

ILRI

Livestock:
a pathway out of poverty

MEDIUM -TERM PLAN
2008–2010

INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

ILRI Medium-Term Plan 2008–2010

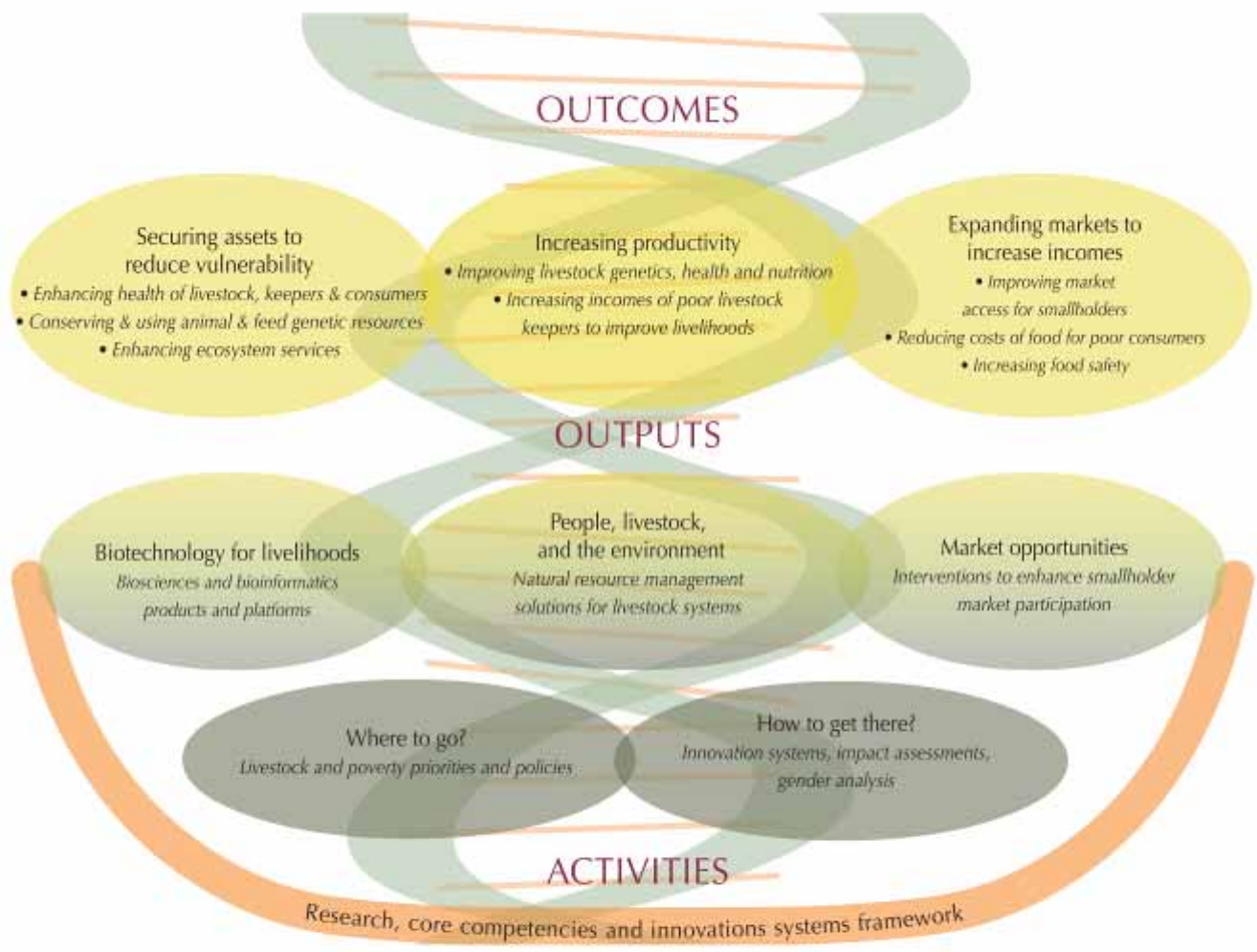
Livestock: a pathway out of poverty



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KNOWLEDGE TO ACTION
REDUCING POVERTY, HUNGER
AND ENVIRONMENTAL DEGRADATION



DYNAMIC LIVESTOCK SECTOR

Increasing demand in developing countries □ More complex pathways and longer market chains □ Supermarket revolution □ Food safety demands □ Pressure on natural resources to double livestock production

ILRI's value proposition

ILRI and its partners conduct collaborative research to create and integrate knowledge that enables diverse stakeholders to develop and use innovative, livestock-based pathways out of poverty.

Figure 1 Knowledge to action: Output–outcome–impact logic for livestock as a pathway out of poverty

Introduction, Context and Program Review

Introduction

The International Livestock Research Institute (ILRI) works at the crossroads of livestock and poverty, bringing high-quality science and capacity-building to bear on poverty reduction and sustainable development. ILRI works in Africa, Asia and Latin America, with offices in East and West Africa, South and Southeast Asia, China and Central America.

All ILRI work is conducted through extensive and strategic partnerships that facilitate and add value to the contribution of many other players in livestock research for development work. ILRI employs an innovation systems approach to enhance the effectiveness of its research. Fundamental change in culture and process must complement changes in technologies to support innovations at all levels, from individual livestock keepers to national and international decision-makers. Through partnerships with organizations ranging from national livestock research institutes and veterinary services to advanced research institutes to the private sector, ILRI develops collaborative knowledge and technological products and helps ensure their appropriate application around the world.

Strategic directions and organization

The global strategy of ILRI is to focus its livestock research efforts on the role of livestock in poverty reduction and environmental sustainability. The strategy takes into account new market opportunities created by increasing demand for high-quality livestock products in developing countries (termed the *Livestock Revolution*) and the many pathways by which livestock can reduce poverty. ILRI's task is to generate and synthesize knowledge and new approaches that can help poor people cope with economic and environmental vulnerability and take advantage of growing livestock market opportunities.

To implement this strategy, ILRI has organized its research program around four inter-related and output-focused themes (MTP 2008-2010 Projects). These are:

- Targeting and Innovation (foresight—where to go and how to get there)
- Improving Market Opportunities (enhancing market access and success by the poor)
- Biotechnology (biosciences and bioinformatics for animal health and genetics)
- People, Livestock and the Environment (natural resource solutions in livestock systems)

In addition, ILRI coordinates the CGIAR System-wide Livestock Program (SLP).

Within each theme, research is implemented in three to four operating projects that focus on research outputs in the medium term (5–8 years). These operating projects are further elaborated under the project narratives below. Cross-theme work is encouraged by a common focus on three outcomes:

- Securing *assets* to reduce vulnerability
- Increasing *productivity* to improve livelihoods
- Increasing *incomes* by enhancing market competitiveness and access.

Figure 1 illustrates the links among ILRI's research projects and the logic of how their outputs contribute to outcomes and impacts that make livestock a pathway out of poverty.

Operational principles and practices underpinning the research agenda

1. Focus on **global livestock challenges**. Livestock systems around the world need to respond to meeting increasing demand for meat and other animal products from limited environmental resources, while protecting the health of producers and consumers, sustaining the natural resource base in the environment and facing the risks associated with market economics and climate change. ILRI focuses on a limited number of global livestock challenges to which it believes it can make a substantial contribution and where it has a demonstrable comparative advantage. These global challenges are: (1) Identifying

- market opportunities for the poor, (2) Enabling sustainable intensification of smallholder livestock systems, (3) Facilitating adaptation of livestock systems to climate change and (4) Managing emerging diseases. ILRI also wants to maximize the impact of lessons learned from the most relevant and dynamic livestock systems by applying them in less productive systems. ILRI sees its role as not only to generate new knowledge but also to synthesize and learn lessons from the available knowledge on major livestock challenges and disseminate these to potential users; this requires both more cross-thematic work amongst ILRI's research themes and additional external partnerships.
2. **Respond to emerging global issues.** The emergence of avian influenza has reminded us all of the need to be alert to unanticipated events and factors that pose risks for both human and animal health and well-being. The growing understanding of the forces behind climate change has helped to clarify the need for research on ways to mitigate or adapt to its impacts, particularly for vulnerable, poor livestock keepers in marginal environments. While ILRI's strategy focuses on long-term issues in ensuring sustainable productivity and intensification of livestock systems, we also need to be able to respond to emerging issues in a timely fashion. This highlights the important role of ILRI's reconstituted **Targeting and Innovation** Theme. These scientists are scanning the horizon and identifying emerging issues to which ILRI can contribute new knowledge.
 3. **Think globally, act regionally.** ILRI's approach to livestock research in various regions will be different, depending on the relevance of the identified global livestock challenges in particular regions, the capacity within the regions to respond, and the added value that ILRI can bring as an *international* livestock research institute. For example, ILRI's expanding programs in South and Southeast Asia and in southern Africa are being tailored to the very different circumstances in each of these regions. ILRI looks for opportunities to work with other CGIAR centres as well as with regional and national research entities, development organizations and private-sector partners worldwide.
 4. Take a **systems approach to livestock research.** ILRI's approach is focused on understanding and addressing the opportunities for livestock research to contribute to poverty reduction in high-priority production to market systems. We are increasingly looking not only at the needs of smallholder producers but also at ways to address poverty along the whole value chain, through input supply and employment in market chains. ILRI is applying innovation systems thinking to the design and implementation of its research projects so as to better link research outputs to outcomes and impact; this process includes improving *ex-ante* project design and *ex-post* impact analysis to help ensure that ILRI research efforts are appropriately targeted and focused. An **Innovation Works** initiative has been established to guide ILRI themes and partners in these areas.
 5. Identify **ILRI's research niche** amongst many actors. ILRI is a relatively small player globally and needs to know how to add value with the research capacity it has internally and who it can mobilize externally as partners. In the research area, ILRI can add value by generating and synthesizing new knowledge on major global livestock challenges. In the development context, ILRI can add value by linking this knowledge to partners working regionally and nationally. ILRI sees its role with development partners as a provider of research evidence that can guide larger investments by governments and development agencies in projects that are managed and implemented by others. As an example, over the past year, ILRI has negotiated a partnership arrangement with a development agency for the management and development components of a large GEF-funded research-development project on improved conservation and use of ruminant genetic resources in West Africa. ILRI will be sub-contracted to provide research and knowledge inputs, leaving the project management to others. Similar arrangements are being negotiated in other new proposals under development.
 6. Find **new ways of working** in a complex world. ILRI recognizes the complexity of livestock systems and the partnerships required for its research to have impact. By taking an innovation systems approach to research design, a key component is to understand the key actors and their capacity to respond and innovate on the basis of new knowledge and

evidence of prospective benefits to end users. Another innovative approach in the conduct of research is to increase the efficiency and catalyze the efforts of different research partners through creating operational research platforms. The following are examples of research platforms that ILRI is playing a strong role in developing.

- a. A ***Biosciences eastern and central Africa (BecA)*** joint venture, with a hub at ILRI's Nairobi campus, which is a shared research platform with state-of-the-art research facilities, available for use by the African scientific community, advanced research institutes, other CGIAR centres, and ILRI's Biotechnology Theme. This new biosciences platform hosted by ILRI will strengthen and accelerate the applications of biosciences to constraints in African agriculture. It will also strengthen ILRI's capacity to undertake biotechnology research through improved research infrastructure and equipment as well as strengthened research collaboration with leading bioscientists within and outside Africa. The BecA network also includes a major capacity building effort that supports research projects and fellowships with African scientists, with particular emphasis on women and young scientists. ILRI's role in the BecA joint venture is primarily to establish the new and upgraded biosciences facilities at its Nairobi campus; to manage the shared research platform in ways that make it accessible and affordable to the African scientific community, CGIAR centres and other ILRI partners; and to facilitate research projects led by scientists coming from a variety of African research institutes and universities. The BecA project includes a substantial grant of approximately USD 20m for refurbishment and expansion of ILRI's biosciences research facilities and equipment. This capital grant is included in ILRI's operational budget for 2008 and 2009.
- b. A project on ***Improving Productivity and Market Success (IPMS) of Ethiopian Farmers*** is providing a common research-for-development platform involving farmers, livestock producers, the Government of Ethiopia and other centres supported by the Consultative Group on International Agricultural Research (CGIAR). IPMS facilitates the testing and application of innovation systems that use global public goods generated by ILRI and its CGIAR partners to enable smallholder farmers and livestock producers to expand their access to, and success in, markets.

ILRI sees research platforms and networks as important mechanisms for linking global public good outputs and their applications at regional and national levels. Another example is a Joint Laboratory on Livestock and Forage Genetic Resources that ILRI runs in partnership with the Chinese Academy of Agricultural Sciences (CAAS), in Beijing. ILRI also led development of a public-private partnership for developing new vaccines and diagnostic products for orphan livestock diseases. This initiative has now evolved into a not-for-profit company, GALVmed (Global Alliance for Livestock Veterinary Medicine), that ILRI partners on specific projects.

