disease control, and of health and standards certification methods assessed and options identified for countries, small-scale and poor producers to comply with changing animal disease control measures, standards, and procedures under developing country conditions (3–5 years)	Polymakers and analysts, regulatory authorities, development investors, private sector exporters and importers of livestock products, producer associations, researchers	Increased awareness of factors influencing smallholder capacity to comply with SPS guidelines and private sector sanitary and quality norms among policy-makers, regulators, and development agencies in the developed world	Increased and more stable producer incomes through better access to high-value export supply chains for livestock products
Output 3 Targets 2006	<p>Characterisation and scoping analysis of small ruminant health delivery systems and market access in the Near East–North Africa</p> <p>Policy domains identified and documented for regulatory and institutional change in developing countries that will help meet SPS concerns, while minimising negative impacts on small-scale producers.</p>	<p>Ministries of Livestock and other providers of livestock health services in Near East–North Africa</p> <p>Polymakers and analysts, regulatory authorities, development investors, private sector exporters and importers of livestock products, producer associations, researchers</p>	<p>Adoption of improved options for the delivery of animal health services to market-oriented small ruminant producers in targeted zones</p> <p>Increased participation of smallholder producers in safer livestock product supply chains than would be the case without the project</p>	<p>Increased compliance with animal health and safety regulations by small-scale producers and traders leading to increased and more stable producer incomes through better access to high-value domestic and export supply chains for live small ruminants and meat</p> <p>Improved producer incomes and more stable and cheaper supplies of livestock products to the urban poor and export markets than would otherwise be the case</p>
Output 3 Targets 2007	Strategies and options identified and promoted for mitigating animal health and food safety constraints to the production to consumption chain for smallholder beef production in four countries of Central America	Private sector processors and trader, regulators, producer associations and researchers in Central America	Adoption of revised protocols for internal beef trade in the four participating Central American countries of the study	Increased food safety in the Central American beef chain and decreased risk of the spread of animal disease

	Outputs	Intended User	Outcome	Impact
	Costs and benefits of complying with SPS regulations for the economy and poor livestock producers in Ethiopia and Kenya identified	Policymakers, private traders, producer associations, researchers	Improved procedures adopted for handling meat exports to the Middle East	Increased and more stable meat exports to the Middle East from the study countries
Output 3 Targets 2008	Identification and pilot testing of improved strategies for provision of animal health services to poor farmers in selected countries of Near East—North Africa	Ministries of Livestock, other health service providers and market agents in the target countries	Ministries of livestock and other health service providers in the target countries adopt new procedures for health services provision	Increased private sector compliance with improved animal health and safety standards
	Costs and benefits of complying with SPS regulations for the economy and poor livestock producers in Sudan and Syria identified	Ministries of Livestock, other health service providers and market agents in the target countries	Ministries of livestock and other health service providers in target countries adopt new procedures for health services provision	Increased private sector compliance with improved animal health and safety standards

Project (Theme) 4: Biotechnology to Secure Livestock Assets

Project Narrative

Project description

Animal diseases represent a major threat to the livestock assets of the poor in low-input systems and also limit the productivity and income generation potential of these assets. The need to increase food production is putting pressure on governments and individual farmers to introduce—through substitution or crossbreeding—supposedly more productive but less adapted exotic livestock genotypes into stressful, low-input, production environments. Such introductions usually expose poor farmers to increased risks. These environments are invariably dependent on indigenous livestock genetic resources, which have evolved in diverse local environments and which carry unique genes that define productive and adaptive capabilities. Securing and building these assets for the poor is a cornerstone of poverty alleviation. The overall goal of the Project is to mitigate threats to livestock assets so as to reduce risks of worsening poverty. This is achieved by applying biotechnological tools to reduce mortality and morbidity through enhanced animal health and improved animal genotypes generated through better understanding and use of inherent genetic diversity. Use of locally adapted and disease resistant livestock and the development of appropriate interventions such as diagnostics for disease surveillance and vaccines and therapeutics for disease prevention and treatment, are considered effective ways through which the livestock assets of the poor can be secured and multiplied. In marginal areas, a combination of animal health (vaccines and diagnostics) interventions and use of well characterised and improved indigenous genotypes will underpin the strategy. In rapidly changing systems, for example in higher potential areas where smallholder dairying is increasingly important, animal health interventions to reduce disease risks are most critical. In addition, while the focus will be on technologies to secure assets, the project will also generate impacts through increased productivity and improved market access, especially in intensifying systems. In the genetics area, interventions will include those targeted at improving income generation potential. Thus, in addition to work on characterisation and mapping of the diversity of livestock genetic resources in developing countries, the development of appropriate breeding strategies to improve productivity in low-input systems will be an important activity of the Project. This will include an analysis of options that might combine the use of both marker-based breeding technologies and conventional breeding approaches, taking into account traits most relevant in these production systems. Current vaccine and diagnostics research focuses on priority killer endemic livestock and zoonotic diseases of Africa some of which are important in other regions as well. Potential value of work on emerging livestock diseases as well as on issues of health regulations associated with market access will be assessed on the basis of poverty impact potential, alternative suppliers and ILRI's comparative advantage. The approach being taken in both vaccine development and genetic improvement work is one in which ILRI works closely with consortia of strategic international collaborators (including ARIs & private sector) and national partners to ensure that the best practices (both technical and institutional arrangements) can be applied in other diseases, animal genetic resources and in other regions of the world under different settings.

Rationale

The thrust of this Project is securing of livestock assets in environments where disease is recognised as a major constraint. To this end, development of vaccines and diagnostics for the major killer livestock diseases as well as characterisation of, and breeding for, disease resistance are the pillars of the Project. There is great demand for safe, effective and thermostable vaccines which can be delivered and used in systems characterised by infrastructural constraints. In addition, diagnostics remain a major constraint to the development of livestock disease control and eradication programs for many important diseases in developing countries. In Africa, emergence of sub-regional economic communities is creating opportunities for regional trade, the exploitation of which will be greatly enhanced by creation of disease-free zones through availability of simple cost-effective diagnostics, including 'point-of-transaction tests' for important diseases. The Project focus is on those livestock diseases which affect the poor but are not covered by other actors in the livestock health domain (i.e., 'orphan diseases'). Broad

genetic characterisation to map diversity in livestock resources is seen as a critical step towards the development of strategies for both improved utilisation and conservation strategies. This is because there is very little known about the genetic diversity in indigenous livestock breeds and potential for genetic improvement in developing countries. Questions include: how much diversity exists in specific populations; uniqueness of populations; what breeds/populations to conserve; what conservation methods to apply; and how the genetic diversity in indigenous breeds can be utilised to generate greater benefits for the poor livestock keepers, without compromising the diversity. Although there are similarities between crop and livestock conservation and use issues, there are also non-trivial differences, and hence possible approaches. These arise from a combination of differences in the biology and, importantly, in the state of scientific knowledge. For example, there are no working models for livestock genetic improvement in low input systems in developing countries, nor true equivalents of the seed systems that are critical for the success in crop production. Furthermore, given the time required to effect genetic change in livestock, it is even more critical that development of breeding objectives take into account on-going evolution in the production systems, hence there is need to understand the system changes and the key drivers.

Progress being made in genome sequences of livestock species is opening new ways for the identification and improved understanding of economically important traits and genes. These developments are catalysing the emergence of new tools, e.g., bioinformatics and gene expression units—such as microarrays, the application of which represent new opportunities with significant potential for gene discovery research. These are common platforms/technologies for both vaccine research (i.e. antigen identification) and genetic improvement. The current genetics research focuses on the identification and characterisation of genomic regions implicated in trypanotolerance in cattle and resistance to helminth parasites in small ruminants. With its limited capacity, ILRI cannot do all that is required in all these spheres. ILRI, thus, through strategic alliances, seeks to build capacities and strategies that allow NARS partners to scale out outcomes. A new mechanism for supporting partners is through the Biosciences east and central Africa (BecA) which is an innovative joint venture involving NEPAD, ILRI and stakeholders of countries in the sub-region and is providing a platform of state-of-the-art research facilities and capacity for application of biosciences in agriculture. These partnerships and institutional arrangements are allowing ILRI to expand the impact of its expertise—in such areas as immunology, molecular epidemiology and animal genetics—and research outputs—focusing on what gets done rather than just what ILRI does. While the research is organised into three teams (which correspond to the Project objectives)—characterisation of genetic resources, animal disease control and, genetic improvement—animal health/adaptive attributes remain a unifying element. This, plus use of common technology platforms ensures that complementarities and synergies are fully exploited and duplication avoided.

Specific Objectives

The specific objectives of the Project (which also correspond to the key outputs of the Project) are, therefore:

- **Output 1:** Vaccines and diagnostics to help reduce animal mortality and morbidity;
- **Output 2:** Adaptive traits and genes identified and characterised, their potential role in breeding programs assessed, and breeding strategies appropriate for low-input smallholder systems developed
- **Output 3:** Genetic diversity in indigenous AnGR quantified, its distribution mapped and strategies for conservation and enhanced use developed

The implementation of the Project will involve close collaboration with international and national scientists, private sector partners, extension personnel and, in some cases, farmers and policy makers. In addition, graduate training is embedded in many of the project activities. Thus, the Project will enhance, through participation in research and in application of specific biotechnologies and training, the expertise and capacity of NARES and other strategic partners to undertake research and development utilising both traditional and advanced biotechnologies in animal health and genetics. To better target the activities, priority diseases for which vaccines and diagnostic work will focus will be determined in collaboration with Project 1. Work on

characterisation and improved utilisation of animal genetic resources will also focus on populations that are especially relevant to developing countries, particularly those native to these regions.

Links to System Priorities

The CGIAR System priority setting process identified research on sustainable management of natural resources as a means to achieve both sustainability and poverty alleviation. Work on characterisation and improved utilisation of AnGR will contribute to System Priority 1 which aims at sustaining biodiversity for current and future generations and specifically to 1c which focuses on conservation of indigenous livestock. Gene discovery aspects of this Project are linked to System Priority 2d on 'Genetic enhancement of selected species to increase income generation by the poor' and more specifically to goal 3 on 'smallholder livestock improvement for tolerance to biotic and abiotic stresses'. Research in this Project is also linked to Priority 3, '... opportunities for high-value commodities and products', specifically to 3d, 'income increases from livestock' goal 1 of which includes research to reduce production risks through development of low cost vaccines and diagnostic tools and development of breeding strategies which include breeding for adaptive attributes such as disease resistance.

Output implementation strategy

An important element of the strategy of this Project is the establishment of a network of collaborators considered essential for its success, both through facilitating access to essential technologies and ensuring that research products are relevant and are eventually applied in the local contexts. A key strategy is to stay alert to technological advances to ensure that the best of relevant science is accessed, assessed and, where appropriate, brought to bear on this research. For the ECF vaccine—a key expected output in this medium-term—the strategy to deliver target outputs (proof of concept and field trials to facilitate licensing) revolve around strategic partnerships: collaboration with The Institute for Genomics Research (TIGR) and Ludwig Institute for Cancer Research (LICR) formed the foundation for the sequencing of the parasite and subsequent identification of candidate antigens. In this MTP period, trials to demonstrate proof of concept (that the antigens in combination with appropriate delivery systems can confer protection), the output target for 2005, will be conducted in the ILRI animal facilities. Following proof of concept, the private sector partner, in collaboration with ILRI, the Kenya Agricultural Research Institute (KARI) and the Department of Veterinary Services of the Kenyan Ministry of Livestock and Fisheries Development (MOLFD) will conduct closely monitored field trials (initially using purchased experimental cattle and subsequently in farmers' herds) (output target for 2006), to facilitate registration/licensing of the vaccine (2007/2008).

As in the vaccine research, the diagnostics work will also involve laboratory and field components: Activities in the laboratory involve evaluation of the diagnostic test using sera from experimentally inoculated cattle. This will be followed by evaluation in multiple laboratories using sera from animals naturally infected under field conditions to validate data obtained with experimental sera. This will facilitate registration/licensing and development of production modalities with the involvement of a private sector partner to enable roll out for wider use.

A significant part of the gene discovery research (development of resource families and associated genotyping and phenotyping) has, because of the nature of the work, been done within ILRI, but has been driven by graduate students and postdoctoral scientists, mainly from sub-Saharan Africa. Continuing over the next three years, relevance of the identified QTLs/genes (output target for 2005–06) will be tested on-farm and will involve close collaboration with NARS scientists, extensions service personnel and farmers. In parallel, gene expression studies (2005–06) will be undertaken within ILRI labs. On-farm assessments of the QTLs will provide a basis for pilot studies in West Africa to develop/refine strategies for incorporating QTL information in breeding programs (2007–08). With regard to mapping of the diversity of AnGR, the strategy is one in which country or region-focused studies are driven by local scientist(s), some of whom are graduate fellows undertaking the research as part of their student projects. Continent level analysis is achieved through strategic selection of samples (from the

national/sub-regional subsets) that are representative of unique sub-populations that constitute the populations of interest, e.g. African cattle. Laboratory analyses have been and will continue to be undertaken both in ILRI and in national institutions, where feasible. Thus, the NARES are essentially involved at all stages: formulating hypotheses (NARS scientists), sampling (policy makers in approving Material Transfer Agreements and scientists and farmers in field sample collection), DNA extraction, genotyping and/or sequencing, data analysis and write-up (scientists, principally graduate/research fellows). The same strategy and partnership approach is applied in other aspects of the AnGR work, including on-farm phenotypic characterisation. Substantial progress has been made on broad diversity mapping in African cattle and evolutionary links to populations of other regions established. A comprehensive mapping of the Yak diversity in Asia has been completed. Mapping of the genetic diversity in African sheep and goat populations are well underway as is similar work on African and Asian chicken diversity. The current MTP will see expansion of diversity assessment into Asia, principally focusing on chickens and small ruminant, and development of the Domestic Animal Genetic Resources Information System (DAGRIS). The recently opened (2005) joint laboratory between ILRI and the Chinese Academy of Agricultural Science in Beijing (P. R. of China) as well as ILRI office in New Delhi (India) are pivotal to such expansion into the Asian continent.

Strategies for output–outcome logic

The output delivery strategies described above for both vaccine and diagnostics research have in-built mechanisms to effect desired outcomes (that is, reduced mortality and improved productivity through application of these technologies). The outputs themselves are tailored to address identified needs—high priority killer livestock diseases—and then special consideration is given to known delivery issues that constrain application of such technologies in the target production systems. Thus, safety, thermostability and cost-effectiveness are considered important requirements for all ‘new generation’ vaccines deployed in tropical environmental contexts of developing countries. In addition, the research involves consortia designed to ensure that the product development to consumption chain is complete. Encapsulating a public–private partnership domain, this continuum, consists of Advanced Research Institutes (ARIs) (sources of technology), the private sector (for technology sourcing as well as expertise in product development, licensing and marketing) and NARS (field trials of products, facilitating local licensing/registration and links to local policy makers and product consumers). In this process, business planning is key. The process includes analysis of prospects, demand, and likely benefits; proactively engaging the private sector in the research process, with clear understanding—informed by business planning—that they have responsibility for delivery of these products to farmers; engagement of farmers in field testing and policy makers in the research process as soon as proof of concept is demonstrated. On-farm trials, closely involving farmers, will ensure that technology uptake is based on farmers’ understanding of its relevance and effectiveness (hence potential impact) and will facilitate rapid adoption. While recognising the role of government departments of veterinary services in policy/regulation, the research strategy places the responsibility for technology commercialisation on the private sector and ensures that engagement of these stakeholders happens early enough in the research process. The overall research strategy will ensure that, by the time the technology is taken to the field, adoption and impact issues will have been thoroughly analysed. This is an approach which can be generally applied to the development of vaccines against orphan diseases in different production systems.

The two adaptive traits currently being addressed under output 2, trypanotolerance and resistance to helminth parasites, have been identified as high priority constraints to livestock production and improved tolerance/resistance is considered a potentially powerful means of improving productivity without compromising adaptability and environmental health. To translate the target outputs into desired outcome—i.e., improved animal genotypes with better performance (reduced mortality, increased productivity) and/or generation of new, novel, gene intervention strategies, the gene discovery component of the research will be followed by two key parallel activities: on-farm trials to evaluate relevance of identified quantitative trait loci; and additional lab-based research to understand the gene function and associated host–parasite interactions that underlie tolerance or resistance. The former will involve on-farm performance

evaluations working with NARS and farmers, thus allowing farmers to assess relevance of the technology while also getting the skills required to apply it.

The expected outcome from output 3 is enhanced use of promising, indigenous AnGR in breeding programs and establishment of conservation programs. To translate the target outputs, principally generation of diversity assessment data, into this outcome, will require active dissemination of the generated data/information to stakeholders. The Domestic Animal Genetic Resources Information System (DAGRIS) is one avenue to achieve this. Other avenues include awareness creation through collaborators involved in the project, tailor-made training/awareness workshops and courses, publication of results through appropriate outlets accessible to key stakeholders and links of diversity assessment outcomes to utilisation activities within ILRI's own research and those being undertaken by NARS (where advice on choice of breeds for breeding programs is required).

For all the outputs, the research process involves engagement of key relevant partners both in the planning and implementation, ensuring that outputs are tailored to capacities and needs of partners, including farmers.

External Conditions (Assumptions)

It is assumed that facilities, transporters and legal and policy environments continue to allow movement, storage and manipulation of biological material, including germplasm (especially DNA), disease organisms and their vectors and the conduct of appropriate animal trials. Collection and movement of DNA for genetic diversity studies, it is assumed, will continue to take place without major sovereignty and technical barriers so long as CBD provisions and related undertakings are met. For products of animal health research to reach the farming community, there is need for effective systems of delivery at national and community levels, not dependent on the public sector. In addition, it is assumed that, despite the continued absence of requisite infrastructure, policy environments will allow NARS and extension services to work closely with partners such as NGOs, the private sector and farmer organisations to facilitate delivery of products at low enough costs that can be accessible to poor farmers.

Users

Government, parastatal and private breeding programmes, NARS, extension services, including veterinary services/laboratories, and individual livestock producers and producer groups

Collaborators

NARS partners: Department of Animal Breeding and Genetics, Bangladesh Agricultural University, **Bangladesh**; Institut National des Recherches Agricoles du Benin (INRAB) and regional extension offices, Projet d'Appui à la Gestion de la Recherche Agricole Nationale/GTZ, **Benin**; Gansu Agricultural University, Lanzhou, Huazhong Agricultural University, Wuhan, Institute of Animal Science (Beijing), Kunming Institute of Zoology, South China Agricultural University, Guangzhou, The Chinese Academy of Agricultural Sciences (CAAS), **China**; Direction Nationale de l'Élevage, Ministère de l'Environnement, **Guinea**; Indian Council of Agricultural Research, National Research Centre on Yak (ICAR), **India**; Bogor Agricultural Institute, **Indonesia**; Agricultural Biotechnology Research Institute of Iran (ABRII), **Iran**; Department of Veterinary Services-Kenya Veterinary Association (DVS-KVA), Egerton University, IMCB-A, Nairobi, Jomo Kenyatta University of Agriculture and Technology, Kenya Agricultural Research Institute—Trypanotolerance Research Centre (KARI-TRC), Kenyatta University, Kenya Veterinary Vaccines Production (KEVEVAPI), Mpala Research Centre, Nanyuki, University of Nairobi, **Kenya**; Département de Recherches Zootechnique et Vétérinaires—FOFIFA, **Madagascar**; DNAMR/Mali, Ministry of Environment, **Mali**; Pakistan Agricultural Research Council, **Pakistan**; Direction de l'Élevage, Ministry of Environment, **Senegal**; National Livestock Research Institute, The Rural Development Administration (RDA), **South Korea**; University of Peradeniya, **Sri Lanka**; Animal Resources Research Corporation, **Sudan**; Sokoine Agricultural University, **Tanzania**; Department of Livestock Services, Ministry of Environment, **The Gambia**; Livestock Health Research Institute (LRI), Makerere University, National Animal Genetic

Resources Centre & Data Base (NAGRC&DB), **Uganda**; National Institute of Animal Husbandry, **Vietnam**

ARI partners: University of New England, Armidale, **Australia**; BOKU—University of Natural Sciences and Applied Life Sciences, **Austria**; Ludwig Institute of Cancer Research (LICR), University of Liège, **Belgium**; University of Victoria, **Canada**; University of Mediterranean, Marseille, **France**; Bernhard Nocht Institute for Tropical Medicine, Dummerstorf University, Institute of Animal Breeding, Animal Production in the Tropics, Georg-August University, University of Hohenheim, University of Kiel, ZEF, University of Bonn, **Germany**; Trinity College, University of Dublin, **Ireland**; Hebrew University, University of Haifa, **Israel**; Institute of Zootechnics, University Cattolica del S. Cuore, **Italy**; Japan International Research Centre for Agricultural Sciences (JIRCAS), Nagoya City University Graduate School, National Institute of Agrobiological Sciences, Tsukuba, National Institute of Animal Health, Sapporo, Hokkaido, Shirakawa Institute of Animal Genetics, Tokyo University of Agriculture, **Japan**; King Saud University, **Saudi Arabia**; Roslin Institute, **Scotland**; The National Institute for Agriculture and Food Research & Technology of Spain (INIA), **Spain**; National Veterinary Institute (SVA), Swedish University of Agricultural Sciences (SLU), **Sweden**; Swiss Federal Institute of Technology (ETH), Swiss Tropical Institute, **Switzerland**; Wageningen Agricultural University, **The Netherlands**; Brunel University, Centre for Tropical Veterinary Medicine (CTVM), Institute of Animal Health, Moredun Research Institute (MRI), The Wellcome Trust, University College, Dublin, University of Edinburgh, University of Liverpool, University of Manchester, University of Nottingham, University of Oxford, Veterinary Laboratories Agency (VLA), **United Kingdom**; Oak Ridge National Laboratory, Oak Ridge, TN, Southwestern Medical Centre, University of Texas, Texas A&M University, The Jackson Laboratory, Bar Harbor, ME, University of Iowa, University of Montana, Bozeman, MT, University of Tennessee, Memphis, TN, University of Stirling National Centre for Genetic Resource Preservation (USDA-ARS), TIGR, University of Maryland, University of Florida, Bovine Functional Genomics Laboratory, Beltsville, MD (USDA-ARS), **USA**;

CGIAR partners: Systemwide Genetic Resources Policy Initiative, IPGRI, FPRI, ICARDA, ICRAF, ICRISAT, IITA,

Regional and eco-regional partners: ASARECA; SADC; CORAF; ITC, The Gambia; CIRDES, Burkina Faso.

International Organisations: International Atomic Energy Agency (IAEA), **Austria**; Department of Animal Health and Production (FAO), **Italy**; UNEP-GEF, **Kenya**; UNDP, **Mali**; UNDP-GEF, **Senegal**; Banque Africaine de Développement (BAD/AfDB), **Tunisia**

Private Sector: Merial PLC, SVANOVA Biotech AB, AGEN Biomedical, Pevion, VMRD (Veterinary Medical Research and Development Incorporated)

Project 4: Biotechnology

	Outputs	Intended User	Outcome	Impact
(ILRI Project 4) Output 1	New/improved vaccines and diagnostics developed (Africa and Asia) (3–5 years)	Livestock farmers; Departments of veterinary services; Private sector , NARS and ARI researchers	Reduced mortality and improved livestock productivity	Livestock assets of the poor secured
Output targets 2006	Proof of concept for schizont ECF vaccine demonstrated in animal trials	ILRI, NARS in Eastern and Southern Africa & ARI researchers; Private Sector companies	Experimental vaccine in use in pilot field trials; vaccine efficacy data publicised in bulletins, reports and in peer-reviewed journals.	Capacity of NARES in product development enhanced.
	A diagnostic antibody detection test for trypanosomes developed and validated (using experimental sera)	INARS & ARI researchers; Private sector companies	Diagnostic antibody detection test in use in field trials	Capacity of NARES in product development enhanced.
Output targets 2007	Protocols for field trials of an ECF vaccine developed and the vaccine field-tested.	NARES in eastern and southern Africa , and ARI researchers; Private Sector firms	Use of vaccine following promotion through public awareness meetings and dissemination of project results through publications, including reports to national governments, NGOs, NARS, private vets, private sector, farmers, ARI's & IARCs.	Increased income and improved livelihoods of livestock keepers
	A field tested diagnostic kit for trypanosomes available for use	NARES, and ARI researchers; Private Sector firms	Expanded use of vaccine following wider promotion and increased awareness generated through early adopters	Increased income of farmers
Output targets 2008	Protocols for an ECF vaccine licensing/registration developed and applied and vaccine launched for field use	Livestock keepers, NARES and Private sector	ECF vaccine is in use by livestock keepers in all endemic areas resulting in reduced ECF-related mortality and morbidity	Increased income of farmers and improved environmental health resulting from reduced animal losses and acaricide use in ECF-endemic areas of eastern and southern Africa
	Proof of concept for tick vaccine candidates demonstrated and made available to guide commercial production of a tick vaccine	ILRI, NARES & ARI researchers; Private sector companies	An experimental tick vaccine. The vaccine efficacy data publicised in bulletins, reports and in peer-reviewed journals.	Capacity of NARES in product development enhanced.
(ILRI Project 4) Output 2	Output 2; Adaptive traits and genes identified and characterised, their potential role	Livestock keepers by way of Animal breeders, NARES and ARI research.	Improved animal genotypes with better performance (reduced mortality, more productive) and new, novel, gene intervention	Increased farmer income and farmers' herds/flocks secured

	Outputs	Intended User	Outcome	Impact
	in breeding programs assessed, and breeding strategies appropriate for low input smallholder systems developed (Africa and Asia) (3–4 years)		strategies.	
Output targets 2006	Gene expression studies in one trypanosome species (<i>T. congolense</i>) in the mouse and cattle completed and results available for use in design of gene discovery research	ILRI, NARS and ARI scientists working on host/pathogen interactions	Improved understanding of the disease process to inform design of subsequent studies	
	One pilot study of field relevance cattle trypanotolerance QTL completed as an input into the development of a strategy for QTL utilisation in breeding programs.	ILRI, NARS and ARI scientists working on host/pathogen interactions	Improved understanding of performance of characterised genotypes used to plan future gene discovery research and utilisation strategies	
	Fine mapping of helminthosis resistance genes in mice completed and results available for use in the sheep QTL mapping research	ILRI, NARS and ARI scientists working on host/pathogen interactions	Improved ability to interpret results of QTL mapping for gastro-intestinal nematode resistance in sheep	
Output targets 2007	Trypanotolerance candidate QTLs/polymorphisms identified and promising ones short-listed for functional investigation.	Livestock keepers, NARS and ARI scientists, especially animal geneticists/breeders	Genes and polymorphisms with field significance to trypanotolerance short-listed for functional investigation	
	Farmers' genotype/trait preferences documented and used to inform selection criteria in breeding strategies	Livestock keepers by way of breeders, NARS and ARI researchers	Improved animal genotypes with better adaptation and productivity	Increased farmer income and farmers' herds/flocks secured through use enhancement of tolerance in herds
	Framework for a breeding strategy available and first pilot breeding project initiated and running in West Africa			
Output targets 2008	Mechanisms/gene action involved in trypanotolerance elucidated	Scientists in NARS and ARI studying host/pathogen interactions	Information on mechanisms/gene action used to design breeding strategies and to inform	Increased income of farmers in