7. ***Build the research capacity*** of partners. The long-term impact of ILRI's work depends on the strengths of its partners, since they are responsible for the delivery of innovations in livestock systems. ILRI focuses on improving the capacity of institutions to address global livestock challenges. For example, with avian influenza, ILRI is working with the departments of veterinary services in several African countries to develop the capacity of their staff to conduct surveillance and to develop suitable control strategies should there be an outbreak of avian influenza. This approach also strengthens the capacity of national and regional institutions to respond to outbreaks of other zoonotic diseases in future.
8. ***Improve management*** skills. To improve its performance, ILRI is investing in developing its internal capacities for institutional ***learning and adaptive management***. This includes improving management skills of senior and middle-level managers as well as strengthening the capacity of individual ILRI researchers working within ILRI's research themes.

Lessons learned 2006–7: Towards a more efficient and effective research program

ILRI is evolving its strategy and research agenda in light of lessons learned by staff and management during their implementation and with guidance from ILRI's Board of Trustees, Science Advisory Panel and External Program and Management Review panel during 2006.

Implementing the EPMR recommendations

A major event in 2006 was an external program and management review (EPMR) of ILRI. The EPMR affirmed that ILRI's strategy should continue to focus on global livestock-poverty issues with emphasis on tropical livestock production and marketing systems. The review encouraged broader regional implementation of the strategy, especially in Asia. The review panel agreed with ILRI's focus on dynamic market-oriented smallholder livestock systems and with ILRI's emphasis on finding ways for poor people to benefit from expanding their livestock income opportunities as producers, input suppliers, market agents and employees. The panel challenged ILRI to put greater effort into marginal pastoral and agro-pastoral systems by looking at ways to reduce the vulnerability of these livestock keepers and increase the sustainability of their livestock systems. Annex 1 provides recommendations of the review, the response by ILRI's board and management, and the steps being taken to implement each of the recommendations within a given timeframe.

Regarding implementation of ILRI's research agenda, the EPMR also made specific recommendations as to how ILRI could better implement its work on livestock and the environment. The review endorsed ILRI's continued emphases on applications of biotechnology to animal health, development of new vaccines and diagnostics to control livestock diseases, and tackling emerging zoonotic diseases, such as avian influenza.

During 2006, ILRI responded to these recommendations on the scope and management of its research agenda, and these responses and actions are included in this MTP, as annotated in Annex 1. Most recommendations of the review were implemented immediately. Others of a more systemic nature are being implemented over 2008–2010 and progress in this will continue to be reported in subsequent MTPs.

ILRI's alignment with CGIAR system priorities

The main CGIAR system priorities (SP) to which ILRI research contributes are the two livestock-specific system priorities;

- Income increases from livestock (SP 3B)
- Conservation of indigenous livestock (SP 1C)

Over 50% of ILRI's resources go towards the above two system priorities. ILRI also contributes to several other priorities where livestock play an important role in the ecosystem and/or the policy and institutional research agenda.

Many of the new elements introduced by the CGIAR system priorities—such as income improvement, more coordinated efforts in natural resource management, and integrating policy and institutional research with technologies—are central to ILRI's strategy and research plan.

The CGIAR system priorities to which ILRI contributes are:

SP 3: Reducing rural poverty through agricultural diversification and emerging opportunities for high-value commodities and products

SP 3B Income increases from livestock

SP 1: Sustaining biodiversity for current and future generations

SP 1C Conservation of indigenous livestock

SP 2 Producing more and better food at lower cost through genetic improvements

SP 2D Genetic enhancement of selected species to increase income generation by the poor

SP 4 Poverty alleviation and sustainable management of water, land and forest resources

SP 4A Integrated land, water and forest management at landscape level
SP 4C Improving water productivity
SP 4D Sustainable agro-ecological intensification in low- and high-potential environments

SP 5 Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger

SP 5A Science and technology policies and institutions
SP 5B Making international and domestic markets work for the poor
SP 5C Rural institutions and governance
SP 5D Improving research and development options to reduce rural poverty and vulnerability

ILRI contributions to the CGIAR system priorities are summarized below.

- ***Reducing rural poverty through agricultural diversification and emerging opportunities for high value commodities and products (SP 3)***

Income increases from livestock (SP3B): ILRI sees great opportunities for poor people to benefit from the increasing demand for livestock products in developing countries. Over half of ILRI's resources are invested in this system priority, which provides a unifying focus for ILRI's work across key tropical livestock systems in developing countries.

- ***Producing more and better food at lower cost through genetic improvements (SP 2)***

Genetic enhancement of selected species to increase income generation (SP 2D): ILRI's research on breed improvement in livestock is also linked closely with market-oriented activities as new breeds are intended to open up new market opportunities for smallholder livestock keepers (e.g. identifying dairy cows able to be more productive for smallholder dairying in the tropics; sheep with disease tolerance that enables them to enter expanding export markets in the Middle East).

- ***Sustaining biodiversity for current and future generations (SP 1)***

Conservation of indigenous livestock (SP 1C): The other livestock-specific system priority where ILRI plays a leadership role is on conservation of animal genetic resources (AnGR). ILRI has led the development of a draft framework plan on AnGR for the CGIAR, in collaboration with ICARDA. Bioversity International and the System-wide Genetic Resources Program (SGRP) are also contributing to the thinking in this important area by sharing their experiences in the conservation and characterization of plant genetic resources for food and feed crops.

- ***Poverty alleviation and sustainable management of water, land and forest resources (SP4)***

Integrated land, water and forest management at landscape level (SP 4A)

Increasing global attention is being paid to environmental issues and the positive and negative impacts of livestock on the natural resource base. Livestock are recognized to have important implications relative to several environmental concerns, including climate change, land degradation and the ability of people to utilize marginal lands in a sustainable way. The research challenge is to investigate ways that better link crops and livestock to intensifying production while enhancing positive benefits and reducing negative effects of livestock in the environment.

Improving water productivity (SP 4C): One of the increasingly scarce natural resources highlighted in the CGIAR system priorities is water. ILRI only began livestock-water research in 2005. ILRI has worked closely with IWMI in developing a framework for enhancing livestock-water productivity. Further work on implementing research on livestock-water productivity will be focused on the landscape level (SP 4A, with some contributions also to farm-level improvements (SP 4C).

Sustainable agro-ecological intensification in low- and high-potential environments (SP 4D): In the broader livestock-environment context, ILRI has placed most emphasis on pastoral systems where it is looking at options for livestock keepers to diversify their livelihood opportunities, reduce their vulnerability and improve options for sustainable land use. ILRI has previously placed little emphasis on intensifying systems in which other actors such as FAO-LEAD were active.

However, with the greater rate of intensification of livestock production in developing countries, ILRI will give more emphasis to research on this system in this coming MTP period.

- ***Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger (SP 5)***

Livestock provide broad but complex pathways out of poverty. This complexity provides greater research challenges requiring integrating technologies with enabling policies and more efficient institutional arrangements. However, the challenges also provide the opportunity for broader benefits beyond productivity and income increases to primary producers; these benefits include backward linkages for suppliers of input services as well as many employment opportunities along livestock value chains.

Cross-cutting research priorities

Many of the lessons learned and outputs from ILRI's work cut across two or more system priorities. For example, the policy and institutional research aspects contribute towards:

- Improving science and technology policies & institutions (SP 5A);
- Making international markets work for the poor (SP 5B)
- Improving rural institutions and their governance (SP 5C) and
- Improving research and development options to reduce rural poverty and vulnerability (SP 5D).

The policy and institutional research by ILRI also links with other livestock research by ILRI, which jointly contributes to other system priorities, notably:

- Income increases from livestock (SP 3B)
- Livestock-environment issues (SP 4D)

Research on sanitary and phyto-sanitary issues for livestock trade, with a focus on promoting risk-based assessment systems and helping the poor to enhance market opportunities directly contribute to making international and domestic markets work for the poor (SP5B).

Research and capacity building activities moving beyond the CGIAR system priorities

As a facilitator of research-for-development platforms, ILRI hosts some additional stand-alone capacity building activities that complement ILRI's own research program. These include the regional network component of the BecA project (governed and managed by a regional steering committee and the BecA secretariat) and the non-research components of the IPMS project that support specific development and capacity-building activities.

Human nutritional and market development activities were noted as non-system priority activities in the MTP commentary of last year. ILRI is now more clearly defining ILRI's appropriate niche in these important activities through partnership arrangements. ILRI's livestock research over the next three years will seek to benefit human health and nutrition outcomes but these are mediated through livestock research on income increase through livestock (SP 3B) rather than by specific human nutritional research projects. Such work will be conducted within broader CGIAR collaborations on agriculture and health and nutritional benefits of food-based interventions with public health and nutrition collaborators elsewhere. For market development activities, ILRI is focusing its role as a research and knowledge provider and actively engaging development partners for managing and implementing field activities.

Programmatic achievements and lessons learned 2006

Evolving strategy and research agenda

ILRI's evolving strategy and research agenda is building on prior research results and experience in implementing the strategy and the previous ILRI medium-term plans. One of the main challenges is that ILRI is a relatively small research institute with global responsibilities. ILRI's response to this task has been to identify and work on a limited number of global livestock issues that are linked to its overall vision of livestock as a pathway out of poverty.

Another challenge has been how to draw lessons on these global livestock issues from a variety of representative systems and sites across different geographic regions to make the findings globally relevant as well as applicable to the key livestock regions in sub-Saharan Africa and South Asia, where poverty is most prevalent. During the past year, some key emerging global issues influenced the on-going shaping of our strategic thinking. These included a growing emphasis on how to respond to rapidly changing challenges of environmental sustainability (with emphasis on climate-change issues) and the continued and growing importance of emerging diseases, currently typified by avian influenza. During 2006, ILRI made important efforts to respond to both these global challenges of climate change and emerging diseases and to position itself to make future contributions on these and the other global livestock issues.

Targeting and Innovation

Given the complex and dynamic nature of livestock production and marketing systems, foresight of how these systems are changing is a critical element of ILRI's approach. In the previous MTP, ILRI highlighted plans to realign work on targeting with that on innovation systems. This integration is as critical to allowing ILRI to both understand and influence pro-poor livestock outcomes and impacts (as described in Figure 1). This change in organizational structure was made at the beginning of 2007 and the number of themes reduced from five to four, with a new theme for Targeting and Innovation replacing two separate themes. Our experience is that the development of innovation for livestock research capacity will be a gradual process both in building research capacity in this area and in integrating this capacity across the research program of ILRI and its partners. Another challenge is to find the research skills needed, since these require a combination of livestock science and innovation-systems disciplinary skills. It will also require a gradual process of building capacity of partners in a new area. Expertise in innovation systems as it can be applied to livestock systems is limited and we are relying on a combination of mentoring younger researchers as well as collaborations with some key innovation systems experts.

There have been some important initial lessons learned in the application of innovation-systems research approaches to key livestock research for development challenges. For example, within the IPMS project, experience has been gained in process monitoring and response-capacity assessment for livestock market chains. Research findings from previous work on supply chains for feeding are being synthesized into a conceptual framework that can be broadly applied, by looking at who are the key actors and analysing how to build their response capacity in improving livestock feeding systems.

A cross-cutting Innovation Works initiative has been started. This group will provide research support across the ILRI research program in learning tools such as monitoring and evaluation, outcome mapping, impact assessment and gender analysis. This research-support capacity is closely linked to the strengthening of research methods (biometrics, data management, GIS) capacity through a joint ICRAF-ILRI Research Methods Group that was formed in 2006.

ILRI's previous investments in research on GIS, systems analysis and synthetic spatial analyses of livestock and poverty have positioned ILRI well to provide relevant research evidence on the broader environmental and developmental implications of livestock system changes. This work began with targeting high-priority areas and options for livestock-water investments and will expand into animal genetic resources, feeding and health research. This capacity has allowed ILRI to contribute research outputs quickly to demands from donors for evidence on spatial targeting to support investments in adaptation to climate change. Research outputs were quickly synthesized in an analysis published as a book, ***Mapping Climate Vulnerability and Poverty in Africa***, 2006.

This and other data have supported initial decision-making on targeting climate change adaptation efforts by investors. This work is described in the ILRI 2006 outcomes, prepared for the 2006 performance indicator report to the World Bank. These general targeting outputs now need to be pulled together to assess potential livestock adaptation options under different contexts that can then be tested and adapted. Collaboration with the Innovation Works and Research Methods Group to optimize design and monitoring and evaluation of these future interventions will be critical.

Improving Market Opportunities

Much of the recent work under the Market Opportunities Theme has focused on market chains, particularly in the dairy sector. Research evidence has then been used by national and regional dairy sector regulators and non-governmental organizations in training and interventions to improve hygiene along the market chain. This work will continue, building on initial efforts in risk analysis and control strategies in local markets in East Africa. However, in areas where there is greater demand for livestock products than supply and in systems in which severe production deficits relative to market demand exist, we plan to put greater emphasis on input supply chains, particularly for breeding and feeding in collaboration with other ILRI projects. The initial focus of this work will be in South and Southeast Asia in pig and dairy systems but will be expanded to dairy systems in East Africa and indigenous ruminant meat systems in West Africa over the next three years.

ILRI's dairy research has documented multiple pro-poor benefits along the value chain, including backward linkages for supplying feed, employment on farm and in distribution and delivery of milk; this work is creating a critical body of knowledge on improving market chains, particularly in improving informal market chains. In collaboration with NGO and CSO partners, we support projects to scale up and out the lessons learned in East Africa and South Asia. Documenting process lessons and impacts of policy research on understanding and mitigating risk in informal milk markets were synthesized in 2006 and will support these scaling out efforts in the next few years.