	Outputs	Intended User	Outcome	Impact
			vaccine/drug discovery research	trypanosomosis-endemic areas through improved control of the disease
(ILRI Project 4) Output 3	Output 3: Genetic diversity in indigenous AnGR quantified, its distribution mapped and strategies for conservation and enhanced use developed (Africa and Asia)(5–6 years)	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility; NGOs; private sector (breeding companies and breed societies)	Enhanced use of promising, indigenous AnGR in breeding programs	Diversity in livestock assets of the poor secured and livelihoods improved through improved use of promising breeds/traits
Output targets 2006	Centres of origin of genetic diversity of African and Asian chickens identified (mtDNA level) and distribution of diversity in African goat mapped	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility; private sector (breeding companies and breed societies)	Improved Conservation and utilisation strategies for chickens in Africa and Asia developed	Diversity in livestock assets of the poor secured
	Domestic AnGR Information System (DAGRIS) expanded to cover Asia and information on chickens included	Educators, livestock keepers and breeders, NARES, private sector	Information on chickens (and other AnGR) available on the web and CD-ROM for use in designing breeding programs	Livestock assets of the poor secured through enhanced use
	Distribution of diversity in African goat populations mapped	NARES, ARIs, policy makers, livestock keepers, FAO, Global Environment Facility, private sector (breeding companies and breed societies)	Diversity hotspots for goats in Africa (i.e. geographical locations, breeds, populations) identified and the information used in developing conservation and utilisation strategies	Livestock assets of the poor secured through enhanced use
Output targets 2007	DAGRIS functionality expanded to include GIS information, starting with African cattle populations	Educators, livestock keepers and breeders, NARES, private sector	DAGRIS as a decision-making tool linking livestock diversity information with agro-ecological data, facilitating spatial and temporal analyses	
	Distribution of genetic diversity of African sheep genetic resources mapped	Educators, livestock keepers and breeders, NARES, private sector	Diversity hotspots (geographical locations, breeds, populations) for sheep in Africa identified to inform conservation and use strategies	Livestock assets of the poor secured through enhanced use
Output targets 2008	Polymorphism of disease resistance candidate genes of the MHC (geneomic region) in Asian rural chicken populations mapped.	Chicken breeders (NARES and private sector); rural chicken keepers	Candidate chicken populations associated with disease resistance identified as first step in breeding for disease resistance	Livestock assets of the poor secured through enhanced use

	Outputs	Intended User	Outcome	Impact
	Scope of DAGRIS expanded in Asia and information on Asian pig populations included	Educators, livestock keepers and breeders, NARES, private sector	Information on pigs (and other AnGR) available on the web and CD-ROM for use in designing breeding programs	Livestock assets of the poor secured through enhanced use
	A framework for community-based management of AnGR developed and tested (Benin, Kenya, Ethiopia)	Educators, livestock keepers and breeders, NARES, Development Agencies, policy makers, NGO	Empowerment (through provision of critical information) of local communities for sustainable use of AnGR	Livestock assets of the poor secured through enhanced use

Project (Theme) 5: People, livestock and the environment

Project narrative

Project description

This project seeks to respond to the increasing pressure on the natural resources that sustain the livelihoods of poor people and to provide livestock-based options to increase agricultural productivity. It also aims to promote integrated natural resource management strategies suitable to the resource endowment for a range of stakeholders that will ultimately contribute to reducing poverty. By using and developing holistic, integrated approaches, project activities focus on enhancing the role of livestock in contributing to the sustainable livelihoods of poor households, in particular the natural resource and human health assets. The research explores five areas of opportunity, and within these includes strategies to learn generic lessons from past and ongoing research in specific hotspots in terms of agricultural systems and geographic regions. These five areas can be summarised as follows: options to address and to better understand the opportunities and challenges emanating from livestock and water interactions, where livestock may help to improve the overall productivity of water if appropriately managed; the multiple roles of livestock in systems undergoing dynamic changes; feeding strategies and the related potential for increased livestock contribution (e.g. through manure) to intensifying crop–livestock systems; forage diversity; and, largely through a facilitative and catalytic role, understanding the positive contributions (e.g. in child nutrition and in mitigating HIV/AIDS) and negative impacts (particularly through zoonoses and other issues in urban areas) of livestock to human health. For all these areas, approaches designed to address the needs of a range of end users in existing and emerging systems are used and the project works with a diversity of partners, often playing a facilitative and brokering role for new partnerships.

Rationale

In many parts of the World, burgeoning populations, trends towards urbanisation and changing market economies are placing new demands on small scale farmers, their livestock, and the environments in which they subsist. Such changes also present opportunities which include providing options that can help farmers to respond to such dynamism in ways that enable them not only to benefit from the new demands for livestock and their products, but to do so in sustainable ways that contribute to their livelihoods. This project addresses research at the interface of people, their livestock and their environment where systems are undergoing transition in order to provide enhanced understanding and new solutions to the challenges presented. When there are such dynamic changes, stakeholders are more likely to respond positively to new options. Demands for agricultural water are increasing. Our research seeks to develop tools to enhance understanding of the potential of livestock to contribute to water productivity, and to provide new options to enhance such benefits. In systems facing transitions because of diverse pressures on land resources, especially pastoral and agro-pastoral systems, there are opportunities to develop new ways of sharing information and approaches with the diverse groups of stakeholders often involved in such transitions, where livestock may have a role to play in facilitating smooth transitions and providing ecosystem services. Feeding livestock and balancing their needs with increasing demands for agricultural land has resulted in research directed at improving the fodder quantity and quality from food crops. This needs also to consider feeding strategies and balancing livestock feed options with other demands for crop biomass, as well as other roles of livestock such as the provision of manure. Forage resources may fulfil specific niches that enable farmers to respond to new market demands for livestock products and having databases and information on forage species is designed to enhance the access of different partners to such materials. Opportunities for livestock to contribute to human well being are being studied through literature review and a pilot study, and such aspects also need to be balanced with improved understanding of potential detrimental human health effects, especially in relation to urban agriculture.

Specific objectives

- To better understand livestock–water interactions and develop livestock-related options for improved management, use and conservation of water in SSA and Asia.
- To define strategies and processes for better management of livestock in agro-pastoral and pastoral systems to improve and sustain livelihoods of the poor in SSA and Asia

- To identify strategies to reduce health risks and improve nutritional benefits associated with livestock keeping
- To develop approaches for improved feeding options and natural resource management in intensifying crop–livestock systems in SSA and Asia
- To save, study and use forage diversity to contribute to agricultural sustainability of smallholder farming systems

Studies on livestock and nutrient cycling and the role of livestock in intensive production systems, are not included in the current research portfolio because there are other players engaged in these areas. ILRI will continue to liaise with such players to ensure that appropriate opportunities, should they arise can be developed in the future. It is also important to note that the objectives focus on the livestock aspect, but frequently involve partnerships with others who have capacities in, for example, water management, integrated natural resource management, human health and nutrition, crop breeding.

Links to CGIAR system priorities

Research on water–livestock interactions, and on livestock roles in land use change relate in particular to system priority 4, *Poverty alleviation and sustainable management of land, water and forest resources*, and also have potential linkages to system priority 2 *Producing more and better food at lower cost through genetic improvements*, with respect to the potential of, for example improved food–feed crop varieties as well as to system priority 5, *Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger*. Human health and livestock nutrition research is cross cutting in terms of the system priorities and relates to system priorities 3b *Income increases from livestock* and system priorities 4 and 5. Forage diversity work is at the core of system priority 1, *Sustaining biodiversity for current and future generations*, especially sub-priority 1b *Promoting conservation and characterisation of under-utilised plant genetic resources to increase the incomes of the poor*. Research on feeding options and mitigating feed scarcity links to system priority 2, especially the research undertaken on food–feed crops, and increasingly, with the agenda moving towards a more holistic systems approach, to resource management issues as elucidated in system priority 4.

Output implementation strategy

Development of livestock-related options for improved management, use and conservation of water necessitates an improved understanding of the role of livestock in relation to agricultural water productivity. The project aims to do this both by developing a framework for water productivity in relation to livestock, and by using this together with information on livestock–water investment options, to bring livestock to the fore in the agricultural water agenda. Sharing such approaches with local, national, regional and international partners, especially in the context of the Challenge Program on Water and Food (CPWF) will allow for validation of the framework, which is first being undertaken in the Nile Basin,. Alongside the increased understanding of such technically focused issues, related policy issues will also be explored. Bringing this information together for SSA will generate preliminary approaches and lessons that may also be used in other regions.

For livestock systems undergoing dynamic changes especially in land use, there are new opportunities for improved natural resource management. This research aims to understand how such changes impact on ecosystem services and especially the role of livestock within these, together with potential trade-offs that need to be considered if such systems are to be improved. Beginning in east and west Africa where there are established partnerships and projects, such understanding will be, through working with stakeholders and communities, translated into policies and strategies that can be evaluated for improved livestock husbandry and integrated natural resource management. Such evaluations will lead to options that may be tested in wider areas of east and west Africa, and taken up by other stakeholders. Likewise, the generic lessons and approaches can be considered in contributing to similar studies in Asia and in bringing together globally relevant lessons.

Strategies to reduce health risks and improve nutritional benefits associated with livestock keeping require a dual approach to investigate the positive and negative aspects. For the former, a combination of literature reviews and case studies will be implemented to identify generic issues in terms of the role

of livestock and animal source foods in human nutrition, and specific options for Ethiopia, which, combined with broader understanding will then be translated into strategies for, initially, other locations in east Africa. A particular positive aspect of livestock products to be considered will be the role in mitigating directly or indirectly the effects of HIV/AIDS. ILRI's role here is mostly facilitative and catalytic, aiming to provide research partners with information to orient research. The negative aspects of livestock and human health will focus on urban areas in terms of developing appropriate participatory risk analysis frameworks and methodologies. Cysticercosis is a particular zoonosis that is inherently self-targeting to poor people and efforts to develop a global campaign for this disease will not only lead to specific products that address this issue, but also to an increased understanding of the strategies, institutional partnerships and roles needed to address other zoonoses.

Intensifying crop–livestock systems, especially in South Asia and SSA present new challenges in terms of feed requirements for livestock and opportunities for the livestock to contribute to integrated natural resource management. Research already underway to develop approaches to identify improved food–feed crops, and increase the availability of such genotypes will be built upon through collaboration with Project 1 to target such research in the future in relation to potential impact. The implementation and partnerships here are closely linked to the SLP. Identification of systems and regions together with appropriate strategies (together with Project 2) for partnerships will further contribute to improved options for both feeding and natural resource management.

In order to ensure that the forage diversity for which ILRI has a global responsibility is saved, studied and used to contribute to agricultural sustainability of smallholder farming systems, our strategy includes ensuring that the material is managed to international genebank standards, that clean planting material is available for distribution and that an appropriate duplicate collection is established for safekeeping. With this basis, information on the material will be increasingly made available to diverse end users and will work together with Project 2 to develop innovations to facilitate access to fodder resources by partners. Information on the forage resources will also contribute to a global catalogue of such material.

Strategy for output–outcome logic

In order to be effective in delivering outputs, it is important to choose carefully with whom, how and where the research is implemented. The choice of where is based on changing livestock systems where there are good opportunities for new livestock-based interventions to make a difference, and often a need to better understand the role of livestock in such systems. This in turn provides generic lessons, approaches and at times technologies that may be subsequently adapted and applied in other regions where similar systems begin to undergo change. In relation to rapidly changing environments, opportunities and challenges, innovation systems approaches are essential to ensure that diverse groups of stakeholders are able to respond as the systems change. For many of the research topics included within Project 5, this necessitates close collaboration with Project 2.

Research on livestock water interactions focuses on the Nile Basin in the first instance, and includes at least three different systems within this region. Collaboration with Project 1 is important in domain delineation. The project contributes to the CPWF which provides a vehicle for interactions with partners both within the Nile Basin, and subsequently to other water basins and beyond. At the local level, the research engages with NARS and NGOs, enabling players here to include appropriate livestock based strategies in their water productivity agendas.

ILRI's research in East and West Africa is providing opportunities to learn lessons from different approaches used in the two regions, to identify commonalities that may then be applied elsewhere. Understanding spatial dimensions of land use change links to Project 1 skills. Research on sustaining lands and livelihoods implemented with NARS, ARI and CG partners, involves local engagement with policy makers and working with communities on aspects of ecosystem services. Livestock focused research on land and biodiversity management and on conflict, within the broader agenda of the Desert Margins Programme facilitates other local and international partners to better integrate livestock aspects into development strategies.

Human health and livestock interactions necessitates new partnerships with medical and nutrition agents as well as veterinary partners (and thus links to Project 4) with ILRI playing a facilitating role in most instances. In urban areas, working together with, for example the Urban Harvest initiative, to engage

municipal authorities is also important. Discovering new institutional relationships and mechanisms is important in bringing the livestock perspective to the human health agenda. Linking this research to policy and food safety issues, as well as risk analysis, entails collaboration with Project 3.

Research on mitigating feed scarcity and increasingly on the natural resource management issues that emerge from a systems approach in this area focuses on crop–livestock systems, especially in South Asia and West Africa where the systems are intensifying rapidly. In this context, important strategies include influencing private and public suppliers of germplasm to make dual purpose varieties available and provide rapid screening tools for selecting feed traits, working together with grass-roots organisations to understand how knowledge can be shared and ensure that farmers’ perspectives influence our research (with Project 2). Working together with Project 1, will help to better target regions and systems for such research. Many of the collaborative ventures in this research area are also closely integrated with the System-wide Livestock Programme.

Ensuring that forage genetic resources are available and accessible to end users involves working together with other CG and ARI partners in the context of global public goods, sharing of knowledge and ensuring appropriate genebank standards. Working with local partners to better understand the needs of end users—be they national genebanks, or development partners seeking forage solutions—is also important here. Again, links with the System-wide Livestock Programme are important.

External conditions

Addressing research so that major changes taking place in livestock systems are translated into positive benefits for the poor means working with both conventional, but also new groups of partners who may contribute to the driving forces in these changing systems. Research on livestock and water engages a new range of partners, including NARS, CG centres and advanced institutions who had not previously worked together. Working together with community groups and local policy makers becomes more important for livestock–environment issues. New ways of engaging with those involved in the private sector and in seed production and input supply services as well as NARS, extension services and NGOs features strongly in research addressing aspects of feed resources. New strategies involving health agents and municipal authorities at local levels are needed for the research on livestock and human health.