Zoonotic diseases

The initial global emphasis on avian influenza research has been on monitoring viral populations and considering strategies to reduce the risk of a global pandemic. Most funding and research efforts have been placed on technologies (vaccines, antiviral drugs, diagnostic tests) to eradicate or control avian influenza and in global-warning systems to predict and combat a global pandemic. This has been important. However, with the establishment of endemic avian influenza in several developing countries in Asia and Africa, there is also a need for research to identify critical risks for the poor and how these can be mitigated; these include: What are practical options for surveillance and control in endemic countries to improve both animal and human health? How can smallholder poultry production systems be adapted to reduce risk and what might be alternative market arrangements? The risk mitigation strategies can play an important role in reducing the overall risk of a potential avian influenza pandemic. To address these issues, ILRI, IFPRI, FAO's Pro-poor Livestock Policy Initiative and some advanced research institutions have developed and will initiate a project assessing and comparing risk and its control across a number of countries in Asia and Africa.

In field activities to understand the risk of avian influenza and to control it in a cost-effective manner, there is a critical role in enhancing the capacity of veterinary services. The use of participatory-epidemiology approaches to improving surveillance for avian influenza has been very successful, particularly in Indonesia. ILRI has developed a networking approach in consultation with OIE, FAO and national programs to expand these participatory approaches on an experimental basis. Enhanced capacity of veterinary services will be critical; ILRI is enhancing the capacity of veterinary services by supporting their work in gathering critical information and assessing risks and field impacts of vaccination and other control strategies.

Biotechnology

Vaccines and diagnostics

ILRI's vaccine and diagnostics research is at a crossroads. Despite important scientific success in parasite genomics, antigen discovery and immunological screening that led to the development of prototype recombinant vaccines for East Coast fever, these vaccines have not consistently stimulated protective cell-mediated immunity. Some subsequent work in 2006 with different adjuvant systems has so far failed to make a major difference. With other research teams in North America and Europe facing similar constraints for other human and animal diseases, ILRI's vaccine team has embarked on a major reassessment of vaccine experimentation strategies. While exploring possible new strategies for sub-unit vaccines, ILRI in the short-term is providing support to transferring the technology for producing the live infection-and-treatment method (ITM) vaccine against East Coast fever (ECF). Using these vaccine field situations over the past several years, external groups have improved the inoculation procedure to reduce the incidence of adverse reactions with no reported loss in vaccine efficacy. During the past two years, ILRI has played a key role in a process aimed at facilitating wider application of the vaccine, and there has been considerable progress in getting the agreement of policymakers and regulators, convened by the African Union, for the widespread deployment of ITM. ILRI in partnership with GALVmed, a consortium of public and private entities with expertise in product development, will be improving the production technology with a view to transferring it to the other interested parties in both the private and public sectors.

ILRI will evaluate its past vaccine research and consider opportunities for research into other vaccines and diagnostics through a centre-commissioned external review to be conducted in late 2007 and early 2008. Further details are provided in the Biotechnology project narrative.

Livestock genetics

Considerable thought has been put into adapting research strategies in livestock genetics and breeding. In the area of animal genetic resources (AnGR), previous efforts at quantifying diversity and identifying diversity hotspots and actual and potential threats to diversity are being consolidated and synthesized. This understanding of animal-genetic diversity provides a basis for future research to better understand the relationships between genetic diversity in livestock populations and systems change (both market and natural resource systems) through collaborative research by the Biotechnology, Market Opportunities and Targeting and Innovation themes. An understanding of the key drivers, such as market demand, that influence changing diversity will be used to conduct field experiments on how these drivers might be influenced through different technical, institutional and policy options, to explore the benefits of conservation (by utilization) of indigenous livestock as compared to the use of non-indigenous livestock.

Livestock breeding

As noted in the 2007–9 MTP, another major shift in livestock genetic improvement strategy has been to place a greater emphasis on considering practical breeding systems for delivering improved livestock in high-priority production systems. In 2006, two new staff were recruited to help develop this research area. ILRI has not previously had much emphasis in this area, as it considered that this was the role of national systems, farmer organizations and small and medium-sized enterprises. While these actors must be the main implementers of breeding programs, ILRI now realizes that the chance of successful implementation of such programs can be greatly enhanced by ILRI supporting partners in the design, testing and evaluation of practical breeding options, particularly for smallholder systems and for breed improvement in indigenous livestock systems.

People, Livestock and the Environment

The implications of the Livestock Revolution are that a doubling of livestock demand will need to be met from the same natural resource base by 2020. The research challenge is to intensify production through better feeding, genetics and management, while ensuring environmental sustainability of the system. This requires integrating different components of production, markets and environmental research. No other research institute is better placed than ILRI to achieve this integration of research effort.

Food-feed dual-purpose crops

ILRI has made good progress on research on dual-purpose food-feed crops in collaboration with crop research centres. The methodologies for selecting improved varieties for human food and animal feed are now well established for major dual-purpose crops (cowpea, groundnut, pigeon pea, maize, sorghum, pearl millet and rice) in crop-livestock systems in Asia. Simple and reproducible methodologies for livestock nutritional selection have been developed and can be used by national crop-breeding systems, for example for sorghum, groundnut and pearl millet in India. In 2006, methodologies and approaches were consolidated. Next steps will now be to: (1) extend these approaches widely to key crop-breeding institutions; (2) examine broader feeding strategies, including the use of crop by-products and (3) integrate research on feeds and forages with environmental assessment, considering water, lands and nutrient flows.

Forage genebank

In the tropical livestock systems of Africa and Asia, forage diversity provides important potential future options, although at present forages are more selectively utilized than staple crop residues in smallholder farming systems. As part of its international public-good commitment, ILRI has been upgrading its forage genebank (18,760 forage accessions completed) as part of collaborative activities under the System-wide Genetic Resources Programme (SGRP). ILRI and other CGIAR Centres have placed the plant genetic resources accessions they hold under international auspices as part of the International Treaty on Plant Genetic Resources for Food and Agriculture, which was signed on 16 October 2006.

As part of its global public good role, ILRI has been strengthening the knowledge management and accessibility of the collection through improving the data quality of accessions, using GIS tools for passport data, and mapping distribution of species and suitability for use. Information is being made available through the ILRI website as well as through SGRP's SINGER. We see important opportunities for plant researchers to use this collection, especially those looking to investigate unique characteristics of tropical grasses in relation to drought resistance, disease resistance and potential new applications such as biofuels. We will also continue to focus on targeted efforts to make forage resources available in specific settings. An important success of this approach has been to support national programs with disease-resistant Napier grass varieties to support the scaling out of smallholder dairy activities across East Africa. ILRI will work with national partners in East Africa over the next few years to scale up disease-resistant Napier grass in coordination with ASARECA.

Livestock and water

ILRI only recently became involved in research looking at the role of livestock in more efficient and effective use of water, in collaboration with IWMI. Initial efforts have focused on setting the scene for livestock-water research by developing a conceptual framework and providing targeting information on potential research and development investments. In 2006, an important synthesis of this work was published by the ILRI livestock-water team in the chapter *Water and livestock for human development* as part of the Comprehensive Assessment of Water Management and Agriculture (CA) book, *Water for food; water for life*. This work has highlighted for the first time the important role of livestock in water issues globally. This framework, along with the methodologies developed, will allow ILRI, IWMI and other partners to design, test and evaluate livestock interventions at landscape and farm levels for improvements in water quality and water use efficiency. A starting point will be to assess water productivity in feed and forage production as an important aspect of environmental sustainability in intensifying crop-livestock systems.

Pastoral systems

ILRI's research to assess changes in pastoral livelihoods and livestock-related ecosystem services in East and West Africa has focused on issues of assessing ecosystem viability and livestock management options, together with multi-stakeholder processes for negotiation, cost sharing and policy formulation. Capacity-building activities have contributed to moving outputs to outcomes, especially in East Africa. The work on natural resource management for the pastoral poor by the Kitengela Landowners Association (KILA) and ILRI was the focus of an award-winning poster at the 2006 CGIAR AGM. Integrating these approaches into a broader vulnerability and sustainability context, and facilitating their applications beyond East Africa, will be the next steps for ILRI. This is consistent with the EPMR recommendation to give more emphasis to pastoral systems.

Public health, food safety and zoonoses

Research to protect and improve human capital through public-health interventions targeted to poor producers and consumers of livestock and their products was initiated in 2006 through two major collaborative programs. The first program is with Cornell University, focused on adapting risk-based approaches for food safety. It involves both the People, Livestock and Environment and Market Opportunities themes. The work on food safety is adapting epidemiological risk analysis to the context of informal and other domestic markets for livestock products and development of an appropriate methodology. The second new program is with the Swiss Tropical Institute to improve the assessment and control of zoonoses. The food safety work fits well with research in the Market Opportunities Theme, while the zoonoses research links closely with other research to reduce human vulnerability in both marginal and intensifying systems, under the People, Livestock and the Environment agenda.

Operational changes and achievements 2006

Geographic scope of ILRI's operations

ILRI expanded its operations in southern Africa in 2006. A regional representative was appointed, an office established in Maputo, Mozambique, and initial projects in livestock markets and the role of livestock in reducing vulnerability were launched. These efforts have built on a scoping study of livestock opportunities in southern Africa, conducted together with ICRISAT. ILRI will next focus more attention on realigning and strengthening its activities in West Africa in 2007 and 2008.

ILRI has progressively increased its presence and research activities in Asia since ILRI began operations in 1995. The 2006 EPMP provided an opportunity to reflect on these experiences and to consider both new opportunities and new ways of working in the different regions of Asia (South, Southeast and East Asia). A concerted effort to reassess the ILRI Asia strategy relative to ILRI's global strategy and to consider new implementation arrangements will be undertaken in late 2007 and early 2008.

Partnerships strategy

Research partnerships are fundamental to ILRI's strategy. All our research is conducted in partnership with others, and the capacity of partners is critical if ILRI's research efforts are to lead to development of outcomes and impacts. To improve our contributions to partnership and capacity building, ILRI has conducted two centre-commissioned external reviews in 2005 and 2006—one on capacity strengthening and the other on partnerships.

Capacity building and training

Subsequent to the 2005 capacity-strengthening external review, an internationally recruited position to head capacity strengthening at ILRI was advertised and the incumbent took up the post in January 2007.

ILRI's capacity-building efforts are conducted in the context of its research partnerships. There is great emphasis on targeted support to increase capacity in other institutions. Two examples of important capacity-strengthening initiatives that illustrate this point are:

- Building capacity to do advanced bioscience research as part of the BecA platform and the Joint Laboratory for Livestock and Forage Genetic Resources with CAAS, in Beijing.
- Imbedding capacity development for veterinary services through participatory approaches to provide in developing countries veterinary-service competencies that are critical for both implementing surveillance and control operations and learning how to do these better.

Biosciences eastern and central Africa (BecA)

Important progress has been made over the past year in developing the BecA/ILRI shared research platform. The laboratory design elements, including environmental impact assessments, were completed and implementation approved in September 2006; the funding agreement was signed in January 2007. An intense two-year phase (until March 2009) has now commenced for the construction and development of the platform at the ILRI campus in Nairobi as well as the development of a research and capacity building program with partners in the region. An

experienced construction manager was appointed in late 2006 and recruitment of a platform research manager is soon to be finalized. Considerable management inputs are required in the short term to establish and nurture this ambitious venture but we expect long-term efficiency gains from sharing many common laboratory facilities and consolidating facilities management to better support research.

Innovation Works

To improve its research performance, ILRI has been strengthening key elements of its internal capacity. Progress has been made in establishing and strengthening the new Innovation Works initiative, particularly in the areas of monitoring and evaluation, outcome mapping, impact assessment and gender analysis. This has been done in the context of strengthening our capacity to translate knowledge into action. In improving our thinking on this we have engaged actively with two outside groups, the Innovation Expedition (Canada) and a team from Harvard University.

Human resources: leadership and management

Many of the new approaches taken up by ILRI require strengthening of our human resource capacity, particularly in the management and leadership skills of staff. In 2006/7 considerable investment was made in building the capacity of staff in these areas. Further attention is needed in improving our skills in recruiting key individuals with skills for strategic analysis, as well as improving our capacity to mentor younger staff and partners in those skills.

ILRI/ICRAF alignment in corporate services

To improve the efficiency and effectiveness of corporate services and other research support operations, ILRI and ICRAF are aligning these services. In 2006 the CGIAR Secretariat agreed to co-finance alignment activities over the next three years. A joint Research Methods Group (including biometrics) was established in 2006 to serve researchers at both institutes. A joint ICT unit is being established in 2007.

The Medium Term Research Agenda 2008–10

Summary of program and organizational changes since the ILRI 2007–9 MTP

1. ***A global ILRI*** will strengthen its focus on integration of ILRI and partner research on key global livestock issues and how these can be adapted to priorities and capacities in targeted regions.
2. Targeting and innovation: The Targeting Opportunities theme, as proposed in the last MTP, was reconfigured to include research on innovation systems, and renamed as the ***Targeting and Innovation Theme***.
3. Livestock and human health: ILRI has aligned and strengthened its epidemiological and risk assessment research to address both animal and human health impacts within the Improving Markets Theme. This will allow a more integrated approach to improving the quality, safety and pro-poor access of livestock products to local, regional and export markets. Appropriate research evidence will be made available to both the veterinary and public health communities for improved delivery of animal health services and developing risk-based, rather than rule-based approaches to improving livestock product safety. Enhancing the role of livestock in nutritional security and human health will be pursued by strategically promoting the livestock perspective in the nutrition and public health research communities in both vulnerable pastoral and smallholder intensifying production systems. ILRI views the improvement of health of poor producers and consumers of livestock products as a critical outcome of its research and will review its research across themes to contribute more meaningfully in this area.
4. Vaccines and diagnostics research: A significant review of research on ***vaccines and diagnostics*** will be undertaken: ILRI's focus on new and on-going vaccine and diagnostic projects will be assessed in a Centre-Commissioned External Review to be conducted in early 2008. Approaches to speeding up vaccine development for novel vaccines to stimulate cell-mediated immunity will be explored with partners. In the short-term the transfer of technology

for the infection-and-treatment method of East Coast fever vaccination will be undertaken with public and private partners.

5. Livestock genetics and breeding: ILRI will link its research on the characterisation of livestock genetic diversity to an assessment of drivers of change in target production and marketing systems with a view to improving the use of indigenous breeds as appropriate. A proportion of the livestock genomics portfolio will use molecular tools to investigate and understand the function of genes in disease resistance in cattle and sheep. Research to better understand successes and failures in breeding programs will be undertaken to inform the design and implementation of programs in smallholder intensifying and agro-pastoral systems.
6. The ***People, Livestock and the Environment*** (PLE) Theme will be increasing its emphasis on integrating production and environmental research in both pastoral and intensifying systems, initially in livestock feeding, water and land use.
7. ***Research services***: Investments are being made to improve research quality and to improve skills and approaches for translating research outputs into development outcomes and impacts through incorporation of an innovation systems approach into research planning and implementation, improved use of monitoring and evaluation, outcome mapping, impact assessment and gender analysis.
8. ***ILRI ICRAF Alignment in Corporate services***: A 3-year plan has been developed for the alignment of corporate services between ILRI and ICRAF. The intention of the alignment process is to increase the efficiency of operations of both institutes, so as to release more resources for international livestock and agroforestry research programs.

Highlights of the 2008 Project Portfolio

Evolution of the globalization of ILRI

- Development of briefs on key global livestock issues in which ILRI is engaged in and as necessary identify the need for synthesis papers on key gaps
- Identification of the relative importance of global issues in different regions of Africa and Asia and how these reflect regional priorities through a systematic consultation process with key opinion leaders and stakeholders
- Implementation plans for Asia livestock activities developed with partners with different partnership and implementation modes considered for different regions

Capacity building and partnerships

- Scaling up support for capacity building in research platforms (BecA, joint livestock and forage genetic resources in China, SAKSS)
- Institutional capacity building for research and development partners to ensure outcomes and impacts (e.g. build capacity of public and private partners for the production, distribution and delivery of ITM)
- Assessment of opportunities for capacity building within regional networks in Asia and southern Africa
- Professionalize partnership management at ILRI by strengthening initial agreements on roles and responsibilities, and improving communication and lesson learning through the partnership process.
- Institutionalization and strengthening capacity of the Ethiopian NARS within IPMS

Strengthening ILRI research support

- Focus on improving monitoring and evaluation, outcome mapping, impact assessment and gender analysis skills to support ILRI and partner research programs through the innovation works unit
- Focus on improving data management and research quality control through the joint ICRAF-ILRI research methods group
- Improve internet and data transfer capacity
- Major phase of infrastructure development and platform management services for the BecA hub (2007-9).

Human resources and administration

- Continued efforts to align corporate services with ICRAF
- Continued focus on improving leadership and management skills of ILRI staff

Targeting and Innovation

- Build on initial targeting work for climate change vulnerability hot spots to analyse key drivers of livestock-mediated adaptation options
- Analysis of drivers of livestock change in the main tropical livestock production and marketing systems to inform research priorities (feeding, natural resource and environmental management, genetics and breeding, health)
- Support for ex-ante work for targeting animal health technologies
- Diagnostic framework for innovations interventions applied in market chain and feed scarcity projects in India, Ethiopia, southern Africa and Nigeria
- Collaboration between Targeting and Innovation group and Research Methods group on design for testing options for social experimentation with livestock-related interventions
- Build on diagnostic work on entry points for livestock to reduce vulnerability in pastoral and agro-pastoral systems for engaging development partners to design and test risk management strategies

Market Opportunities

- Collaboration with development partners to use research knowledge generated to guide the design and evaluation of programs for large scale dairy development in East Africa
- Evaluate impact of dairy policy and regulatory interventions for improving market opportunities for the poor

- Synthesis of tools for risk assessment applied to promoting public health and pro-poor market access options in domestic and regional markets
- Assessment of institutional arrangements for input supply and marketing in smallholder pig systems in South-East Asia
- Strategies to enhance the capacities of veterinary services to improve their skills in surveillance and assessment of avian flu risks and the success of control efforts
- Comparative study of avian flu risks across a variety of Asian and African countries and an assessment of the impacts of disease risk control and mitigation strategies

Biotechnology

- Develop, with research partners, a process for improving knowledge sharing and innovation through a vaccine research network, as a platform for addressing common constraints to vaccine development
- Improve the production process for infection and treatment method (ITM) of vaccination for East Coast fever and make available vaccine for distribution and delivery in 2009
- Collaboration with AU-IBAR, NARS, GALVmed and local private sector companies on improved institutional arrangements for distribution and delivery of ITM vaccine for East Coast fever as well as technology transfer of the production process
- Initial synthesis of major drivers of livestock system changes in the context of their effect on livestock genetic diversity
- Proof-of-concept of new technologies to provide cross-bred dairy cattle to the livestock sector in East Africa

People Livestock and the Environment

- Package tools for selection of dual purpose staple crops for use by national crop breeding programs
- Initial synthesis of targeting feeding strategies by key production and marketing system
- Focus on enhancing knowledge availability and management to improve the accessibility of the forage genebank collection to researchers
- Apply tools for livestock-water interventions in IWMI's target river basins in SSA and possibly South Asia
- Realign human health work on market and consumer food safety risks with the Market Opportunities theme
- Synthesis of system diversification approaches from field studies in pastoral and agro-pastoral systems in East and West Africa

ILRI contributions to broader CGIAR initiatives

ILRI and the regional plans for collective action in Africa

ILRI supports the Regional Plans for Collective Action in Africa, a new Alliance-led process to catalyze the contributions of global agricultural research to regional agricultural research priorities. ILRI has put staff time and financial resources into leading the Alliance efforts to develop the regional plan for eastern and southern Africa (ESA). In early 2007, ILRI, on behalf of the Alliance, recruited and is hosting the ESA collective action plan Coordinator. ILRI is working closely with other Centres, facilitated by the Coordinator, on resource mobilization and implementation plans. The progress in such collective actions is difficult to predict and will depend on the availability of resources as well as commitment of individuals and groups of Centres to work together in areas such as natural resource management and market development in which collective action is most needed.

The ESA plan has four research flagship areas that are under development. The People Livestock and Environment Theme is contributing to proposal development in the Integrated Natural Resource Management flagship and in plans for a symposium in the Genetic Resources flagship. The Targeting and Innovation and Market Opportunities Themes are contribution to the planning for a conference and proposal development for the Markets and Institutions flagship. ILRI is also providing general support to the flagship areas on highly stressed and unstable environments through contributions to planning for agricultural research development in southern Sudan. The joint ICRAF-ILRI Research Methods Group are contributing to research methods capacity development linked to regional research priorities

ILRI was an active contributor to the development of the Regional Plan for Collective Action in West and Central Africa (WCA) and ensuring links to the ESA plan. ILRI's main activities in West Africa in animal genetic resources, animal health and crop-livestock systems are not initial priorities for collective action in WCA. We expect that as links develop between the collective action plans and the Sub-Saharan Africa challenge program that ILRI's research contribution to crop-livestock intensification in challenge program pilot sites will also link to collective action efforts in WCA

System-wide and eco-regional programs

ILRI coordinates the CGIAR System-wide Livestock Program (SLP) and participates in 6 other system-wide programs (see Box 1 below). ILRI's participation in these programs is determined by the opportunities for livestock research to add value to the objectives of the program and its capacity to contribute. Livestock research could add value to some system-wide and eco-regional programs in which ILRI does not currently participate in, but limitations in human resource capacity necessitate that we focus on a sub-set of programs.

System-wide Livestock Programme

The SLP is a multi-centre initiative that adds value to the outputs of individual CGIAR centres and their partners by creating and exploiting synergies in crop-livestock research to reduce poverty in areas where small-scale mixed crop-and-livestock production is widely practised.

Details of the global activities of the SLP are presented separately, as an ILRI project narrative. Each participating centre in the SLP also highlights its contribution to SLP in its centre medium-term plan. Below are the highlights of ILRI's contribution to the SLP.

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

ILRI research plays three major roles in the SLP. The first is in coordinating research on major drivers of change in crop-livestock systems. ILRI's main effort in this area is to develop conceptual frameworks that can contribute to assessments 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 programs of CGIAR centres working on plants used as dual-purpose food-feed crops. The major thrust has been on establishing methods for assessing, and indicators of, 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's People, Livestock and Environment Theme. For ILRI, this is a very strategic and high-impact research area, since the improved dual-purpose crops identified can be bred and disseminated through the well-established breeding programs of CGIAR crop centres and their public and private partners. As noted in both the People, Livestock and Environment and SLP project narratives, as the livestock nutrition technical research is being finalized, ILRI's contribution is evolving to livestock feeding strategies in a broader systems context in which tradeoffs between using crop residues for feed, conservation agriculture and other crop uses need to be considered.

The third area in which ILRI contributes to the SLP is in coordinating research on innovative partnerships and strategies for mitigating feed scarcity in crop-livestock systems. Initial work has been conducted with public, private and NGO partners in India and Nigeria and is expected to expand in 2006/7 to scale-out lessons in these two countries and to extend studies to Ethiopia, Syria and Vietnam. This is reported under the Targeting and Innovation and People, Livestock and Environment themes.

Additional details of SLP's new strategy and medium term plans are found in the SLP project narrative.

Other system-wide and eco-regional programs

One of the 6 system-wide initiatives that ILRI contributes to is the **Collective Action and Property Rights Initiative (CAPRI)**. An ILRI scientist serves on the steering committee and assists in CAPRI's PhD fellowship program.

ILRI has collaborated with the **Participatory Research and Gender Analysis (PRGA)** program, most recently on a joint analysis of opportunities for gender mainstreaming within ILRI. Currently PRGA is planning to implement a new strategy and we will assess opportunities for joint work as the PRGA team develop their plans.

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

Collective Action and Property Rights (CAPRI), led by IFPRI
Participatory Research and Gender Analysis (PRGA), led by CIAT
Desert Margins 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 Bioversity
System-wide Livestock Programme (SLP), led by ILRI

ILRI (People, Livestock and Environment Theme) has been an active participant in the **Desert Margins Programme (DMP)** over the past 4 years. One livestock scientist has been directly involved in and funded by DMP. For 2008, ILRI has two output targets that contribute to DMP. One will be to synthesis of changes in resilience and adaptive capacity related to different land use and policy scenarios in a Sahelian agro-pastoral system in Niger. The second is on options for enhancing livestock-mediated strategies for sustainable management of natural resources and conflict management in East and West Africa. ILRI also supports strengthening capacity in DMP

member countries to undertake land degradation and biodiversity conservation research and to apply and evaluate best-bet technologies and practices.

ILRI (People, Livestock and Environment Theme) has been working with members of the **Rice-Wheat Consortium (RWC)** for the Indo-Gangetic Plains since 2005 to describe and understand crop-livestock interactions in the rice-wheat systems of these plains. The research adopts a systems perspective to evaluate the contributions of crops, livestock and their interactions to the livelihoods of resource-poor families and to identify 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 and **Urban Harvest** continue to collaborate on the role of livestock in urban agriculture. ILRI is advising on a dairy goat component of a project led by Urban Harvest testing interventions for HIV/AIDS-affected households in Kenya.

ILRI (People, Livestock and Environment Theme) is working closely with other CGIAR centres as part of the **System-wide Genetic Resources Programme (SGRP)** in the areas of forage and livestock genetic resources. ILRI is applying the common CGIAR centre policy instruments and guidelines on genetic resources, biotechnology and intellectual property rights developed through the program. The SGRP plays a strategic role in coordinating collaborative action among centres on genetic resources management, research and capacity development. This program represents the system at international fora and contributes to global agendas and policy development.

ILRI is involved in the system-wide upgrading of genebanks and activities on the collective action for the rehabilitation of global public goods in the CGIAR genetic resources system through the SGRP. ILRI is seeking to work more closely with CIAT and ICARDA on developing a common approach to the conservation and sustainable use of forages in the CGIAR. Planning is under way to strengthen research collaboration in the CGIAR on animal genetic resources, both through the SGRP and with Bioversity International and ICARDA. Two important planning meetings in 2006 addressed opportunities for collaboration and the FAO sponsored First International Technical Conference on Animal Genetic Resources, to be held in September 2007 in Interlaken, Switzerland, will address priorities for the sustainable use, development and conservation of animal genetic resources worldwide. The ILRI Director General is presenting the lead paper on animal genetic resources at the scientific component of the inter governmental conference.