Because of the strong interactions with NARS and other national partners for much of the research implemented in Project 5, their continued (and perhaps increased) interest and ability to participate are key ingredients in ensuring the aims of the research are achieved—working together in new and innovative partnerships and finding different ways of working that are needed to respond to dynamic systems is a new challenge to be addressed. It is anticipated that such will be further strengthened through participation in initiatives at regional and sub regional levels, for example, the development of sub-regional MTPs in SSA. Availability of funding for staff and for specific projects is in many cases a key component, and clearly will increasingly relate to the system priorities, and the links to these have been explained above.

Collaborators

Other CG centres

CIAT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, IPGRI, IRRI, IWMI, WARDA, World Fish

SWPS/ERPs, CPs

Challenge Program on Water and Food (CPWF), CG Climate Change Working Group, Collective Action and Property Rights (CAPRI), Desert Margins Programme (DMP), Rice–Wheat Consortium (RWC), System-wide Genetic Resources Programme (SGRP), System-wide Livestock Programme (SLP), System-wide Initiative on Malaria and Agriculture (SIMA), Urban Harvest, Sub-Saharan Africa Challenge Program (SSA CP).

NARS (including NGOs and Private Sector)

Institut de L'Environnement et des Rescherches Agricoles (INERA), **Burkina Faso;**

Ada Liben Wereda Dairy Cooperative, Addis Ababa University (AAU), Alemaya University of Agriculture, CARE-Ethiopia, Ethiopia Health & Nutrition Research Institute, Ethiopian Agricultural

Research Organization (EARO), Mekelle University, Oromia Agricultural Research Organization, Oromia Bureau of Agriculture, Oromia Bureau of Natural Resources Management, SASAKAWA Global 2000, The Ethiopian Rainwater Harvesting Association, **Ethiopia**;
 Animal Research Institute, **Ghana**;
 Andhra Pradesh Rural Livelihoods Project, Angaru Agricultural University, ANTHRA, BAIF Development Research Foundation, CCS Haryana Agricultural University (HAU), Indian Council of Agriculture Research, Indian Veterinary Research Institute, National Dairy Development Board (NDDB), National Research Centre for Sorghum Indian Directorate of Rice, Rural Development Trust, **India**;
 African Wildlife Foundation, Department of Resource Surveys and Remote Sensing (DRSRS), Friends of Nairobi National Park, Kenya Agricultural Research Institute (KARI), Kitengela Landowners Association, University of Nairobi, **Kenya**;
 Centre Régional de formation et d'application en agrométéorologie et hydrologie opérationnelle (AGRHYMET), Institut National de Recherche Agronomiques du Niger (INRAN), **Niger**
 Abeokuta University of Agriculture, Ahmadu Bello University, Bauchi State Agricultural Development Project, Federal Livestock Department, Institute for Agricultural Research (IAR),
 Justice, Development and Peace Commission (JDPC), Kaduna State Agricultural Development Project (KADP), Lake Chad Research Institute, National Animal Production Research Institute (NAPRI), National Livestock Projects Division (NLPD), National Water Resources Institute, University of Ibadan, **Nigeria**;
 Agricultural Research Council (ARC), **South Africa**;
 Ministry of Science and Technology (MOST), **Sudan**;
 African Wildlife Foundation, Sokoine University, Tanzania National Parks (TANAPA), Tanzania Wildlife Research Institute, **Tanzania**;
 Livestock Research Institute (LIRI), Makerere University, National Agricultural Research Organization (NARO), The Ugandan Rainwater Harvesting Association, **Uganda**.

ARIs

Commonwealth Scientific and Industrial Research Organization (CSIRO), **Australia**;
 UC Louvain University, **Belgium**;
 Guelph University, **Canada**;
 Danish Bilharziasis Laboratory, Royal Veterinary and Agricultural University of Denmark, Danish Institute of Agricultural Sciences, **Denmark**;
 Germany's Ministry for Economic Cooperation (BMZ), University of Hohenheim, **Germany**;
 Wageningen Agricultural University, ITC, **The Netherlands**
 Swiss Federal Institute of Technology, Swiss Tropical Institute, **Switzerland**;
 Centre for Tropical Veterinary Medicine (CTVM), Macaulay Land-Use Research Institute, Rothamsted Research, University of Edinburgh, UC London University, University of Reading, **United Kingdom**;
 Colorado State University, Cornell University, University of Maryland, Montana State University, Harvard University, University of Oklahoma, University of Wisconsin, **United States of America**.

Regional organisations

Asia Pacific Association of Agricultural Research Institutions (APAARI), Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), AU-IBAR, Cysticercosis Working Group for Central and Southern Africa, The African Highlands Initiative, The Comprehensive Assessment of Water Management in Agriculture (CAWMA),

International organisations

World Health Organization (WHO), Food and Agriculture Organization (FAO), United Nations Environment Programme, World Bank

Project 5. People, livestock and the environment

	Outputs	Intended User	Outcome	Impact
(ILRI Project 5) Output 1	Livestock-related options for improved management, use and conservation of water in SSA and Asia Links: CGIAR Challenge Program on Water and Food			
Output targets 2006	Livestock–water productivity framework developed and tested for key systems in the Nile Basin	Participants, partners and beneficiaries in the CGIAR Comprehensive Assessment of Water Management and Agriculture; CG, ARI and NARS researchers	Information on livestock water productivity effectively used by stakeholders to develop sustainable management schemes	Improved livelihoods of farmers in Nile Basin countries resulting from increased agricultural production from available water
	Methodology for assessing livestock water productivity tested at local, national and regional levels in the Nile Basin.	Participants, partners and beneficiaries in the CGIAR Challenge Program on Water and Food (CPWF); CG, ARI and NARS researchers	Methodologies used to characterise livestock use of and impact on water resources in the Nile Basin.	Reduced vulnerability of farmers depending on water resources in Nile Basin resulting from improved sustainable water–livestock management options
	Policy and investment options to enhance the benefits of integrated livestock–water management in the Nile Basin identified and documented	Policy makers and development agencies, investment institutions with particular emphasis on agricultural water development	Improved policies for integrated livestock–water management developed for the Nile Basin.	Improved use of water resources for sustainable livestock production by farmers in the Nile Basin
Output targets 2007	Impacts of livestock on water resources in the Nile Basin evaluated and documented	Participants, partners and beneficiaries in the CGIAR Comprehensive Assessment on Water Management and Agriculture and the CPWF	Information on livestock water resources and interactions effectively used to improve coherence and integration of research and development efforts in the Nile Basin	Increased livelihood options for farmers with livestock in the Nile Basin
Output targets 2008	GIS decision support tools to assess livestock–water interactions made available	Policy makers and regional organisations	GIS tools used to target appropriate policy options for improved and sustainable livestock water productivity in the Nile Basin	Improved livestock water production in Nile riparian countries and scaled out to other CPWF benchmark basins.
	Methodologies and approaches to address technical and policy research and development issues for livestock water management	Participants, partners and beneficiaries in the CGIAR Challenge Program on Water and Food (CPWF); CG, ARI and NARS	A range of methodologies and approaches used by partners to develop research and development strategies for livestock water	Improved livestock water production options for farmers in SSA and Asia

	Outputs	Intended User	Outcome	Impact
	made available	researchers	management in SSA and Asia	
(ILRI Project 5) Output 2	Defined strategies and processes for improved land and water management in smallholder livestock systems undergoing dynamic change in SSA and Asia Strategies to better manage livestock in agro-pastoral and pastoral systems to improve and sustain livelihoods of the poor in SSA and Asia outlined Links: DMP			
Output targets 2006	Changes in pastoral livelihoods and livestock related ecosystem services in east and west Africa assessed and documented	NARS, ARI and CG researchers, community organisations and policy makers	New information on changes in pastoral livelihoods and ecosystem services effectively used by key stakeholders to develop alternative land use options	Enhanced pastoral livelihoods due to sustainable land management by community land managers in east and west Africa
	Impacts of improved livestock based natural resource management for the pastoral poor in east Africa analysed and documented	Researchers, policy makers, community members	New policies and management options developed for pastoral people in east Africa	Poor pastoral people in east Africa benefit from improved natural resource management
Output targets 2007	Policy implications of changes in pastoral livelihoods and livestock based ecosystem services in east and west Africa evaluated and documented	NARS, ARI and CG researchers and community organisations	Move effective strategies and policies for livestock and land use management systems developed for dynamic pastoral systems	Improved livelihoods for livestock keepers in changing pastoral systems in east and west Africa
	Interventions to improve livestock husbandry and sustainable land management in east and west Africa developed and tested	Community organisations, NGOs, researchers	Researchers, NGOs and community members evaluate and utilise alternative options for livestock husbandry and sustainable land management.	Communities in east and west Africa benefit from improved livestock husbandry and land management
	Livestock–environment–livelihood issues affecting the poor dependant on livestock assessed and documented at different levels of scale	Policy makers, investment institutions, development agencies, researchers	Information on livestock–environment–livelihood issues used to develop appropriate planning and funding scenarios for research and development	Sustainable livelihoods and land management improved in at-risk systems because of more targeted and efficient strategies that balance livestock–environment–livelihood

	Outputs	Intended User	Outcome	Impact
				needs
Output targets 2008	Options for enhancing livestock-mediated strategies for sustainable management of natural resources and conflict management under scenarios of changing land use in east and west Africa evaluated	NARS, ARI and CG researchers. Community organisations, policy makers	Improved options for livestock-based mediation of natural resource management and balanced conflict resolution developed	Reduced conflict in smallholder livestock systems undergoing dynamic changes in east and west Africa
	Scientific information needed to evaluate changes in pastoral livelihoods and livestock based ecosystem services in Asia assessed	NARS, ARI and CG researchers. Community organisations, policy makers	New information on changes in pastoral livelihoods and ecosystem services effectively used by key stakeholders to develop alternative land use and livelihood options in Asia	Improved livelihoods for farmers in changing ecosystems in Asia
(ILRI Project 5) Output 3	Strategies to reduce health risks and improve nutritional benefits associated with livestock keeping Links: Urban Harvest			
Output targets 2006	Appropriate research framework and methods for assessing health risks associated with African based intensive urban livestock activities and designing mitigation strategies tested and documented (*in collaboration with Project 3)	NARS researchers (university and public medical and veterinary); international medical and development agencies; municipal policy makers and interest groups	NARS researchers and policy makers use methodology based on risk analysis and participatory approach to address health risks associated with urban livestock activities	Urban livestock activities in SSA contribute as livelihood opportunities for the poor while minimising potential human health risks
	Relative importance of individual livestock diseases and syndromes in terms of their impact on the poor in Sub-Saharan Africa evaluated (*in collaboration with Project 1)	Regional and international development and donor agencies; national research policy makers	Decision makers used improved information on relative importance of livestock diseases and syndromes to guide investment in veterinary research and development to maximise impact on poverty reduction in SSA	Improved health among the poor in communities keeping livestock in Sub-Saharan Africa
Output targets 2007	Potential critical contribution of animal-source foods (ASF) to child nutrition in the Ethiopian highlands documented Appropriate nutrition education messages and livestock-based	Health agents (government ministry; NGOs and international health agencies) and development agents (government ministry; NGOs and international development agencies)	Nutritional messages encouraging strategic use of ASF especially for young children developed and disseminated in Ethiopia Appropriate interventions based on raising of small and micro-livestock	Increased use of ASF in child diets contributing to improved nutritional and health status in Ethiopia

	Outputs	Intended User	Outcome	Impact
	strategies to enhance impact of ASFs in child nutrition in Ethiopia formulated		promoted to enhance sustainable, continuous access to ASF	
Output targets 2008	<p>Potential critical contribution of animal-source foods (ASF) to child nutrition among East African urban poor documented</p> <p>Appropriate nutrition education messages and livestock-based strategies to enhance impact of ASFs in child nutrition in east Africa formulated</p>	Health agents (government ministry; NGOs and international health agencies) and development agents (government ministry; NGOs and international development agencies)	<p>Nutritional messages encouraging strategic use of ASF for young children developed and disseminated in east Africa</p> <p>Appropriate interventions proposed based on raising of small and micro-livestock promoted to enhance sustainable, continuous access to ASF</p>	Increased use of ASF in child diets contributing to improved nutritional and health status in east Africa
	<p>Information on role of animal-source foods (ASF) to orient research priorities for medical care of persons with HIV/IDS understood and documented</p> <p>Appropriate nutrition education messages and livestock-based strategies to enhance impact of ASFs on persons with HIV/AIDS formulated</p>	Health agents (government ministry; NGOs and international health agencies) and development agents (government ministry; NGOs and international development agencies)	<p>Nutritional messages encouraging strategic use of ASFs as components of an integrated treatment for HIV/AIDS widely disseminated;</p> <p>Appropriate interventions proposed to support HIV/AIDS-affected households based on raising of small and micro-livestock promoted to enhance sustainable, continuous access to ASF</p>	Increased use of ASF by persons with HIV/AIDS contributing to improved nutritional and health status, with substantially delayed onset of disabling symptoms of AIDS and death
	<p>Assessment of extent and impact of cysticercosis</p> <p>Methodology for an integrated veterinary-medical disease burden assessment for cysticercosis</p> <p>A generic model for partnerships and processes to orient research on zoonoses of the poor developed</p>	NARS researchers (university and public medical and veterinary); international agricultural, medical and development agencies; national and international policy makers	Researchers and policy makers at national and international levels as well as potential investors and funding agencies, develop improved control efforts for cysticercosis	Global promotion of integrated control measures leads to reduced incidence—and possibly even eradication—of cysticercosis, improved public health, as well as improved incomes for pig producers and market agents
(ILRI Project 5) Output 4	Approaches defined for mitigating feed scarcity and improved feeding options in intensifying crop–			