Challenge Program for Water and Food

The ILRI-led proposal titled 'Increasing water-use efficiency for food production through better livestock management—The Nile River Basin' is in the implementation phase, with a focus on using tools (spreadsheet model and GIS approaches) to assess feed and environmental options that enhance the contribution of livestock to water productivity. Whilst this project focuses on the Nile Basin, ways to apply the methods developed in other basins in the broader context of the CPWF, as well as other regions are being pursued.

New research outside of the Nile Basin will enable the tools developed to be applied by stakeholders in other situations and the main **modus operandi** for this is to engage young scientists from different areas, especially where crop livestock systems are intensifying (e.g. as postdoctoral scientists) to work with the ILRI and IWMI teams, learn the approaches and then work together with their home institutes in applying and modifying these in their target regions. Working together with the Targeting and Innovation theme, with the Basin Focal Projects of the CPWF for key SSA river basins will also be explored in order to enhance the potential IPG nature of livestock water productivity assessments generated from cross-basin comparisons.

Sub-Saharan Africa Challenge Program

The role of ILRI in support of the Sub-Saharan Africa Challenge Program (SSA-CP) continues to be in providing strategic scientific advice and research inputs. ILRI has helped to identify science entry points, investment priorities and context-specific technical, policy and institutional options

for reducing poverty at three of the program's pilot learning sites. The work includes development of an analytical framework that will facilitate comparative analysis and lesson learning within and across all the sites. The outputs of this research will help set priorities and target the science and technology investments at all the SSA-CP sites. It will also facilitate dialogue between the Forum for Agricultural Research in Africa (FARA) and lead Institutions on SSA-CP investments.

At the request of FARA, ILRI led a consortium of research and development partners to develop a proposal on crop-livestock intensification options across the three pilot learning sites. ILRI was also requested to be on the Core Research Support Team that will provide strategic guidance and analytical inputs to the SSA-CP.

Financial highlights

Financial health indicators

ILRI's research program is largely long term in nature. Adequate provisioning for completion of research activities, therefore, requires sustained, prudent management of assets supported by an energetic fund-raising strategy. ILRI has assumed responsibility for creation and management of the BecA/ILRI shared research platform, which will upgrade ILRI's research facilities, while also making them more accessible to scientists throughout the eastern and central Africa region. This and other innovative platforms and new ways of doing business are being implemented at a time when unrestricted resources are levelling off and fund raising is becoming more complex. ILRI has therefore further strengthened its fund-raising capacity and its financial planning processes to assure that operations are sustainable.

ILRI's financial projections are presented below (Table 1).

Table 1: ILRI projected operating levels and related financial indicators 2006–2010

	Expenses/Budget (in \$k)	Operating result (\$k)	Short-term solvability (#days)	Long-term financial stability (#days)
2003	30,215	106	147	133
2004	31,711	3,226	163	148
2005	32,272	2,065	231	224
2006	35,408	(4,223)	189	174
2007	50,352	(2,040)	78	91
2008	47,004	(1,176)	74	93
2009	34,248	(1,249)	107	119
2010	32,999	0	132	145

The current CIDA grant that finances the BecA initiative, mainly the capital costs for the shared biosciences research platform at ILRI, will end in 2009, thereby bringing the ILRI overall budget back towards its long term trends.

The ILRI Board has approved a large drawdown on reserves, starting in 2006, to invest in both infrastructure and additional human resources, including a large investment in management skills for research managers, that will help move ILRI's research agenda (and fund-raising) forward. This investment in new research leaders is already paying off in terms of new appointees bringing in some large research grants in 2007, and this trend is expected to increase in 2008-10. This will raise the level of the financial health indicators in 2009 and 2010.

Those projections are based on conservative estimates for unrestricted and restricted income and assume careful geographic expansion/redeployment and strict management of unrestricted expenses.

The context for resource mobilization is rapidly changing with new actors and new, more complex, approaches emerging. Building on the EPMR recommendations, ILRI has strengthened its resource mobilization capacity by engaging a resource mobilization officer, developing a forward looking set of global livestock issues that require public good research and engaging actively with partners in developing such large scale initiatives.

The institute is highly aware of the challenges for funding the BecA/ILRI shared platform beyond the completion of the present grant in 2009. This challenge is being addressed by a three way approach of mobilising additional funding by: (1) attracting an increasing number of research projects to use the platform's facilities; (2) providing research and related services to third parties on a fee for service basis; and (3) seeking long term program support to maintain the essential core competencies and basic functions of the platform. Beyond ILRI's own efforts to raise the required funds, BecA is a member of the NEPAD African biosciences initiative and works closely

with sister networks and the NEPAD Science and Technology secretariat to mobilize resources for these biosciences platforms in Africa.

ILRI has also embarked on other less traditional fund-raising initiatives:

- ILRI is constantly seeking to obtain human resources in more flexible arrangements such as joint appointments and long term visiting scientists.
- This is a natural outcome of deeper, larger partnerships that bring in expertise but also more fund-raising opportunities, even if those benefits must be weighed against the costs of the additional management complexity.

MTP PROJECT NARRATIVES

Targeting and Innovation

Rationale for the MTP project and changes

The livestock sector in the developing world is changing rapidly, largely as a result of rising populations, incomes and demand for animal foods. The challenge for developing countries is to find ways to meet the increasing demand for livestock products utilizing the same or a declining resource base and facing the prospect of an increasingly variable, and often drying, climate.

Structural changes in the livestock sector can significantly affect both poverty and the environment. But whereas it is little known that many poor people are failing to benefit from opportunities arising from their countries' growing livestock sectors, livestock production increases to meet the increasing demand are increasing both the impacts of livestock on the environment and public attention to this environmental issue.

ILRI addresses both the equity and environmental issues arising from the rapidly changing livestock sector in developing countries. Scientists are investigating such questions as, How can more poor people benefit from livestock growth? What role do livestock play in the strategies people employ to cope with external shocks? What risk management options can reduce the vulnerability of livestock and their keepers to climatic shocks? How does applying a 'poverty lens' to the livestock research agenda help identify interventions that enable farmers to stay or climb out of poverty? How do livestock and livestock enterprises impact specific environments and circumstances? How can we use this knowledge to develop optimal technical and policy interventions?

Staff in ILRI's Targeting and Innovation Theme identify gaps in livestock research; evaluate technical, policy and institutional options for sustainable poverty reduction in areas where livestock are the mainstay of poor livelihoods; and synthesize knowledge on important livestock-poverty issues in specific contexts in the developing world. Outputs of this Theme facilitate priority-setting in ILRI's other themes, sharpen the poverty focus within ILRI and its research and development partners, and influence the global livestock development agenda.

Outputs of the Targeting and Innovation Theme are delivered through strategic and applied research in the following four broad output areas.

- ***Livestock systems evolution:*** This operating project assesses major trends and future scenarios of livestock-sector development in the developing world, identifies researchable issues key to sustainable poverty reduction, and draws implications for livestock research and development agencies working to use livestock as instruments for sustainable poverty reduction. Work in the current MTP period, 2008–2010, focuses on two major areas: (1) understanding the complexity of livestock systems and how they are changing as a guide for priority-setting in ILRI's other themes; and (2) synthesizing knowledge to help ILRI and its research and development partners address global livestock challenges. A major output in the MTP period will be analyses of the drivers of change in livestock systems in the developing world and the specific ways in which these drivers are related to poverty. This research builds on previous ILRI work to create scenarios of livestock development and to map livestock and poverty in the developing world. This research will assess the major change drivers in livestock systems so as to characterize the links between livestock and poverty, project future trends under different scenarios, and identify emerging research issues. The work characterizing livestock-poverty links will identify hotspots and other high-priority intervention areas, which will help ILRI's other themes target for more in-depth research areas where there is high probability of maximizing the impacts of livestock research on poverty reduction. For example, this research will help link work by ILRI's Biotechnology Theme to characterize livestock genetic diversity in West Africa to trends in livestock production, markets and demand so that the research can identify the most appropriate strategies and options for conservation and use of West Africa's indigenous animals. Quantitative scenarios of livestock futures will be developed and used to compare the utility of implementing different research-based interventions and to help scale out research impacts. In the

second output area, the Theme will deliver two major papers during the MTP period. The first will synthesize knowledge on climate change and livestock to help identify key knowledge gaps in how smallholder and pastoral livestock production contributes to climate change and how climate change and variability affects these livestock systems. A second paper will analyze livestock-environment issues with a poverty and livelihood lens. This output will provide context-specific insights into social equity and environment issues in livestock development. Future synthesis work is planned in the areas of animal health and genetics.

- ***Livestock, poverty, and livelihoods:*** This operating project maps poverty, links livestock and poverty spatially, and determines the roles of livestock in poverty pathways. Work in this MTP period focuses on asset-based approaches to pathways out of poverty for people and communities dependent on livestock for their livelihoods. This work combines disciplinary research approaches with spatial and non-spatial and qualitative and quantitative methods to understand the roles of livestock in pathways into and out of poverty. The asset-based approach applied in previous work on livestock and poverty dynamics suggests two research areas for this MTP period. The first builds on empirical evidence that livestock help people secure their livelihood assets by reducing their vulnerability to a wide range of shocks. Scientists are researching vulnerability and risk management in pastoral, agro-pastoral and other marginal areas in sub-Saharan Africa and South Asia. The second research area investigates the role of livestock in helping poor people build their productive assets through improved technologies, market access and institutions. It will also investigate interventions to enhance the policy, institutional and public context in which household livelihood decisions are made. Outputs from ILRI's other themes feed into the work to identify intervention options. ILRI's Market Opportunities Theme, for example, provides insights into institutional arrangements for linking poor people to markets. Feeding strategies from the People, Livestock and Environment Theme and vaccines from the Biotechnology Theme provide technical options for improving livestock productivity. Future research will evaluate technical, policy and institutional interventions that help households manage risk and take advantage of new opportunities in livestock enterprises.
- ***Targeting pro-poor livestock interventions:*** This operating project combines spatial analysis and household modelling to quantify impacts and evaluate trade-offs of alternative livestock interventions on food security, livelihoods and environmental outcomes. This research aims to identify development pathways, strategic investments and targeted technical, policy and institutional options in specific livestock systems. During this MTP period, this Theme will develop an ex-ante poverty impact model integrating a livestock-sector model and a partial equilibrium multi-market model in collaboration with ILRI's Market Opportunities Theme; the integrated model will be used to assess the potential benefits poor people derive from interventions in the dairy and ruminant sub-sectors in sub-Saharan Africa and South Asia. The Theme will also use spatial and household-level decision-support tools to identify and evaluate feeding strategies for specific livestock systems and, jointly with ILRI's People, Livestock and Environment Theme and other CGIAR centres in sub-Saharan Africa and South Asia, to assess feed and management options for improving livestock water productivity. Work with ILRI's Biotechnology Theme will evaluate the impact of community-based interventions to improve the profitability, conservation and use of indigenous animal genetic resources. Work on climate change and its impacts on livestock systems will get increased attention. Research outputs will build on previous broad-brush analyses of climate change, vulnerability and hotspots and include assessments of regional impacts on food security and livelihoods of livestock keepers at the household level. Systems approaches will be employed to identify and evaluate options, including index-based livestock insurance and other interventions, to manage increased risks of, and adaptations to, climatic shocks.
- ***Innovation in livestock systems:*** This operating project applies innovation system approaches to understand the processes by which research knowledge is translated into sustainable improvements in livestock livelihoods. Research outputs during the MTP

period include development of a conceptual framework to guide innovation systems research in livestock systems, employing innovation approaches in poverty diagnostic work, action research using monitoring and evaluation to build capacity to create innovations in livestock feeding systems, markets and health. These outputs will be delivered with other ILRI themes. Future work will explore opportunities and challenges arising from changes and trends in specific livestock systems.

Questions raised by the CGIAR Science Council and ILRI's Science Advisory Panel about strategic links between ILRI's Targeting and Innovation and other themes and how outputs of the Theme are guiding priority setting across ILRI prompted work to analyse and characterize key trends in livestock systems in the developing world. Outputs of this work will help identify major research issues, strategic choices in livestock research for development, and implications for ILRI's research agenda in specific livestock-poverty contexts in the developing world. This work will help to anchor key livestock issues such as the environmental impacts of livestock production, animal health and genetics, and livestock intensification within a broader poverty and livelihood context. This big-picture perspective will help guide strategic choices by ILRI and its research and development partners in choosing where to work and what issues to work on.

The Theme has learned much from ILRI's recent EPMR, from centre-commissioned external reviews of Systems Modeling and Spatial Analysis, from comments by the CGIAR Science Council and ILRI's Science Advisory Panel and from active engagement in several development initiatives. These lessons are changing the way we work with others to influence thinking on global livestock challenges. They are helping us to define a broad research agenda. They are helping us to make informed projections about the future of the developing world's livestock economy and its component livestock systems, how the poor will be affected by these systems, and research opportunities for ILRI and others. We will increase our use of the outputs of other ILRI themes to identify and evaluate intervention options and strategies to reduce poverty and vulnerability, work explicitly to raise the level of research dialogue across ILRI, consult more widely with other research and development partners, and engage more fully in global policy dialogue. We will add value and influence research and development partners in two ways. We will selectively generate and synthesize knowledge on important global livestock challenges where our work can help frame the issues within a broader poverty and livelihoods context. And we will use our systems perspective of the links between poverty and livestock production and marketing systems to identify issues and interventions appropriate for specific livestock contexts.