	Outputs	Intended User	Outcome	Impact
	livestock systems in SSA and Asia Links: SLP, RWC,			
Output targets 2006	Approaches and criteria for food–feed crop selection for cowpea, groundnut, pigeon pea, maize, sorghum, pearl millet and rice in crop livestock systems in SSA and Asia identified	National and international public and private crop improvement agencies; cultivar releasing agents	Crop breeding and cultivar releasing agents include fodder value of crop residues in breeding, selection and release programs	Improved livelihoods for farmers having access to improved dual purpose varieties of key crops
	Improved food–feed crop genotypes for 5 major crops in Asia/SSA	Public and private seed multipliers Extension agents and NGO's	New varieties with improved fodder included in seed multiplication and dissemination efforts	Improved livelihoods for farmers having access to improved dual purpose varieties of key crops
Output targets 2007	Methodology/framework for understanding and targeting feed options in Asia and SSA made available	Researchers Policy makers Extension agents and NGO's	Framework used to inform decisions about research and development efforts for feed resources and systems	Sustainable and productive options enhance livelihoods of farmers in Asia and SSA through adoption of appropriate feed resources
Output targets 2008	Systems-based approaches to mitigating feed scarcity in changing crop livestock systems in Asia and SSA developed and tested	Researchers, extension agents and NGO's	System based approaches used to improve productivity and sustainability of mixed crop livestock systems	Improved and sustainable livelihoods for farmers in intensifying crop–livestock systems
(ILRI Project 5) Output 5	Forage diversity saved, studied and used to contribute to agricultural sustainability of smallholder farming systems Links: SLP, SGRP			
Output targets 2006	17,000 forage accessions safely conserved, documented and available as global public goods under the International Treaty on Plant Genetic Resources for Food and Agriculture	CGIAR Centres, ARIs, NGOs and NARS forage research and development officers	Stakeholders use improved access to and information on forage resources to improve productivity and sustainability of farming systems	Improved productive and sustainable farming systems resulting from increased availability of forage resources
	Planting material of adapted forages for scaling up of farmer-preferred forages available	NGOs, NARS forage research and development extension workers, farmers	Improved forages multiplied and disseminated for use to improve livestock productivity	Improved livelihoods for farmers having access to improved forages

	Outputs	Intended User	Outcome	Impact
Output targets 2007	Databases, decision support tools and training materials for improving conservation, management and use of forage diversity developed	National genebanks	New improved access to and conservation, management and use of forage diversity	Efficiency and cost effectiveness of management of forage germplasm improved
Output targets 2008	Global catalogue of forage germplasm to improve access, support improved use and enhance adoption of forages available	ARIs, NGOs and NARS forage research and development extension workers	Information and germplasm is effectively used to contribute to improved, sustainable smallholder livestock systems	Improved, sustainable smallholder livestock systems resulting from increased access to forage resources

Project (Theme) 6: CGIAR Systemwide Livestock Programme

Project narrative

Project description

The CGIAR Systemwide Livestock Programme (SLP) is a multi-centre initiative that supports the CGIAR and Millennium Development Goals of alleviating poverty, achieving sustainable food security and protecting natural resources in the developing world. It provides a mechanism for the CGIAR system to gain efficiency in the use of its resources. The Programme seeks to add value to the outputs of individual CGIAR centres and their partners by creating and exploiting synergies on crop–livestock research to ameliorate feed scarcity in small scale crop–livestock farms.

Eleven centres (CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI and IWMI) and their local and international partners constitute consortia to devise research-based solutions to ameliorate feed scarcity in crop–livestock systems through: a) better targeting opportunities for feed interventions, b) developing superior dual purpose (food and feed) crops, c) developing livestock feeding strategies based on the efficient use of land, water, soil nutrients, food–feed crops, forages and agro-forestry options, and d) identifying institutional innovations to build the capacity of networks of providers of feed-related services and technologies to poor crop–livestock producers.

Beyond its research program, the SLP serves as a system-wide focus for information and knowledge exchange on crop–livestock systems. Approximately 20% of the SLP budget is allocated to information and knowledge exchange through its website <http://www.vslp.org> and through joint publications.

Rationale

As agriculture in the developing world intensifies in response to the increasing demand for food, small scale farmers integrate crop and livestock production as a way to use their resources efficiently. In mixed crop–livestock systems livestock are a means for improving farm productivity, income and market opportunities and overall household livelihoods. Lack of feed in sufficient quantities and of adequate nutritional quality is a broadly distributed factor that limits the ability of crop–livestock producers to reap fully the benefits of their livestock assets. Without appropriate feed innovations, producing the feed required to meet the increasing demand for meat, milk and eggs will result in further degradation of the natural resources that sustain the livelihoods of the rural poor.

Feed resources is an area in which Centres can collectively add value to their individual research. Although the eleven Centres are involved in the development of an integrated and coherent CGIAR-wide research program, their individual contribution to specific objectives and outputs depends on their main areas of expertise. Crop and forestry Centres provide the basic building blocks through their germplasm improvement and distribution programs. ILRI provides expertise on feed traits required for superior dual purpose crops as well as an overall livestock innovations perspective. Non-crop Centres such as ICRAF, IWMI and IFPRI add expertise in natural resource management and policy/institutional analysis to improve the sustainability and impact of feed resource improvement. In 2006 and beyond, the SLP will extend its focus on feed systems to look at the tradeoffs between the removal of crop residues for use as livestock feeds and their recycling for soil improvement in conservation agriculture strategies. This will allow the SLP to provide additional value to existing Centres activities in crop–livestock systems for both poverty alleviation and sustainable production.

Specific objectives

Through consortia involving CGIAR Centres and their partners, the SLP seeks to ameliorate feed scarcity in small scale crop–livestock systems by:

- Developing and applying approaches to identify systems and areas with large feed deficits and to assess *ex-ante* the potential impact of alternative feed interventions.

- Selecting superior cultivars of food–feed crops and exploiting sources of genetic variability for further improvement.
- Developing feeding strategies based on the efficient use of land, water, soil nutrients, food–feed crops, agro-forestry options and forages.
- Devising generic approaches to enhance the capacity and effectiveness of networks of institutions involved in feed innovations.

Links to the CGIAR system priorities

By developing novel approaches to screen crop germplasm for the nutritional value of their residues and applying these approaches in current crop genetic enhancement programs, the SLP contributes to the CGIAR System Priority 2, ‘producing more and better food at lower costs through genetic improvements’, and more specifically priority 2a (maintaining and enhancing yields and yield potential of food staples).

Introduction of agro-forestry options and forages in combination with food–feed crops to nourish livestock are common ways to diversify the use of land and sources of income for small scale farmers. By developing feed technologies to improve the productivity and competitiveness of poor livestock producers, the SLP contributes to the CGIAR System Priority 3, ‘reducing rural poverty through diversification and emerging opportunities for high value commodities and products’, specifically priority 3b (income increases from livestock).

The SLP develops ways to increase feed availability while maintaining or enhancing the productive capacity of the resources available to small-scale livestock-producers. The Programme aims at developing approaches to increase feed availability through the sustainable use of land, water and soil nutrients. In doing so it contributes to the CGIAR System Priority 4, ‘poverty alleviation and sustainable management of water, land and forest resources’, specifically priorities 4c (improving water productivity) and 4d (sustainable agro-ecological intensification in low- and high-potential areas).

The use of feed technologies to support social and economic change in developing countries is hampered by the lack of effective networks of institutions that make these technologies and other related inputs respond to the needs of small scale farmers. By studying the processes involved in feed innovation systems and identifying options to enhance the capacity of relevant actors to meet these needs, the SLP supports the CGIAR System Priority 5, ‘improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger’, specifically priority 5d (improving research and development options to reduce rural poverty and vulnerability).

Output implementation strategy

The SLP targets key crop–livestock systems in areas with high numbers and densities of poor crop–livestock producers, across the range of regions where its participating Centres work. These include west and central Sub-Saharan Africa (WCSSA), east and southern Sub-Saharan Africa (ESSSA), south Asia (SA), south-east Asia (SEA), west Asia and north Africa (WANA) and Latin America and the Caribbean (LAC). In SEA the Programme targets sweet potato–pig and rice–ruminant systems, in SA it focuses on sorghum/millet–legume–dairy, in WCSSA on sorghum/millet–cowpea small ruminants, in ESSSA on maize–agro-forestry–dairy/small ruminants, in WANA on barley–legumes–range–small ruminants and in LAC on dual purpose cattle and crop–small ruminant systems in the Andes. Across these systems, the SLP conducts research in four areas related to feed development.

Targeting priorities for research on feed resources

Within crop–livestock systems numerous research alternatives exist that can be applied to improve access to and supply of feed resources. Objective and quantitative approaches are required to identify the opportunities that offer the greatest returns to investment in scientific development-oriented research. With a leading role of ILRI and with the involvement of CIAT, CIMMYT, CIP, ICRAF, IFPRI, IITA and their partners, this research uses spatial analysis and geographical information systems that integrate demographic, agro-ecological and agricultural

systems data, to identify hot spots with high feed deficits. Options for developing research-based solutions of international relevance are assessed *ex-ante* using a framework and model of crop–livestock systems. This research aims at identifying the research opportunities that offer the greatest potential for impact on poverty alleviation and sustainability. Once the framework and models developed in this research are validated, the Programme intends to use them to evaluate the research proposals for its new initiatives.

Improvement of food–feed crops

Staple crops are the primary source of livestock feed in small scale crop–livestock farms. They constitute a key entry-point for the improvement of mixed farming systems and also provide a unique opportunity to create and exploit system synergies. The SLP brings together crop breeding and animal nutrition scientists from partner institutions within specific social, economic and agro-ecological conditions to develop superior dual-purpose (food and feed) cultivars of the most important crops that sustain crop–livestock systems. The work conducted by CIMMYT, ICARDA, ICRISAT, IITA, ILRI, IRRI and their partners has focused on cereals (millet, sorghum, maize, rice) and legumes (cowpea, pigeon pea, groundnut, grass pea). It is envisioned that with leading roles of CIAT, CIP and IITA this work will expand to root and tuber crops (sweet potato, cassava). The research involves evaluating germplasm and crop breeding materials for feed quality traits using near-infrared reflectance spectroscopy. This methodology allows for the rapid and low-cost screening of large number of entries. Criteria for selection are developed and used to identify superior cultivars in the existing genetic base and sources of genetic variation are identified for further improvement through conventional and market assisted selection. Assessment of tradeoffs between food output and quality and quantity of feed guide the identification of options to maximise farm productivity. Intermediate users of research outputs will be the national and international research crop breeding programs and seed releasing agencies. Functional seed systems (both private and public) will play a key role in the delivery of research outputs to end users and beneficiaries (poor, small scale farmers). These systems exist already in some countries and are evolving in many others in response to intensification and market orientation of agriculture.

In developing countries food–feed crops provide grain, tubers and roots for human consumption as well as fodder/crop residues for feeding ruminant livestock and, in some cases, monogastrics. In these countries the use of cereals as livestock feed, mostly for monogastric animals, increased from 128 million tons in 1982 to 194 million tons in 1994. Projected trends estimate that by 2020 the use of cereal grains as feed in the developing world will amount 519 M tons without significantly increasing cereal prices. With a leading role of IFPRI and ILRI and involving CIMMYT, ICRISAT and their partners, the SLP envisions to conduct a study on the global trade of grain for use as livestock feed and its implications for small scale farmers and, in general, for developing countries.

Feed, livestock and sustainable use of natural resources

Meeting the increasing demand for meat and milk in developing countries in ways that poor livestock keepers benefit from their animal assets requires sustainable options to produce the feed required. Without proper technologies, feed production (and disposal of animal wastes) will impose a greater and severe stress on the already degraded natural resources of the poor. In the longer term, this process can result in lesser opportunities for enhancing the livelihoods of small scale farmers. The SLP conducts research to develop the strategies and technologies required to reverse this down-spiral cycle of poverty and resource degradation. The Programme pursues three lines of work. First, in systems characterised by low soil fertility soil and animals compete for the nutrients contained in crop residues. In these systems CIMMYT, ICRISAT, IITA, ILRI and their partners conduct research to assess the tradeoffs and synergies among animals, crops and soil in order to maximise the efficiency of nutrient use. Second, in systems where water is the main constraint, the Programme is developing an initiative led by IWMI and with inputs of ILRI to minimise the competition for water between livestock and other uses and to maximise, at the watershed level, the productivity of water in relation to feed and drinking needs of animals. Third, in most small scale mixed farms, the diverse patterns of land use result in dynamic and complex forms of feed budgets at the farm level. CIAT, ICRAF, ILRI and crop

oriented Centres investigate options to optimise the use of land through the integration of agro-forestry options, forages and crops in order to develop feeding strategies that meet the nutrient needs of animals in a sustainable manner. These three lines of work aim at developing strategies and generic models of broad relevance and applicability to increase the productivity and sustainability of crop–livestock systems.

Feed innovation systems

The development and successful adoption and use of feed technologies by smallholders require the synergies from a wide range of existing and new partnerships and delivery systems. Within the SLP, ILRI, ICRISAT, IITA, CIAT, ICARDA, ICRAF and their partners conduct research aimed at enhancing the capacity of networks of organisations involved in rural development to respond to the needs for feed of small scale, poor farmers. With initial focus on India and Nigeria, they seek to understand how actors in these networks can interact better to address the needs of the poor. They design experiments to introduce changes in these interactions and draw generic lessons on how institutional capacity can be enhanced. These lessons are shared internationally and options are sought for their application in other countries, thus bringing an international dimension to this novel research domain.

In the four areas of research the Centres work in consortia that involve national and regional partner institutions, including research institutes, universities, non-governmental organisations, private enterprises and policy-making bodies. They involve local communities and other stakeholders to ensure that the research is led by the needs of its beneficiaries and that the solutions developed match their culture and resource endowment. They link with other initiatives to disseminate globally the knowledge generated.

Strategy for output–outcome logic

The frameworks and models developed by the Programme and applied to set priorities for feed interventions result in better targeted research and development investments and thus enhance the likelihood of these efforts to have positive impacts on poverty alleviation and sustainability.

Working in a multi-disciplinary mode involving agro-forestry, crop, livestock, social and systems analysis scientists, the SLP partners develop approaches to assess the role and value of crops, fodder trees and forages as feed resources. These approaches are applied in current crop breeding programs in international and national research organisations to select cultivars with superior value in traits of economic importance as feed. At later stages in the research–development continuum, seed systems provide the mechanism to make the superior dual-purpose cultivars available to end users and beneficiaries.

Potential tradeoffs among feed traits, food yields and the need for soil conservation in sustainable agricultural strategies are analyzed and used to develop tools to aid decision making. Strategies are developed to produce food and feed through the sustainable use of land, water and soil nutrients. These strategies are translated into tools usable by national research and development partners as well as by policy/decision makers.

The principles that underlie the functioning of successful feed innovation systems are understood by analyzing the ways in which networks of institutions involved in the use of feed technologies operate. These networks include associations of farmers and local communities, extension services, official and private enterprises involved in production and dissemination of seed, feed and related inputs, non-governmental organisations and policy/decision makers. As the principles that govern feed innovation systems are understood, opportunities to enhance the capacity of these networks are identified. It is hypothesised that the enhanced institutional capacity results in the provision of high quality feed-related services to poor crop–livestock producers.

The overall outcome of the SLP is therefore international and national research systems, networks of service providers, development actors and policy makers that are more able and interact better to address the needs for feed of small scale, poor crop–livestock producers. This

enhanced capacity of research systems and development oriented institutions is the mediating mechanism to achieve impact on poverty alleviation, food security and sustainable development.

Lessons learned and knowledge generated are shared in a number of formats, both web and print based. The Programme website serves as both a mechanism to share research results and a system-wide source of information and knowledge on crop–livestock systems.

External conditions

In the developing world, population growth, urbanisation and higher incomes of urban settlers are leading to an increasing consumption of meat, milk and eggs. By participating in livestock related markets, poor farmers can generate income and enhance their livelihoods. Integrating crop and livestock production is a common farming strategy practiced by small scale farmers around the world in response to the increasing demand for livestock products. By 2010 more than 90% of the milk and 75% of the meat will be produced in crop–livestock systems with a concomitant increase in importance of food–feed crops. The increasing demand for animal products is imposing a greater pressure on the natural resources. Although non-food functions of animals tend to decrease in importance, livestock continue to play a key role as source of draft for cultivation and transport and nutrient cycling, and have both positive and negative environmental effects. These trends call for innovations that, while improving the livelihood of small scale farmers, also increase the efficiency of production and maintain the natural resource base. Liberalisation of international trade and demand for higher quality products are influencing how animal source foods are produced. Animal care, feeding practices and disease control are changing in response to higher standards of food safety. Regulatory mechanisms on these aspects of livestock husbandry are expected to increase in developing countries. In order to support rural development within this context and to make small scale farmers more competitive for them to participate in local and international markets, national governments will strengthen the capacity of institutions (government and non-government, public and private, formal and informal) to provide services and inputs and to facilitate the linkage of small scale farmers with markets. Such interventions, with funding support from agencies that promote international development, are required to achieve the Millennium Development Goals set by the international community.

Collaborators

CGIAR Centres:

CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI and IWMI.

NARS partners (including NGOs and private sector) in developing countries:

NARS of Bangladesh, Cambodia, China, Colombia, Ethiopia, India, Indonesia, Kenya, Mali, Niger, Nigeria, Peru, Philippines, Syria, Thailand, Vietnam, South Africa and Zimbabwe.

Advanced institutions in developed countries:

Cornell University (USA), Hohenheim University (Germany), Oxford University (UK), Texas A and M University (USA), The Royal Veterinary and Agricultural University (Denmark), University of California (USA), University of Durham (UK), University of Edinburgh (UK) and University of Reading (UK)

The CGIAR Centres are permanent members of the SLP. Their function is to collectively develop a global strategy, identify priorities for the Programme in a coherent manner and provide scientific inputs in their core areas of expertise in the development and implementation of specific research activities. The role of non-CGIAR organisations in both developing and developed countries is project-specific and consists in participating actively in the preparation of proposals and implementation of research activities.

Project 6. CGIAR Systemwide Livestock Programme Log frame

	Outputs	Intended User	Outcome	Impact
(ILRI Project 6) Output 1	A framework to identify areas in crop–livestock systems with large feed deficits and to assess <i>ex-ante</i> the impact of feed innovations developed, tested and applied by a consortium involving ILRI, CIAT, CIMMYT, CIP, ICRAF, IFPRI, IITA and their partners.			
Output targets 2006	A framework for <i>ex-ante</i> impact assessment of feed innovations developed and tested	Researchers, research managers, policy/decision makers and development actors	Enhanced capacity and effectiveness of the CGIAR, its partners and relevant development agencies to target and address the needs for feed of large numbers of poor, small scale crop–livestock producers	
Output targets 2007	A spatial model for identify areas of feed deficits developed	Researchers, research managers, policy/decision makers and development actors	Enhanced capacity and effectiveness of the CGIAR, its partners and relevant development agencies to target and address the needs for feed of large numbers of poor, small scale crop–livestock producers	
Output targets 2008	Feed interventions with greatest potential for impact identified for key crop–livestock systems	Researchers, research managers, policy/decision makers and development actors	Enhanced capacity and effectiveness of the CGIAR, its partners and relevant development agencies to target and address the needs for feed of large numbers of poor, small scale crop–livestock producers	Greater returns to investments and impact of research and development efforts targeted to poor, small scale crop–livestock producers
(ILRI Project 6) Output 2	Superior cultivars of food staple crops with high value as livestock feed developed by consortia involving CIAT, CIMMYT, CIP, ICARDA, ICRISAT, IITA, ILRI, IRRI and their partners			
Output targets 2006	Feed assessment methods (originally developed for screening crop residues of pearl millet and sorghum) validated for use	Crop breeders and research managers in national and international research institutions	Increased capacity of the CGIAR and partner organisations to develop	Needs for feed of small scale crop–livestock producers built into crop

	Outputs	Intended User	Outcome	Impact
	in maize and rice improvement		improved dual-purpose (food and feed) crops	improvement programs
	Superior dual purpose cultivars identified from the existing genetic base for pearl millet and sorghum in South Asia and for maize in East Africa	Private and official seed enterprises and development agencies including NGOs	National seed systems and development agencies learn about the value of food-feed traits and make improved dual purpose cultivars of pearl millet, sorghum and maize available to poor small scale farmers	Greater access and use of improved dual purpose millet, sorghum or maize lead to increases in feed supply and livestock productivity and enhanced livelihoods
Output targets 2007	Feed assessment methods validated and adapted to screen residues of legume crops (groundnut, pigeon pea, grass pea, cowpea)	Crop breeders and research managers in national and international research institutions	Increased capacity of the CGIAR and partner organisations to develop improved dual-purpose (food and feed) crops	Needs for feed of small scale crop-livestock producers built into crop improvement programs
	Conventional and marker assisted selection plans developed for pearl millet	Crop breeders and research managers in national and international research institutions	Increased capacity of the CGIAR and partner organisations to develop improved dual-purpose (food and feed) crops	Needs for feed of small scale crop-livestock producers built into crop improvement programs
	Sources of genetic variation for further improvement identified for dual-purpose sorghum, maize and rice.	Crop breeders and research managers in national and international research institutions	Seed releasing bodies aware of importance of traits in dual-purpose crops and use them as releasing criteria; Breeding programs successfully use criteria for developing dual purpose crops	Needs for feed of small scale crop-livestock producers built into crop improvement programs
Output targets 2008	Feed assessment methods validated and adapted to screen residues of tuber and root crops (cassava, sweet potato)	Crop breeders and research managers in national and international research institutions	Increased capacity of the CGIAR and partner organisations to develop improved dual-purpose (food and feed) crops	Needs for feed of small scale crop-livestock producers built into crop improvement programs
	Trends and forecasts of the global use of grains as animal feed and implications for small scale farmers determined	Researchers, research managers, policy/decision makers, agencies that support international development	Better informed policy/decision makers and research managers	Needs of small scale crop-livestock producers built into research and development efforts
(ILRI Project 6) Output 3	Feeding strategies for small scale crop-livestock farms based on the efficient use			

	Outputs	Intended User	Outcome	Impact
	of water, land, labour, soil nutrients, food–feed crops, agro-forestry options, forages and other farm inputs developed by consortia involving CIAT, CIMMYT, ICRAF, ICRISAT, IITA, ILRI, IRRI, IWMI and their partners			
Output targets 2006	A conceptual generic model of synergies and tradeoffs between the use of crop residues for soil improvement and as livestock feed in crop–livestock systems developed	Researchers, research managers		
Output targets 2007	Model of synergies and tradeoffs between the need for feed and soil nutrients tested under conservation agriculture strategies in west Africa and the Indo-Gangetic Plains in south Asia	Researchers, research managers, policy/decision makers, development actors	Enhanced capacity of the CGIAR and its partners to integrate livestock into natural resource management strategies for crop–livestock systems	
	A framework for assessing options for the efficient use of water in crop–livestock systems developed.	Researchers, research managers and	Enhanced capacity of the CGIAR and its partners to integrate livestock into natural resource management strategies for crop–livestock systems	
Output targets 2008	Broadly relevant strategies to improve the sustainability of conservation agriculture in crop–livestock systems developed	Researchers, research managers, policy/decision makers, development actors	Enhanced capacity of the CGIAR and its partners to integrate livestock into natural resource management strategies for crop–livestock systems	Enhanced sustainability of small scale crop–livestock systems practicing conservation agriculture strategies
(ILRI Project 6) Output 4	Generic principles and guidelines to enhance the capacity of networks of institutions involved in feed innovation systems developed by a consortium involving ILRI, ICRISAT, IITA, CIAT, ICARDA, ICRAF and their partners			
Output targets 2006	Functional networks of institutions involved in feed innovations in India and Nigeria identified and their interactions	Researchers and networks of actors involved in feed innovations in India and Nigeria,	Increased capacity of actors involved in feed innovations at local level in pilot sites	Better services and access to feed technologies by small scale crop–livestock

	Outputs	Intended User	Outcome	Impact
	understood			producers in pilot cases
Output targets 2007	Lessons learnt on feed innovation systems in India and Nigeria built into country plans for rural development	Policy makers, networks of actors involved in feed innovations in India and Nigeria, researchers	Increased capacity of institutions and actors involved in feed innovations at country level in India and Nigeria	Better services and access to feed technologies by small scale crop–livestock producers in India and Nigeria
Output targets 2008	Cross country lessons on innovations systems shared internally to inform relevant initiatives in other countries	International stakeholders, networks of institutions involved in feed innovations and policy makers in countries other than India and Nigeria, researchers and research managers	Increased capacity of institutions and actors involved in feed innovations in countries other than India and Nigeria	Better services and access to feed technologies by small scale crop–livestock producers in countries other than India and Nigeria

ILRI-Cost Allocation: Allocation of Projects Cost to CGIAR Outputs, 2004–2008
(in \$ million)

Project	Outputs	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Project 1: Targeting Research and Development Opportunities						
	Sustainable Production	1.513	1.086	0.900	0.900	0.930
	Policy	3.026	2.172	1.800	1.800	1.860
	Enhancing NARS	0.505	0.362	0.300	0.300	0.310
	TOTAL BY PROJECT	5.044	3.620	3.000	3.000	3.100
Project 2: Enabling innovation						
	Sustainable Production	2.429	1.860	1.550	1.550	1.600
	Policy	0.971	0.744	0.620	0.620	0.640
	Enhancing NARS	1.457	1.116	0.930	0.930	0.960
	TOTAL BY PROJECT	4.857	3.720	3.100	3.100	3.200
Project 3: Improving Market Opportunities						
	Sustainable Production	2.004	3.032	3.000	3.050	3.150
	Policy	1.603	2.426	2.400	2.440	2.520
	Enhancing NARS	0.401	0.606	0.600	0.610	0.630
	TOTAL BY PROJECT	4.008	6.064	6.000	6.100	6.300
Project 4: Application of Biotechnology to Secure Assets						
	Germplasm Improvement	2.793	2.933	3.425	3.675	4.000
	Germplasm Collection	0.559	0.586	0.685	0.735	0.800
	Sustainable Production	5.585	5.864	6.850	7.350	8.000
	Policy	0.893	0.938	1.096	1.176	1.280
	Enhancing NARS	1.340	1.407	1.644	1.764	1.920
	Enhancing NARS	11.170	11.728	13.700	14.700	16.000
Project 5: People, Livestock and the Environment						
	Germplasm Improvement	1.444	2.248	1.925	1.969	2.027
	Germplasm Collection	0.289	0.450	0.385	0.394	0.405
	Sustainable Production	3.177	4.945	4.235	4.332	4.458
	Policy	0.289	0.450	0.385	0.394	0.405
	Enhancing NARS	0.578	0.899	0.770	0.787	0.811
	TOTAL BY PROJECT	5.777	8.992	7.700	7.876	8.106

Project	Outputs	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Project 6: CGIAR Systemwide Livestock Programme (SLP)						
	Germplasm Improvement	0.128	0.146	0.098	0.098	0.098
	Sustainable Production	0.556	0.635	0.423	0.423	0.423
	Policy	0.128	0.146	0.096	0.096	0.096
	Enhancing NARS	0.043	0.049	0.033	0.033	0.033
	TOTAL BY PROJECT	0.855	0.976	0.650	0.650	0.650
	TOTAL BY CENTRE	31.711	35.100	34.150	35.426	37.356

ILRI-Investment, 2004–2008
Investments by Sectors and Commodities (in \$ million)

Sectors & Commodities	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Livestock	31.711	35.100	34.150	35.426	37.356
TOTAL BY CENTRE	31.711	35.100	34.150	35.426	37.356

ILRI-Cost Allocation: Allocation of Projects Cost to CGIAR Regions, 2004–2008
(in \$ million)