Our poverty diagnostics and analysis of livelihood strategies provides a poverty and livelihood focus in work to determine strategies and options for the conservation of indigenous livestock genetic resources in SP1C. Our diagnosis, identification and evaluation of technical, policy and institutional options to take advantage of demand-driven livestock growth opportunities contribute directly to SP3B. Our improved understanding of socio-economic and natural resource drivers and their impacts on smallholder livestock systems, as well as the impacts of the livestock sector on the environment, which are helping to generate options that sustain livestock intensification, contribute to SP4D and SP5A. Our identification of research and development options to reduce poverty support SP3D. Our evaluation of ways in which people can better manage risks and reduce their vulnerability contribute to SP5D.

Description of impact pathways

The Targeting and Innovation Theme delivers three broad research outputs for its target audience: strategic guidance in priority setting for ILRI's themes and senior management; analyses of livestock-poverty-environment links for ILRI and its research and development partners; and support for conducting *ex-ante* impact assessments, targeting investments, and monitoring and evaluation work for ILRI, other CGIAR Centres, national and sub-regional research organizations and development organizations.

Our research on major trends in livestock systems in the developing world responds to demands from other ILRI themes, senior management and external stakeholders such as the Science Council to strengthen the strategic links between the outputs of Targeting and Innovation and ILRI's other themes. Our consultations with other ILRI themes and stakeholders help us identify our research questions and outputs, which systematically characterize livestock production

systems and poverty. These outputs are used to help select research locations and activities as well as livestock poverty contexts.

Our research on livestock-poverty links supports implementation of ILRI's strategy by generating empirical information and knowledge that can be used to refine ILRI's focus and enlarge its ability to respond to global livestock challenges. Outputs of this research disseminated via internet, research briefs and presentations in meetings, seminars and workshops help our partners in the national research systems of developing countries and in development agencies set their research agendas and priorities. Presentations made in a variety of influential fora during this MTP period, for example, will add a missing poverty-and-livelihood context to discussions of the impacts of the livestock sector on the environment provoked by FAO's study, *Livestock's Long Shadow*, published in 2006.

Outputs from the Theme's work on poverty dynamics and the role of livestock in pathways out of poverty informs institute-wide research planning and responses to global livestock challenges. Recent work in southern Africa helped ILRI set priorities and identify strategic entry points for livestock research for development work in the region. Lessons on how to increase the participation of poor people in growing livestock sectors are being used to strengthen pathways out of poverty through enhanced market participation, diversification strategies, and targeted feeding and animal health strategies research. Risk analyses are helping to identify market-based risk management strategies, options to address feed scarcity, and the highest-priority animal diseases for smallholder livestock producers. Dissemination of the knowledge generated in this work is increasing ILRI's usefulness as a knowledge provider in pro-poor global livestock issues. Development agencies are major clients for the outputs of the Theme's work on livestock-poverty issues. Clients such as FAO, the CGIAR Challenge Program on Water and Food, DFID and the World Bank are using this Theme's reports on livestock and poverty, vulnerability, climate change and water productivity to integrate livestock issues into development investments. FAO's emergency division, for example, is using outputs from this Theme's work on livestock, vulnerability and livelihoods in Southern Africa to design and implement livestock-based interventions that will enable households to better cope with their food insecurity through improved risk management. Other clients are using our analysis of hotspots of water conflicts in crop-livestock systems, undertaken with ILRI's People, Livestock and Environment Theme, to improve livestock water productivity in the Nile Basin. The World Bank and COMESA are using our livestock-poverty-vulnerability-climate change analyses to reduce poverty and vulnerability in pastoral and agro-pastoral areas in eastern and southern Africa.

Research on *ex-ante* impact assessment, targeting interventions, and monitoring and evaluation help ensure that ILRI's research outputs are targeted to specific contexts and tracked and evaluated more effectively. Technical, policy and institutional options generated by ILRI's other themes help Targeting and Innovation staff determine optimal intervention options for different areas and circumstances. The main external clients for these outputs are sub-regional research organizations such as ASARECA and FARA, CGIAR system-wide initiatives and Challenge Programs, and development and donor agencies such as FAO, the World Bank, UNDP, EU and DFID. Nearly all of our outputs are developed and delivered jointly with other ILRI themes. This theme is collaborating, for example, with the People, Livestock and Environment Theme, CIP and national partners in China, Vietnam and Thailand to evaluate the ways in which different livestock feeding strategies impinge on livelihoods. We are also working with ILRI's Market Opportunities and People, Livestock and Environment Themes, as well as ICRISAT and partners from the private and public sectors in southern Africa, to identify entry points for interventions in livestock value chains, to test the entry points in action research with development partners, and to monitor and assess the livelihood impacts of alternative livestock-based interventions. And the Theme is working with ILRI's Market Opportunities and People, Livestock and Environment themes, as well as partners from the private and public sectors, to identify innovations that can help solve the problem of fodder scarcity while drawing lessons for building capacity to innovate to improve feeding systems in India and Nigeria.

ILRI hosts the Strategic Analysis and Knowledge Support System (SAKSS) node for Eastern and Central Africa, a key partner in information and knowledge sharing in the region. SAKSS undertakes joint research with the Targeting and Innovation Theme, for example, on vulnerability and risk management in pastoral and agro-pastoral areas in eastern Africa. SAKSS has strong

networks and links in regional economic communities and political organizations such as COMESA and is providing analytical work to support implementation of NEPAD's Comprehensive Africa Agriculture Development Program (CAADP). SAKSS provides a policy and advocacy platform through which research products and knowledge acquired and generated by the Theme are widely disseminated to end users at regional and national levels.

The Theme systematically undertakes activities to enhance translation of its research outputs into outcomes. These include early dialogue with research clients to get agreement on research issues, questions and outcomes; to clarify the roles and expectations of different partners; and to organize feedback sessions for obtaining partner inputs into preliminary research results and outcome-impact logic, lesson learning, and the best ways of scaling up the beneficial impacts of the research project.

The Theme strengthens research capacity in its partners through collaborative work that includes targeted training and skills development. For example, research and policy analysts from sub-Saharan Africa, South Asia and Southeast Asia are being trained in using spatial and non-spatial analytical tools to conduct poverty and vulnerability analyses, to do household modelling, and to design quantitative and qualitative approaches for monitoring and evaluating the effectiveness of poverty interventions. Together with the ILRI-ICRAF Research Methods Group, the Theme is conducting training for regional partners in GIS and other spatial tools for analysing livestock production systems in East Africa and identifying entry points for innovation in sub-Saharan Africa and South Asia. The Theme is also strengthening capacity in project and program design in partner research and development organizations. FAO regional staff, for example, used outputs from the Theme's livestock, vulnerability and livelihoods study in southern Africa to help them design specific interventions. The Theme is training research analysts, NGO staff and other actors in social experimentation, action research, and monitoring and evaluation in a collaborative project to strengthen innovation capacity for livestock feeding, markets and animal health work in West Africa, southern Africa and India.

Research approach to deliver international public goods

The Theme has three major strategies for generating international public goods. First, the Theme is synthesizing empirical information and results from case studies to generate policy-relevant knowledge on livestock-poverty and sustainable development. In the MTP period, syntheses of issues in animal health and at the interfaces of livestock and climate change / environment will provide context-specific knowledge for a broad range of research and development partners addressing livestock issues within a broader poverty and livelihoods context. Second, the Theme is working with the ILRI-ICRAF Research Methods Group to apply statistical principles to empirical research, hypothesis testing and social experimentation on livestock-poverty issues to ensure that results from location-specific research projects generate lessons for similar contexts. These statistics-based approaches to social experimentation and learning will be applied in work on feeding strategies in ILRI's Fodder Innovations Project in India and Nigeria and in its Livestock and Livelihoods Project in southern Africa. Third, the Theme continues to invest in development of widely applicable decision-support tools, methodologies and analytical frameworks. For example, an integrated *ex-ante* poverty impact model is being developed with the Market Opportunities Theme to assess poverty impacts of livestock interventions. This model will be available for use by our research and development partners wanting to evaluate the poverty impacts of their interventions.

Elaboration of partner roles

The Targeting and Innovation Theme has science and development partners. Most of our science partners are from NARS, local universities and autonomous research organizations, sub-regional research organizations, advanced research institutes, and other CGIAR Centres. They are involved in the conceptualization, design and implementation of research activities. Development and policy partners—mainly from donor and development agencies, NGOs, national governments, sub-regional research organizations and regional economic communities—use the research outputs from the Theme in program and project design, strategy formulation, monitoring and evaluation, experimentation and policy advocacy. These partners frequently initiate research studies but usually play a secondary role in designing and implementing research activities.

However, they do provide valuable feedback on research results that the researchers use to revise their project designs. Delivery of our research outputs and transformation of those outputs to outcomes often involve the close collaboration of our science and development partners.

Delineation of the roles of partners is based on complementary skills and expertise as well as differences in comparative advantage. For example, in our work linking livestock and poverty and vulnerability, researchers from advanced research institutes such as Cornell and Columbia universities lead development of the conceptual framework, research questions and key hypotheses on pro-poor livestock growth while researchers at ILRI and partner national research organizations lead empirical work to test hypotheses through fieldwork and household level studies. FAO and COMESA commissioned research through SAKSS to address vulnerability in livestock production systems in eastern and southern Africa. The Theme is implementing these studies in collaboration with research partners from NARS and universities in these regions. FAO and COMESA are using the results to design interventions that reduce vulnerability in pastoral and agro-pastoral systems. The results are also informing concepts and designs of studies on index-based livestock insurance to address climate risks; this work involves Cornell and Columbia universities, the World Bank, WFP, COMESA and sub-Saharan African NARS. ILRI and its science partners are testing the feasibility of weather-based livestock insurance. The World Bank, WFP and other development partners will use the results to design and implement pilot index-based livestock insurance schemes in selected countries. ILRI will monitor and evaluate performance of the pilot interventions to learn lessons for defining research priorities and designing future programs. Working with advanced research institutions in this project ensures that cutting-edge analytical approaches and research tools are applied; the close involvement of our development partners ensures common understanding of how the research outputs are to be used.

Innovation research is particularly collaborative in nature. In its Fodder Innovations Project, the Theme is collaborating with the United Nations University–Maastricht Economic and Social Research and Training Centre (UNU-MERIT), FAO-PPLPI, ICRISAT, IITA, national researchers, NGOs and the private sector to enhance innovations that reduce the ubiquitous seasonal scarcity of livestock fodder in large parts of India and Nigeria. UNU-MERIT, FAO-PPLPI and ILRI are leading development of a conceptual framework for activities that will be tested in social experiments through action research. NARS, NGOs and the private sector are together implementing the action research while ILRI and its science partners help monitor and evaluate activities to track and assess what works and doesn't work, to learn lessons regarding program design and results-based management processes, and to identify IPGs for scaling up. ILRI is involved in other collaborative projects in eastern and southern Africa where our NGO, private-sector and development agency partners are playing similar roles in social experimentation, applying an innovation systems perspectives to livestock systems research.

Science, development and policy partners are working with the Theme on climate change issues. Analytical and modelling work on climate change is undertaken with other CGIAR centres in a collaborative effort between the CGIAR and Earth System Science Partnership (ESSP) as well as with advanced research institutions such as Universities of East Anglia and Edinburgh, Michigan State University and universities in developing countries. Development and policy partners such as DFID, IDRC and the World Bank are supporting ILRI's synthesis and dissemination of knowledge on climate change. DFID and IDRC are using results of our climate change work in setting their research agenda on climate change in Africa and in their advocacy work on the impacts of climate change in the region. ILRI's climate change research results have also been used by a range of partners advocating pro-poor positions; among the recent influential users of ILRI research are the Stern Review on the Economics of Climate Change and the 12th UN Conference of the Parties to the UN Convention on Climate Change.

Targeting and Innovation Logframe

	Outputs	Intended Users	Outcome	Impact
(Targeting and Innovation) 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 reducing poverty in the developing world (3-5 years)	ILRI Themes, regional research organizations (ASARECA, CORAF, SADC, FARA), donors, (DFID, IDRC); development agencies (World Bank, UNEP)	Analyses of livestock development pathways used to set priorities and target interventions in ILRI and its partners research portfolio and integrate livestock issues into the agenda of at least one regional and one donor organization	Enhanced pro-poor orientation of the livestock research and development agenda and increased resource allocation to pro-poor livestock research
Output target 2008	Systematic characterization of livestock systems and poverty in developing countries documented and used to identify priority areas for intervention and key research issues to guide ILRI's research and influence the broader livestock development agenda in the developing world			
	Feed supply and demand and their changes to 2030 projected and used to indicate hotspots of feed scarcity now and in the future in livestock systems in Sub-Saharan Africa and South Asia			
	Global and regional maps of the spatial distribution of livestock production systems in the developing world, revised, documented, and disseminated			
	Synthesis of information and knowledge on climate change and its interaction with livestock documented, and disseminated to identify key knowledge gaps in climate change and livestock research in Sub Saharan Africa			
Output targets 2009	Enhanced understanding of the impact of climate change in livestock systems in East Africa developed and used to inform the identification and design of coping and adaptation strategies for dealing with increased risks in pastoral systems and lessons drawn			

	Outputs	Intended Users	Outcome	Impact
	for the Horn of Africa			
	Characterization of livestock genetic diversity in a poverty-production-market systems documented, and used to identify context specific options for sustainable conservation and use of animal genetic resources in West Africa and lessons drawn for the developing world			
	Synthesis of information and knowledge on the impact of livestock-environment-poverty linkages in specific systems documented and disseminated to inform intervention options on sustainable livestock development in the developing world.			