Project	Regions	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Project 1: Targeting Research and Development Opportunities						
	SSA	3.783	2.715	2.250	2.250	2.325
	Asia	1.009	0.724	0.600	0.600	0.620
	LAC	0.202	0.145	0.120	0.120	0.124
	CWANA	0.050	0.036	0.030	0.030	0.031
	TOTAL BY PROJECT	5.044	3.620	3.000	3.000	3.100
Project 2: Enabling innovation						
	SSA	3.400	2.604	2.170	2.170	2.240
	Asia	0.971	0.744	0.620	0.620	0.640
	LAC	0.243	0.186	0.155	0.155	0.160
	CWANA	0.243	0.186	0.155	0.155	0.160
	TOTAL BY PROJECT	4.857	3.720	3.100	3.100	3.200
Project 3: Improving Market Opportunities						
	SSA	1.202	1.819	1.800	1.830	1.890
	Asia	1.042	1.577	1.560	1.586	1.638
	LAC	0.962	1.455	1.440	1.464	1.512
	CWANA	0.802	1.213	1.200	1.220	1.260
	TOTAL BY PROJECT	4.008	6.064	6.000	6.100	6.300
Project 4: Application of Biotechnology to Secure Assets						
	SSA	8.380	8.796	10.275	11.025	12.000
	Asia	2.790	2.932	3.425	3.675	4.000
	TOTAL BY PROJECT	11.170	11.728	13.700	14.700	16.000
Project 5: People, Livestock and the Environment						
	SSA	4.044	6.294	5.390	5.513	5.674
	Asia	1.444	2.248	1.925	1.969	2.027
	LAC	0.000	0.000	0.000	0.000	0.000
	CWANA	0.289	0.450	0.385	0.394	0.405
	TOTAL BY PROJECT	5.777	8.992	7.700	7.876	8.106

Project	Regions	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Project 6: CGIAR Systemwide Livestock Programme (SLP)						
	SSA	0.342	0.390	0.293	0.293	0.293
	Asia	0.214	0.244	0.228	0.228	0.228
	LAC	0.214	0.244	0.065	0.065	0.065
	CWANA	0.085	0.098	0.064	0.064	0.064
	TOTAL BY PROJECT	0.855	0.976	0.650	0.650	0.650
	TOTAL BY CENTRE	31.711	35.100	34.150	35.426	37.356

ILRI-Expenditures, 2004–2008
Object of Expenditure, (in \$ million)

Object of Expenditures	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Personnel	13.489	14.593	15.100	15.300	15.400
Supplies and Services	9.649	12.083	11.450	12.100	13.400
Collaboration/Partnerships	3.885	4.037	3.900	4.226	4.556
Operational Travel	1.752	1.755	1.300	1.400	1.600
Depreciation	2.936	2.632	2.400	2.400	2.400
TOTAL BY CENTRE	31.711	35.100	34.150	35.426	37.356

ILRI-Financing: Members Unrestricted Grants, 2004–2006
(in \$ million)

Members	2004 (actual)	2005 (estimated)	2006 (proposal)
Australia	0.217	0.217	0.228
Belgium	0.166	0.000	0.000
Brazil	0.000	0.009	0.009
Canada	2.003	1.586	0.985
China	0.050	0.050	0.050
Denmark	0.458	0.448	0.472
Finland	0.448	0.386	0.407
Germany	0.365	0.358	0.377
India	0.038	0.038	0.038
Ireland	0.736	0.835	0.879
Italy	0.559	0.239	0.251
Japan	0.178	0.126	0.139
Korea	0.050	0.050	0.050
Netherlands	0.327	0.322	0.339
Norway	1.324	1.344	1.415
Philippines	0.003	0.000	0.000
Sweden	1.099	0.972	1.023
Switzerland	1.028	0.770	0.811
United Kingdom	1.288	1.247	1.312
United States	2.875	2.875	2.875
World Bank	1.900	2.050	2.050
TOTAL BY CENTRE	15.112	13.922	13.710

ILRI-Financing: Allocation of Members/Non Members Grants to Projects, 2004–2006
(in \$ million)

Project	Members/Non Members	2004 (actual)	2005 (estimated)	2006 (proposal)
Project 1: Targeting Research and Development Opportunities	MEMBERS			
	ADB	0.000	0.000	0.000
	FAO	0.022	0.067	0.000
	Finland	0.000	0.000	0.000
	Germany	0.000	0.000	0.000
	IFAD	0.000	0.084	0.000
	Italy	0.000	0.000	0.000
	Japan	0.017	0.052	0.000
	Kenya	0.011	0.000	0.000
	Netherlands	0.435	0.262	0.110
	Norway	0.277	0.000	0.000
	Rockefeller Foundation	0.176	0.172	0.053
	South Africa	0.025	0.025	0.025
	Sweden	0.000	0.000	0.000
	UNDP	0.000	0.000	0.000
	United Kingdom	0.031	0.159	0.113
	United States	0.076	0.569	0.284
	World Bank	0.045	0.094	0.050
	TOTAL MEMBERS	1.115	1.484	0.635
	NON MEMBERS			
	African Union/IBAR	0.147	0.006	0.000
	Capitalisation of Livestock Programme Experience	0.000	0.000	0.000
	CIP	0.003	0.000	0.008
	Cooperazione Internazionale	0.000	0.073	0.000
	CSU	0.018	0.000	0.000
	Gatsby Foundation	0.000	0.000	0.000
	GEF	0.111	0.000	0.000

	ICRISAT	0.020	0.027	0.028
	IFPRI	0.000	0.027	0.000
	ILRI	0.020	0.000	0.000
	IWMI	0.001	0.000	0.000
	Michigan State University	0.024	0.060	0.020
	Montana State University	0.008	0.000	0.000
	National Science Foundation (NSF)	0.036	0.000	0.000
	Natural Resources Institute	0.000	0.101	0.000
	Others	0.000	0.077	0.077
	UFL	0.025	0.030	0.030
	Volkswagen Foundation	0.000	0.000	0.000
	TOTAL NON MEMBERS	0.413	0.401	0.163
	TOTAL MEMBERS + NON MEMBERS	1.528	1.885	0.798
	Unrestricted + centre inc	3.516	1.735	2.202
	TOTAL BY PROJECT	5.044	3.620	3.000
Project 2: Enabling innovation	MEMBERS			
	ADB	0.267	0.000	0.000
	Australia	0.010	0.056	0.030
	European Commission	0.234	0.034	0.000
	FAO	0.025	0.000	0.000
	Germany	0.362	0.016	0.000
	IDRC	0.074	0.079	0.070
	IFAD	0.488	0.091	0.000
	Kenya	0.048	0.000	0.000
	Philippines	0.044	0.009	0.000
	United Kingdom	0.196	0.048	0.181
	United States	0.395	0.370	0.000
	World Bank	0.030	0.000	0.000
	TOTAL MEMBERS	2.173	0.703	0.281
	NON MEMBERS			
	African Union/IBAR	0.069	0.000	0.000
	ASARECA	0.119	0.769	0.500
	CABI	0.007	0.000	0.000
	Common Fund for Commodities	0.010	0.000	0.000

	Ethiopia	0.048	0.000	0.000
	Land O Lakes	0.135	0.147	0.130
	Limburgs Universitair Centrum	0.019	0.000	0.000
	Others	0.137	0.073	0.049
	Strategic Initiative on Urban and Peri-Urban Agriculture	0.001	0.000	0.000
	Veterinaires sans Frontieres- Belgique	0.000	0.060	0.011
	TOTAL NON MEMBERS	0.545	1.049	0.690
	TOTAL MEMBERS + NON MEMBERS	2.718	1.752	0.971
	Unrestricted + centre inc	2.139	1.968	2.129
	TOTAL BY PROJECT	4.857	3.720	3.100
Project 3: Improving Market Opportunities	MEMBERS			
	ADB	0.000	0.000	0.000
	Canada	0.185	1.648	1.650
	Denmark	0.150	0.070	0.000
	European Commission	0.000	0.791	0.833
	FAO	0.152	0.077	0.070
	Germany	0.160	0.086	0.195
	IFAD	0.235	0.472	0.220
	Netherlands	0.061	0.000	0.000
	OPEC Fund	0.000	0.000	0.000
	South Africa	0.025	0.025	0.025
	United Kingdom	0.328	0.071	0.113
	World Bank	0.030	0.000	0.000
	TOTAL MEMBERS	1.326	3.240	3.106
	NON MEMBERS			
	ASARECA	0.000	0.057	0.000
	Common Fund for Commodities	0.474	0.700	0.687
	CTA	0.006	0.000	0.000
	IFPRI	0.026	0.027	0.000
	ILRI	0.022	0.000	0.092
	Others	0.058	0.037	0.063
	Strategic Initiative on Urban and Peri-Urban Agriculture	0.002	0.000	0.000

	Strengthening Informal Sector Training & Enterprise	0.000	0.028	0.019
	Texas A&M University	0.048	0.000	0.000
	TOTAL NON MEMBERS	0.636	0.849	0.861
	TOTAL MEMBERS + NON MEMBERS	1.962	4.089	3.967
	Unrestricted + centre inc	2.046	1.975	2.033
	TOTAL BY PROJECT	4.008	6.064	6.000
Project 4: Application of Biotechnology to Secure Assets	MEMBERS			
	Austria	0.145	0.303	0.150
	Belgium	0.215	0.127	0.000
	Canada	1.617	1.735	6.000
	China	0.000	0.040	0.050
	European Commission	1.247	0.792	0.833
	France	0.077	0.077	0.077
	Germany	0.245	0.311	0.359
	Ireland	0.095	0.200	0.080
	Japan	0.127	0.115	0.127
	Kenya	0.029	0.021	0.000
	Korea	0.034	0.040	0.025
	Norway	0.001	0.000	0.000
	Rockefeller Foundation	0.103	0.000	0.000
	Spain	0.043	0.150	0.043
	Sweden	0.014	0.000	0.017
	Switzerland	0.047	0.039	0.052
	Syngenta Foundation	0.010	0.000	0.000
	UNDP	0.000	0.000	0.000
	UNEP	0.000	0.000	0.000
	United Kingdom	1.769	0.300	0.000
	United States	0.022	0.091	0.013
	TOTAL MEMBERS	5.840	4.341	7.826
	NON MEMBERS			
	African Union/IBAR	0.028	0.958	0.000
	ASARECA	0.000	0.064	0.050
	Bhutan	0.001	0.000	0.000

	Gatsby Foundation	0.014	0.000	0.000
	GEF	0.194	0.055	0.000
	ICRISAT	0.015	0.000	0.000
	IFPRI	0.013	0.000	0.000
	IITA	0.117	0.000	0.000
	International Atomic Energy Agency	0.058	0.056	0.000
	NERC	0.000	0.000	0.000
	Others	0.076	0.472	0.056
	Wellcome Trust	0.406	0.449	0.643
	WOTRO (WOT)	0.005	0.021	0.006
	TOTAL NON MEMBERS	0.927	2.075	0.755
	TOTAL MEMBERS + NON MEMBERS	6.767	6.416	8.581
	Unrestricted + centre inc	4.403	5.312	5.119
	TOTAL BY PROJECT	11.170	11.728	13.700
Project 5: People, Livestock and the Environment	MEMBERS			
	Australia	0.037	0.062	0.075
	Belgium	0.685	0.515	0.000
	Canada	0.185	1.648	1.650
	Denmark	0.198	0.129	0.000
	European Commission	0.443	0.000	0.000
	FAO	0.017	0.000	0.000
	France	0.077	0.000	0.000
	Germany	0.072	0.037	0.234
	IDRC	0.101	0.105	0.150
	Italy	0.225	0.000	0.000
	Korea	0.000	0.000	0.065
	Netherlands	0.067	0.108	0.150
	Switzerland	0.006	0.050	0.049
	United Kingdom	0.672	0.669	0.565
	World Bank	0.255	0.454	0.481
	TOTAL MEMBERS	3.040	3.777	3.419
	NON MEMBERS			
	Heifer International	0.003	0.000	0.000
	ICRISAT	0.150	0.128	0.000

	IPGRI	0.031	0.000	0.000
	IWMI	0.120	0.196	0.055
	National Science Foundation (NSF)	0.000	0.097	0.000
	Others	0.152	0.013	0.000
	Sasakawa Global 2000	0.015	0.044	0.023
	Texas A&M University	0.050	0.000	0.000
	USE	0.028	0.000	0.000
	Utah State University	0.334	0.000	0.000
	TOTAL NON MEMBERS	0.883	0.478	0.078
	TOTAL MEMBERS + NON MEMBERS	3.923	4.255	3.497
	Unrestricted + centre inc	1.854	4.737	4.203
	TOTAL BY PROJECT	5.777	8.992	7.700
Project 6: CGIAR Systemwide Livestock Programme (SLP)	MEMBERS			
	Canada	0.122	0.518	0.135
	Switzerland	0.518	0.347	0.365
	World Bank	0.215	0.111	0.150
	TOTAL MEMBERS	0.855	0.976	0.650
	NON MEMBERS			
	TOTAL MEMBERS + NON MEMBERS	0.855	0.976	0.650
	Unrestricted + centre inc	0.000	0.000	0.000
	TOTAL BY PROJECT	0.855	0.976	0.650
	TOTAL BY CENTRE	31.711	35.100	34.150

ILRI Staff Composition: Internationally and Nationally Recruited Staff, 2004–2008

Staff Type	2004 (actual)	2005 (estimated)	2006 (proposal)	2007 (plan 1)	2008 (plan 2)
Internationally-Recruited Staff (IRS)	72	77	77	77	77
National-Recruited Staff (NRS)	662	654	660	660	660
TOTAL BY CENTRE	734	731	737	737	737

ILRI-Financial Position: Currency Structure of Expenditures, 2004–2006
(in \$ million)

Currency	2004 (actual)			2005 (estimated)			2006 (proposal)		
	Amount	US\$ Value	% Share	Amount	US\$ Value	% Share	Amount	US\$ Value	% Share
Ethiopian Birr (ETB)	28.857	3.373	10.637%	31.240	3.633	10.638%	32.407	3.768	10.636%
Euro (EUR)	3.189	4.005	12.630%	3.423	4.313	12.630%	3.723	4.474	12.629%
Pound Sterling (GBP)	2.889	5.357	16.893%	3.170	5.769	16.893%	3.306	5.985	16.894%
Kenyan Shilling (KES)	731.954	9.581	30.213%	794.433	10.317	30.211%	824.117	10.703	30.212%
Others (Others)	0.000	0.000	0.000%	0.000	0.000	0.000%	0.000	0.000	0.000%
US Dollar (USD)	9.395	9.395	29.627%	10.118	10.118	29.628%	10.496	10.496	29.628%
TOTAL BY CENTRE		31.711	100.000%		34.150	100.000%		35.426	100.000%

ILRI STATEMENTS OF ACTIVITIES
For the Year Ended December 31, 2004
(in \$ million)

	Unrestricted	Restricted		Total	Total
		Temporary	Challenge Programs	2004	2003
Revenue and Gains					
Grant Revenue	15.111	17.753	0.000	32.864	28.675
Other revenue and gains	2.073	0.000	0.000	2.073	2.127
Total revenue and gains	17.184	17.753	0.000	34.937	30.802
Expenses and Losses					
Programme related expenses	6.890	17.753	0.000	24.643	22.721
Management and general expenses	8.113	0.000	0.000	8.113	8.866
Other losses expenses	0.039	0.000	0.000	0.039	0.034
Sub Total expenses and losses	15.042	17.753	0.000	32.795	31.621
Indirect cost recovery	-1.084	0.000	0.000	-1.084	-0.925
Total expenses and losses	13.958	17.753	0.000	31.711	30.696
Net Surplus / (Deficit) from ordinary activities	3.226	0.000	0.000	3.226	0.106
Extraordinary Items	0.000	0.000	0.000	0.000	0.000
NET SURPLUS / (DEFICIT)	3.226	0.000	0.000	3.226	0.106
Object of Expenditures					
Personnel	7.434	6.055	0.000	13.489	13.802
Supplies and Services	4.276	5.373	0.000	9.649	10.731
Collaborators/Partnership	0.000	3.885	0.000	3.885	2.652
Operational Travel	0.562	1.190	0.000	1.752	1.287
Depreciation	1.686	1.250	0.000	2.936	2.224
TOTAL BY CENTRE	13.958	17.753	0.000	31.711	30.696

ILRI
STATEMENTS OF FINANCIAL POSITION
December 31, 2004
(in \$ million)

	2004	2003
ASSETS		
Current Assets		
Cash and cash equivalents	24.620	16.713
Investments	0.000	0.000
Accounts receivable		
Donor	5.821	7.683
Employees	0.200	0.292
Other CGIAR Centres	0.064	0.139
Others	1.210	0.796
Inventories	0.740	0.821
Prepaid expenses	0.281	0.231
Total current assets	32.936	26.675
Non-Current Assets		
Property, Plant and Equipment	12.154	13.628
Investments	1.816	1.816
Other Assets	0.043	0.051
Total Non-Current Assets	14.013	15.495
TOTAL ASSETS	46.949	42.170
LIABILITIES AND NET ASSETS		
Current Liabilities		
Overdraft/Short term Borrowings	0.000	0.000
Accounts payable		
Donor	11.204	10.257
Employees	1.023	1.018
Other CGIAR Centres	0.066	0.037
Others	1.733	1.462
Accruals	1.905	1.682
Total current liabilities	15.931	14.456
Non-Current Liabilities		
Accounts payable		
Employees	0.696	0.618
Deferred Grant Revenue	0.000	0.000
Others	0.000	0.000
Total non-current liabilities	0.696	0.618
Total liabilities	16.627	15.074
Net Assets		
Unrestricted		
Designated	14.599	16.079
Undesignated	15.723	11.017
Total Unrestricted Net Assets	30.322	27.096
Restricted	0.000	0.000
Total net assets	30.322	27.096
TOTAL LIABILITIES AND NET ASSETS	46.949	42.170

Abbreviations and Acronyms

AARNET	Animal Agriculture Research Network
AATF	African Agricultural Technology Foundation
AAU	Addis Ababa University
ABRII	Agricultural Biotechnology Research Institute of Iran
ACTS	African Centre for Technology Studies
ADRI	L'Agence pour le Développement des relations interculturelles
AGA	Animal Production and Health Division, FAO
AGM	Annual General Meeting
AHI	African Highlands Initiative
AIDS	Acquired Immune Deficiency Syndrome
AnGR	Animal Genetic Resources
APAARI	Asia Pacific Association of Agricultural Research Institutions
ARC	Agricultural Research Council
ARIs	Advanced Research Institutes
ARS	Agricultural Research Services
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa,
AU-IBAR	African Union/Interafrican Bureau for Animal Resources
ASB	American Savings Bank
ASOBRAHMAN	Asociacion Gualtemateca de Criadores de Ganado Brahmán y Derivados
AU-IBAR	The African Union/Interafrican Bureau for Animal Resources
BAD/AfDB	Banque Africaine de Développement / African Development Bank
BAIF	Bharatiya Agro Industries Foundation
BecA	Bioscience eastern and central Africa
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (Germany's Ministry for Economic Cooperation)
CAAS	Chinese Academy of Agricultural Sciences
CAC	Consejo Agropecuario Centroamericano
CALPI	Capitalisation of Livestock Programme Experiences India).
CAPRI	Collective Action and Property Rights
CARE	Cooperative for Assistance and Relief Everywhere
CASREN	Crop–Animal Systems Research Network
CaSt	Capacity Strengthening
CAWMA	Comprehensive Assessment of Water Management in Agriculture
CBPP	Contagious bovine pleuropneumonia
CBRM	Community Based Sustainable Resource Management Project
CCER	Centre Commissioned External Review
CEPEA	Centro de Estudos Avançados em Economia Aplicada
CDs	Compacts Disks
CFC	Common Fund for Commodities
CGG	Cámara de Ganaderos de Guanacaste , COSTA RICA
CGIAR	Consultative Group on International Agriculture
CGUS	Cámara de Ganaderos Unidos del Sur
CIAT	Centro Internacional de Agricultura Tropical (International Centre for Tropical Agricultura)
CILSS	Comité Permanent Inter Etats de Lutte Contre la Sécheresse dans le Sahel
CIP	Centro Internacional de la Papa
CIRAD-EMVT	Centre de Coopération Internationale en Recherche Agronomique pour le Développement: Département Élevage et Médecine Vétérinaire
CIRDES	Centre international de recherche-développement sur l'élevage en zone sub-humide
CISA-INIA	Centro de Investigacion en Sanidad Animal—National Institute for Agriculture and Food Research & Technology of Spain
CLIP	Climate-Land Interaction Project

CONDESAN	Consortio para el Desarrollo Sostenible de la Ecorregion Andina
CORAF	Conseil Ouest et Centrale Africain pour la Recherche et le Développement Agricole (Conference of the Agricultural Research Leaders in West and Central Africa)
CORFOGA	Corporación Ganadera
CP	Challenge programmes
CPWF	Challenge Program on Water for Food
CRISP	Centre for Research & Industrial Staff Performance
CSIRO	Commonwealth Scientific and Industrial Research Organization
CTVM	Centre for Tropical Veterinary Medicine
CYMMYT	Centro Internacional de Mejoramiento de Maize y Trigo (International Maize and Wheat Development Centre)
DAD-IS	Domestic Animal Diversity Information System
DAGRIS	Domestic Animal Genetic Resources Information System
DANIDA	Danish Agency for Development Assistance
DFID	Department for International Development
DIAS	Danish Institute of Agricultural Sciences
DICTA	Dirección de Ciencia y Tecnología Agrícola, HONDURAS
DMP	Desert Margins Programme
DNA	Deoxyribonucleic Acid
DNAMR/Mali	Direction Nationale de l'Appui au Monde Rural / Mali
DRSRS	Department of Resource Surveys and Remote Sensing
DVS-KVA	Department of Veterinary Services-Kenya Veterinary Association
EARO	Ethiopian Agricultural Research Organizations
ECAPAPA	Eastern and Central Africa Programme for Agricultural Policy Analysis
ECF	East Coast fever
EDRI	Ethiopian Development Research Institute
ELISA	Enzyme – Linked Immunosorbent Assay
ERSP	Economic Recovery Strategy Plan
ETH	Swiss Federal Institute of Technology
EU	European Union
EXTRAPOLATE	<i>Ex-ante</i> Tool for RAnking POLicy ALTERNatives
FAGANIC	Federacion De Asociaciones Ganaderas De Nicaragua
FAO	Food and Agriculture Organisation
FAO-PPLPI	Food and Agriculture Organisation—Pro-Poor Livestock Policy Initiative
FARA	Forum for Agricultural Research in Africa
FASID	Foundation for Advanced Studies on International Development
FENAGH	Federación Nacional de Agricultores y Ganaderos de Honduras
FEWSNET	Famine Early Warning System Network
FFS	Farmer Field Schools
FITCA	Farming In Tsetse Controlled Areas
FIVIMS	Food Insecurity and Vulnerability Information and Mapping System
FOFIFA	Centre National de Recherche Appliquée au Développement Rural – Madagascar
GALV	Global Alliance for Livestock Vaccines
GEF	Global Environmental Facility
GIS	Geographic Information System
GRIPS	The National Graduate Institute for Policy Studies, Japan
GRPI	Genetic Policy Resources Initiative
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HAU	Haryana Agricultural University
HIV	Human Immunodeficiency Virus
IAEA	International Atomic Energy Agency,
IAR	Institute for Agricultural Research
ICAR	Indian Council for Agricultural Research

ICARDA	International Centre for Agricultural Research in the Dry Areas
ICASA	International Consortium for Agricultural Systems Applications
ICIPE	International Centre for Insect Physiology and Ecology
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICTA	International Center for Technology Assessment
ICT-KM	Information and Communication Technology Knowledge Management
IDR	Institute for Rural Development—Nicaragua
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGP	Information Géographique Protégée
IICA	Instituto Interamericano de Cooperación para la Agricultura (Inter-American Institute for Cooperation on Agriculture)
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IMCB-A	Institute of Molecular and Cell Biology of Africa Nairobi
IMPACT	Integrated Modelling Platform for Animal Crops Systems in the Tropics
INERA	Institut de L'Environnement et des Recherches Agricoles
INIA	National Institute for Agriculture and Food Research & Technology of Spain
INPHB	Institut National Polytechnique Houphouet Boigny) de Yamoussoukro
INRAB	Institut National des Recherches Agricoles du Benin
INRM	Integrated Natural Resource Management
IPAR	Institute of Policy Analysis and Research
IPGRI	International Plant Genetic Research Institute
IPMS	Improving productivity and market success
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agricultural Biotechnology Applications
ISNAR	International Service for National Agricultural Research
ITC	International Trypanotolerance Centre
ITDG	Intermediate Technology Development Group
ITBDCP	Integrated Tick and Tick-borne Disease Control Project
IWMI	International Water Management Institute
JDPC	Justice, Development and Peace Commission
JICA	Japan International Cooperation Agency
KADP	Kaduna State Agricultural Development Project
KARI	Kenya Agricultural Research Institute
KARI-TRC	Kenya Agricultural Research Institute – Trypanotolerance Research Centre
KDB	Kenya Dairy Board
KEMRI	Kenya Medical Research Institute
KEVEVAPI	Kenya Veterinary Vaccines Production Institute
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KVL	Royal Veterinary and Agricultural University
LICR	Ludwig Institute of Cancer Research
LIRI	Livestock Health Research Institute
LUCID	Land Use Change Impacts and Dynamics in East Africa
MDG	Millennium Development Goals
MEATCO	Meat Corporation of Namibia
MoARD	Ministry of Agriculture and Rural Development
MoLFD	Ministry of Livestock and Fisheries Development
MOST	Ministry of Science and Technology
MRI	Moredun Research Institute
MTP	Medium-Term Plan

NAGRC&DB	National Animal Genetic Resources Centre & Data Base
NAPRI	National Animal Production Research Institute
NARES	National agricultural research and extension systems
NARO	National Agricultural Research Organization
NARS	National agricultural Research Systems
NDDDB	National Dairy Development Board
NePAD	New Partnership for Africa's Development
NGO	Non-governmental organisation
NIRS	Near-Infra Red Spectroscopy
NLDP	National Livestock Development Project
NVRI	National Veterinary Research Institute
OIE	Office International des Epizooties (World Animal Health Organization)
PACE	African Programme for the Control of Epizootics
PATTEC	Pan-African TseTse and Trypanosomiasis Eradication Campaign
PCARRD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PRGA	Participatory Research and Gender Analysis Programme
PRIMAS	Poverty Reduction Intervention Mapping in Agricultural Systems
PROFIEET	Promotion of Farmer Innovation and Experimentation. in Ethiopia
PROLINNOVA	Promoting Local Innovation in ecologically-oriented agriculture
PRSP	Poverty Reduction Strategy Paper
QTL	Qualitative Trait Loci
RDA	Rural Development Administration
RWC	Rice-Wheat Consortium
SADC	Southern African Development Community
SAKSS	Strategic Analysis and Knowledge Support System
SAMIC	South Africa Meat Industry Company
SASA	Social Accountability in Sustainable Agriculture. China
SEAFMD	Southeast Asia Foot and Mouth Disease Campaign
SGRP	System Wide Genetic Resource Program
SIDE	Servicios Internacionales para el Desarrollo Empresarial
SIMA	System wide Initiative on Malaria and Agriculture
SITE	Strengthening Informal Sector Training and Enterprise
SLP	System-wide Livestock Programmes
SLU	Swedish University of Agricultural Sciences
SPS	Sanitary and Phytosanitary Standards
SROs	Sub-Regional Organisations
SSA	Sub Saharan Africa
SVA	National Veterinary Institute (Sweden)
SW/ERP	System-wide and ecoregional programmes
TANAPA	Tanzania National Parks
TIGR	The Institute for Genomic Research
UCL	Universite Catholique de Louvain
UNDP	United Nations Development Programme
UNEP-GEF	United Nations Environment Programme – Global Environmental Facility
UNU-INTECH	United Nations University—Institute for New Technologies
USAID	United States Agency for International Development
USD	United States Dollar
USDA	United States Department of Agriculture
VLA	Veterinary Laboratories Agency
VMRD	Veterinary Medical Research and Development Incorporated
VSF–Germany	Vétérinaires Sans Frontières Germany
WARDA	West Africa Rice Development Association

WHO
ZEF

World Health Organisation
Center for Development Research (Germany)

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