Output targets 2010	Future scenarios of the impact and trade-offs from alternative livestock interventions developed and used to support scaling out of promising research results from specific sites to larger regions in Sub-Saharan Africa and South Asia			
	Synthesis of information and knowledge on animal diseases in specific livestock- poverty contexts documented and used to identify research gaps and inform strategies for reducing poverty through animal health			
(Targeting and Innovation) Output 2	Improved and better targeted policies and strategies identified to guide design and formulation of sustainable pro-poor livestock interventions and poverty reduction (3-5 years)	ILRI Themes, policy makers, policy advisors, NGOs, and development agencies	Targeted livestock interventions used to design pro-poor and vulnerability reducing livestock policies, programs, and projects and formulate effective poverty reduction and risk management strategies in two countries and one major regional initiative in Africa	Improved livelihoods of poor people as a result on evidence based pro-poor strategies, policy, program, and project design
Output targets 2008	Enhanced understanding of household risk management and coping strategies used to identify options for managing risks and reducing vulnerability in livestock systems in 6 country case studies in Eastern and Southern Africa and lessons drawn for addressing vulnerability in similar production systems in developing countries			
	Analysis of the role of livestock in poverty reduction strategies used to facilitate cross-sectoral linkages and support livestock decision makers in poverty dialogue in Uganda and lessons drawn for policy application in Eastern Africa.			
	<i>Ex-ante</i> poverty impact model used to quantify the direct and indirect impact of livestock interventions on poverty in Namibia, Mozambique, and Zimbabwe			

	and lessons drawn for designing and monitoring pro-poor investments			
Output targets 2009	Analytical work on index-based livestock insurance scheme used to test its feasibility in East Africa and lessons drawn for mitigating risks in pastoral and agro-pastoral systems in sub-Saharan Africa and South Asia.			
	Hotspots of vulnerability to food security in pastoral and agro-pastoral systems used to identify priority areas for research and development investments			

Output targets 2010	Options for coping with and managing risks in pastoral and agro-pastoral systems evaluated to identify cost-effective interventions for project design and implementation in COMESA countries			
	Empirical analysis of livestock based livelihood strategies used to identify technical, policy, and institutional options that help poor people build their productive assets and improve the productivity of assets in three case study countries in Southern Africa and lessons drawn for designing interventions arising from livestock growth opportunities in the developing world.			
(Targeting and Innovation) Output 3	Analytical framework and tools for identifying and assessing impacts for livestock based interventions developed and used for targeting pro-poor investment choices (3-5 years)	ILRI Themes, Other CGIAR Centers, regional research organizations, development agencies	Analytical frameworks and decision support tools used to set investments priorities and target interventions by at least 2 major agricultural and rural development investment programs	Targeted investment priorities and interventions maximize the poverty impacts of research and development interventions
Output targets 2008	Options for science and technology interventions identified, evaluated, and prioritized for all Pilot Learning Sites of the SSA-CP in East, West, and Southern Africa			
	Synthesis of trade-offs from conservation agriculture practices used to identify priority research areas for conservation agriculture livestock systems in Sub-Saharan Africa and South Asia			
Output targets 2009	Evaluation of climate change intervention options used to identify adaptation strategies in agro-pastoral areas in Eastern and Southern Africa			

	<p>Evaluation of the impact of community based interventions to improve the profitability of indigenous poultry in Benin and Ethiopia used to identify strategies for sustainable conservation and use of animal genetic resources and lessons drawn for Sub-Saharan Africa</p>			
	<p><i>Evaluation of global feed demand and supply to 2030 used to identify hotspots of potential feed scarcity and improved feeding strategies and options for specific livestock systems in South Asia (with the People Livestock & Environment Theme)</i></p>			

	<i>A framework developed for identifying hotspots of water scarcity in crop-livestock systems used to set research priorities and identifying strategies for improving livestock-water productivity in the Nile River basin (with the People Livestock & Environment Theme)</i>			
	<i>GIS based analyses of livestock water productivity for selected livestock systems in Sub-Saharan Africa (with the People Livestock & Environment Theme)</i>			
	Evaluation of synergies and trade offs in conservation agriculture used to identify options for improving livelihoods in intensifying livestock systems in the Indo-Gangetic Plains of South Asia			
Output targets 2010	Evaluation of the impact of sweet potato as pig feed in intensifying systems of Asia (China, Vietnam and Thailand) used to develop improved feeding strategies			
	Evaluation of feed demand and supply in developing countries to 2030 used to identify hotspots for feed deficits and improved feeding strategies for specific livestock systems in developing countries			
(Targeting and Innovation) Output 4	<i>Enhanced understanding of process and mechanisms that enable the use of research outputs into innovations for sustainable improvement in the well being of poor people who depend on livestock for livelihoods (5-10 years)</i>	ILRI Themes, Other CGIAR Centers, regional research organizations, development agencies	Improved characterization of capacity to innovate, social experimentation, and more effective learning used to design pro-poor livestock interventions in at least 2 major agricultural and rural development investment programs	Enhanced interaction of research with other actors in the innovation process generates quicker and more sustainable livelihood impacts for poor people
Output targets 2008	Conceptual frameworks for addressing fodder scarcity used to identify key research questions and applied in livestock systems in India and Nigeria and lessons drawn for addressing innovation capacity in specific			

	livestock contexts			
	Characterization of actors and institutions involved in insurance and other risk management products in Kenya used to identify promising institutional arrangements for designing index-based livestock insurance for pastoral and agro-pastoral areas and lessons drawn for risk mitigation options in similar production systems in sub-Saharan Africa			
	Protocols developed for guiding action research on how to build and sustain innovation processes in livestock feed and animal health in Sub-Saharan Africa and South Asia			

Output Targets 2009	Guidelines for enhancing innovation in animal feeds and animal health sub sectors synthesized and lessons drawn for designing interventions using innovation systems approaches in Sub-Saharan Africa			
	Characterization of innovation capacity used to diagnose and identify relevant entry points for strengthening innovation in feed and animal health in Ethiopia, India and Nigeria			
	Principles and guidelines developed to guide the strengthening of Learning-based Innovation Monitoring and Evaluation (LIME) systems in livestock fodder and animal health contexts in Sub-Saharan Africa and South Asia			
	Protocols developed for guiding action research on how to build and sustain innovation processes in the context of access to livestock markets in Ethiopia			
Output targets 2010	Characteristics of successful livestock innovation processes synthesized from action research activities in India, Nigeria and Ethiopia and lessons drawn for designing livestock innovations			
	<i>Innovation system based strategies to address access to and use of fodder resources, especially in relation to new market opportunities (with the People Livestock & Environment Theme)</i>			

Rationale for the MTP project and changes

Livestock products have long been a pathway by which poor people generate income. Rapidly growing and changing livestock markets in the developing world provide real opportunities—but also significant challenges—for participation by the poor in those growing markets. Threats to smallholder farmers arise from the increasing integration and complexity of livestock product markets; increasing demand for food quality, safety and convenience; and, at the producer level, constraints to smallholders' productivity and ability to produce high-quality products due to lack of technology, inputs, resources and information.

Some consumer segments in developing countries, particularly in Asia, are clearly demonstrating higher demand for Western-style product quality and safety attributes, and markets now offer an increasingly integrated modern market chain that places value on food safety, on high and uniform quality, and on increased scale of production to capture economies of scale in collection and processing. These higher end markets, part of the 'supermarket revolution', will play an increasingly important role even in poor countries. However, due to demand for cheap products with traditional characteristics, markets for traditionally processed, or unprocessed informal, products continue to predominate in most developing countries, even while demand for higher quality increases at the higher market end. Because traditional and indigenous products are not easily supplied by larger scale formal markets, or substituted for by imports, they create unique opportunities for small-scale producers and market agents. This research program builds on those unique opportunities, whether in the form of 'raw' (unpasteurized) milk, fresh pork, indigenous poultry, or range-fed, organically raised small stock. These markets may be local or international, particularly as disposable incomes among migrant communities rise. In both informal and formal market chains—from producers to consumers—food safety is a concern both from the point of view of the health and nutrition of producers, consumers and market actors and as a potential barrier for smallholders to access higher end markets. The public health issues related to livestock and livestock products play an increasingly important role in ILRI's Improving Market Opportunities Theme, which is further supported by the new integration into the Theme of human health-related work formerly managed within ILRI's Theme on People, Livestock and the Environment. The Markets Theme addresses the dualistic nature (traditional and modern) of livestock product markets and aims to help 'bridge the gap', supporting the role of smallholders in the transition process and providing research support to help these actors and processes provide opportunities for the poor.

Because livestock market chains are long and complex, they provide many opportunities for the poor to participate through input and service supply and in myriad ways through the marketing and processing of livestock products. ILRI thus assesses livestock value chains (including inputs and services supply) for pro-poor opportunities, then targets sectorally and regionally the best systems and components where the poor can benefit, with a focus on dairy, pigs and poultry.

Although research shows that many smallholder livestock products remain competitive with output from large-scale farms and with imports, 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 our focus on **smallholder competitiveness**. This requires not just improved output market linkages but also increased farm productivity through improved technologies and, critically, access to appropriate and reliable livestock services and inputs—the 'backward' linkages that support productivity.

- **Smallholder competitiveness in changing markets:** In this first output, the competitiveness of poor producers is targeted through research on improved technologies, institutions and policies that address changing production systems and markets for outputs and services/inputs. The focus is farm-level, action-oriented and recognizes the complex, multi-objective nature of poor farm households. The work typically involves smallholders, service and input suppliers in smallholder settings, and buyers and integrators in mixed crop-

livestock systems and intensifying peri-urban systems. There are two main areas of attention in this output: a) institutions and strategies to support sustained uptake of improved production technologies, and b) contractual and organizational arrangements to support smallholder participation in markets. The focus systems are smallholder dairy systems in sub-Saharan Africa and Asia, smallholder pig systems in Southeast Asia, and livestock systems that depend particularly on indigenous breeds in sub-Saharan Africa. The initial work on scoping of smallholder pig systems in northeast India and a new ACIAR-supported project on policies to support smallholder pig producers in Vietnam began in 2007. In 2008, a new output on the role of indigenous livestock in enhancing competitiveness and sustainability of smallholder producers will start with an ILRI-wide project in West Africa funded by GEF and the AfDB, in close collaboration with the genetics group of ILRI's Biotechnology Theme. In this current MTP period, increasing attention is given to the role and effectiveness of input and service provision to smallholder farmers, particularly those that are market-mediated. Thus in 2008 a new output target has been added to provide an initial assessment of fodder and feed market case studies, with a view towards establishing the background needed to developing new work in the area of inputs and service markets. Additionally, work is being developed to address animal health services, in line with the increased integration of epidemiology into the Markets Theme.

Even the most competitive small farms may not be viable if they cannot respond to changing demand for food safety, quality and uniformity. Design of better marketing institutions and strategies would allow smallholders to meet new requirements, hence a focus on **changing demand** structures that motivate the need for new **institutions**. These structures need to be implemented in the context of continued dominance of the traditional, informal markets that resource-poor producers and consumers chiefly rely on, so that **bridging the gap** between formal and informal markets, in terms of quality and safety, must be one objective.

- **Changing demand and market institutions:** This output addresses the drivers of change in livestock markets supplied by the poor, including potential changes in demand for better quality products, increased safety and higher levels of processing. It considers private-sector and collective responses to the new market opportunities and requirements, the impact of changes in industrial organization through the supply chain on small-scale producers, and the means for helping the latter and small-scale market agents to respond. It also assesses the impact of these changes on access by poor urban consumers to low-cost livestock-source foods. The output increasingly examines the actual safety characteristics of livestock products in alternative market channels and applies a quantitative risk-analysis approach to understand potential food safety-livelihood synergies or trade-offs to inform decision-makers. The primary targets are institutional options for smallholder livestock producers and the supply chains that serve them. A secondary target is options for appropriate levels of food safety and enhanced risk mitigation strategies in local markets. Some of the work is action-oriented and includes pilot testing technical and institutional options where appropriate with development partners. Changes in the Theme portfolio in 2008 include incorporating the public health dimensions of food safety and risk analysis to complement the existing focus on market standards related to food safety, responding to a recommendation of ILRI's EPMR, and a new project on improving smallholder market participation in four southern African countries. This will allow lessons and approaches developed in East Africa and India to be extended for comparative analysis.

Beyond these domestic markets, major global procedures for control of animal disease 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 these standards are often too high for small-scale operators in developing countries to meet, hence a focus on **animal health for trade**.

- **Animal health for market access and trade:** The purpose of this output is to address the animal health-related barriers to the access of poor and small stakeholders to local, national,

regional and/or international markets. Through the identification, development and evaluation of animal disease control, surveillance or livestock and livestock commodity certification methods, this operating project helps stakeholders meet animal health and food safety standards restricting their access to various markets. This work draws attention to the high costs of compliance with existing sanitary and phyto-sanitary (SPS) and other standards facing producers in developing countries who wish to sell into 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. Risk analysis from veterinary epidemiology is combined with analysis of the costs and benefits of different options and policies, including the implications for both direct and indirect impacts on the incomes of the poor. Such methods further provide the basis for improved pro-poor decision- and policymaking through assessments of cost-effective animal health alternatives and the means for stakeholders to more effectively respond to zoonotic and emerging diseases that potentially reduce market opportunities, such as highly pathogenic avian influenza (HPAI) and Rift Valley fever. High losses in smallholder systems due to HPAI and the major investments being made in HPAI control that will affect the viability of smallholder systems have made this area a key focus over the medium term. Furthermore, through applied research and capacity-building, the output disseminates innovative and more effective animal health and food safety solutions that contribute to an increase in market participation. A key element of this operating project is in its collaboration with other ILRI themes in developing research priorities for animal health and food safety, assessing the impacts of animal diseases in terms of public and environmental health, and evaluating new diagnostic and preventive tools for diseases. The focus of partnership with lab-based organizations (such as advanced research institutions) and policy and standard-setting organizations (such as OIE, FAO and CODEX) will be to demonstrate interactions between the context and practical requirements of developing countries with the technical options available in different parts of the world. One output target on animal health constraints to markets (in the Near East and North Africa) was moved from 2007 to 2008 due to slow project progress as a consequence in part of complex partnerships and multiple country sites. Several similar SPS compliance cost analysis targets in 2007 and 2008 were rewritten and consolidated into one comprehensive target for 2009 due to the need to generate new funding to complete those, which has yet to be achieved. A new target for Ethiopia livestock export analysis was added for 2008, given new interest by partners there for export opportunities linked to smallholders.

Alignment of the MTP with the CGIAR system priorities

The Market Opportunities Theme is completely aligned with System Priority 3b (CGSP 3b): 'Income Increases from Livestock'. The Theme 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 Dec. 2005, p. 46).

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

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

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

Description of impact pathways

All work under the Market Opportunities Theme starts with emerging needs of producers responding to changing market opportunities and seeks options for more sustainable production and market participation by small-scale producers, especially the poor and disadvantaged. The focus is on building national ownership for results and engaging key decision-makers at policy, development and private-investment levels early in the research, through national collaborators and joint projects. Particularly in research on technical and institutional options, action research and pilot testing is conducted jointly with development partners, which are either public or non-governmental institutions or the private sector. Working with local and national partners to demonstrate potential for impact is essential for proving the relevance of research outputs and for drawing the strategic lessons for applications in other settings and regions internationally. The complexity of livestock product market chains—including live animals, fresh products and highly processed traded products—is reflected in the complexity of market actors, institutions and regulators. Impact orientation in research thus requires a multi-institutional approach to understanding and influencing market opportunities, including small and large private-sector agents and business service and input providers.

The strategy for pathways to convert our outputs into outcomes and impact is oriented towards three different **output or deliverable types** (not representing the three Theme outputs but which cut across them). These are **policy** outputs, **developmental** outputs (technologies and strategies) and **methodology** outputs. A key unified strategy for delivering in each of these areas is **working through partnerships**; however, those partnerships differ for output types and also differ according to the stage of delivery.

- **Policy outcomes and impacts.** The partnership strategy for delivering at the policy level is to work with **advocacy coalitions** at international, regional and national levels, using policy-research outputs that have regional and global relevance. The key to the success of such coalitions is for partners to have similar **pro-poor goals** but **different** and complementary capacities; members of such coalitions are likely to include some policy partners and decision-makers themselves, credible researchers, global information networks, and research and development donors. A key element to the success is to include **pro-poor civil society organizations** that have a particular interest in and specialized capacity for pro-poor policy advocacy. In the case of animal health policies, it is often essential to engage international organizations and standards-setting organizations such as the Office International des Epizooties, highlighting equity and poverty alleviation issues through risk-based rather than rule-based approaches. Such coalitions might conduct joint outcome mapping at early stages to identify the policy change targets and strategies, regular joint reviews of progress and strategy, joint public forums generally led by decision-makers or CSO partners, inter-site exchanges for cross regional learning, and joint communications efforts and materials. An important example of this type of advocacy coalition approach can be found in the work led by some of this project's team members on pro-poor policy change towards greater acceptance of small-scale milk marketing in East Africa. In 2008 the work continues at a regional level in East Africa, with ILRI now playing a smaller facilitating and capacity building role to support an effort led by the East and Central Africa Program on Agricultural Policy Analysis (ECAPAPA, a network of ASARECA) aimed at applying the same policy lessons in 'regional policy harmonization'. Similarly, in the State of Assam in northeast India, the same policy lessons are being adapted and applied, with ILRI supporting capacity of the Assam Government to address traditional milk markets. This model of working with advocacy groups

is being replicated in a project being initiated in Vietnam addressing pig meat markets and policies. The global relevance is demonstrated in a) policy approaches tested locally and nationally that can be adapted to other countries and settings, and b) policy engagement strategies that can also be applied to other commodities, systems and issues elsewhere.

The **outcomes** targeted by these policy-related outputs are: a) **changes in mind set** among policy makers, accompanied **by increased capacity to address** a wider range of sometimes complex pro-poor policy questions, followed by b) actual **pro-poor shifts** in public policy and investment interventions, either in the form of written or implemented policy. Depending on the type of policy addressed, **impacts** will be in the form of improved welfare of resource-poor producers, market actors and or consumers.

- **Developmental outcomes and impact.** Although the Market Opportunities Theme addresses market systems overall, that analysis often points to the need to demonstrate the relevance and impact of specific innovations locally and nationally. The partnership strategy for delivering these types of technology and institutional strategy outputs lies in working through **joint research and development partnerships** at national and local levels. The key to success in these cases is **effective linking** of researchers with investors and development agencies and implementers. These sorts of partnerships typically include government development agencies (extension services and regulators), private-sector investors and service providers, both small- and large-scale, including business development service (BDS) providers, NGOs and producer associations, and national researchers and donors. ILRI's role may be facilitating, catalyzing or leading such partnerships, depending on need, as well as synthesizing and translating the lessons learned to generate global public goods. Examples of the types of activities that such a JR&D partnership would conduct are: joint outcome mapping and regular monitoring and evaluation, joint R&D planning, field research to pilot test the technology and institutional strategies that emerge from research, joint communication development, inter-site exchanges, and short courses to improve skills to increase uptake. There are several Markets Theme examples of these types of partnerships, particularly in donor projects that have a strong development orientation. In such cases the ILRI research role is only one component, aimed towards better science-based targeting and application of development interventions, with a view towards learning lessons of international relevance. An important example is the Central American Beef Markets project, funded by the Common Fund for Commodities (CFC). ILRI's research in that case facilitates the interventions of a number of public and private development organizations in four countries in that region. These non-research organizations work directly with producers and market agents, and so allow the scaling up of research outcomes for impact that is sustained due to their continued presence and role after donor project cessation. Another example lies in the dairy work in Assam, northeast India, in which ILRI's role is to contribute the research component to a high-profile, government-led pro-poor dairy development effort. In all of these cases, outcome mapping or similar planning exercises help to manage the evolution of ILRI's role among other partners from leader in some cases, catalyst in others, to facilitator and supporter as the R&D project matures. In all cases, the partnership with development partners in specific settings is used as an **opportunity for ground-truthed lesson-learning** about market and technology innovations for application in other international settings.

The **outcomes** targeted by these technology and institutional strategy-related outputs are a) the **sustained uptake** of pro-poor institutional models and technologies through **improved capacity of development partners** and b) **demonstrated market innovations with international relevance**. Depending on the type of issues addressed, **impacts** will be in the form of improved welfare of resource-poor producers, market actors and or consumers.

- **Methodology outcomes and impacts.** The partnership strategy for delivering new or refined research methods and tools is to work through **multi-level research partnerships**. The key to success in these cases is **being a bridge** between the international science community, advanced research institutions, other international agricultural research centres, and NARS.

These partnerships typically include cutting-edge advanced research institutions, usually based in the North, international centres with complementary skills and interests, and capable NARS institutions and individuals. Alternatively, in the case of action research on methodology in surveillance and animal health delivery, appropriate partners include public-sector service delivery organizations, non-governmental organizations and international agencies involved in program implementation. Again, there are several examples in the Market Opportunities Theme of these types of partnerships, which are strongly aimed at **research capacity building** among our research partners, which will in turn lead to positive development consequences, rather than direct welfare impacts on our primary target beneficiaries. Some examples of these partnerships include the joint work with IFPRI and national partners that adapted integrated modelling approach to address the complexity of contract farming/industrialization in pig systems in Vietnam, linked to the University of Queensland. An important partnership has been with Cornell University and national partners to develop adapted risk analysis approaches to food safety in local livestock product markets that are appropriate to data-poor developing-country settings. Another example is in on-going work with the GRIPS/FASID Graduate Program of Japan, which brings cutting-edge innovative spatial analysis into work with national partners on changing crop-livestock systems in East Africa.

The **outcome** targeted by these methodology and skills -related outputs is a) the development and dissemination of **improved research methods** internationally, and b) increased research capacity nationally and regionally. Depending on the type of issues addressed, and much more indirectly than in the above cases, **impacts** will be in the form of improved capacity for sustained research on livestock marketing and related policy issues to improve the welfare of resource-poor producers, market actors and or consumers.

Research approach to deliver international public goods

The international public goods generated by the Market Opportunities Theme emanate from the basic approach applied throughout of:

- assessing livestock value chains in their entirety (technical, institutional and policy elements)
- from that analysis, identifying sectors and regions with greatest opportunities for the poor to benefit from markets, either as input suppliers, producers or market agents.
- evaluating and demonstrating the transferability of policy approaches learned or innovations developed (dairy policy: East Africa to South Asia; policy approaches: East Africa dairy to Southeast Asia pigs)
- influencing the international agenda to move to pro-poor market approaches that apply risk-based systems with different options for the poor to succeed.

The international public goods emanating from the research represent in all cases lessons for innovations in policies or institutional strategies that emanate from research in a specific site or context that have generic relevance in other sites, eco-regions and continents, and so have strategic international implications. They can be categorized in a manner related to the three types of outputs that are described above in the impact pathway discussion.

Given that public policies play a key role in market regulation, infrastructure and performance, policy-related IPGs figure prominently in work of the Market Opportunities Theme. A key example is work on policies to address small-scale informal milk markets that began in Kenya, described above, and is associated with output 2 in the logframe. The policy-related IPG lessons from that work are a) the policy option itself, of formalizing the raw milk trade, and b) the analysis of the process of policy change emanating from research. Although the original work was Kenya-specific, interactions with stakeholders in other countries, some outside the region, demonstrated that policymakers elsewhere could benefit from the lessons learned. As described above, the lesson is now being applied in other countries in East Africa and in northeast India.

A key area of attention for the Market Opportunities Theme is the application of risk-based approaches to understanding food safety and animal disease implications of livestock and

livestock product markets. Such approaches are required to go beyond simple 'no-risk' policies to understand potential tradeoffs in risk vs. livelihoods among various participants in market chains, from consumers to livestock producers themselves. This work is generating IPGs in several areas, including methodology innovation to adapt the approach to developing-country settings, new institutional and regulatory options to best balance risk and livelihoods and, in the future, new understanding of policies to allow poor countries to apply equivalent risk-control measures to meet SPS standards in livestock exports (output 3).

Finally, in the area of methodologies, the Theme has in the past developed, and continues to develop, new and adapted methodologies for research on livestock markets and systems in developing countries that have broad relevance. One example is work on adapting risk-analysis approaches to livestock and livestock products to better fit the needs of developing countries, approaches that particularly gauge the impacts on the resource-poor producers as well as poor consumers (output 2). A second example is the use of participatory techniques to better adapt epidemiological surveillance and research methodologies to the realities of developing countries and smallholder communities. These tools are also being developed as more sustainable methods for use by national governments to comply with SPS requirements and enhance access to markets. Although not detailed in the current output targets, previous work on smallholder competitiveness with IFPRI and others had developed new approaches to holistically understand the factors, including non-market benefits from livestock assets, that underlie continued sustained smallholder producer viability (output 1). Another example relates to methodologies for addressing value chains that are currently being revised, the objective being to better identify leverage points (interventions that would have the highest impact) while ensuring good scientific rigour in the analysis.

Elaboration of partners' roles

Important parts of this research are implemented with IFPRI through a revised Joint ILRI-IFPRI Program (JP) on Livestock Market Opportunities. The focus areas of the JP mirror the 3 output areas of the Market Opportunities Theme and are subsets of the latter, although aimed primarily at policy and institutional outputs. The three elements of the revised JP are 1) organizational options for better linking farmers to changing markets, 2) private-public partnerships for compliance with SPS standards and changing market demands, and 3) analysis of cost of compliance with animal disease constraints to markets, alternative strategies and policies and their associated risks and costs. Currently activities for much of this partnership work are in Asia and focused on contract-farming research in India. NDRI and NCAP (ICAR institutes) play a lead role with ILRI, IFPRI, FAO-PPLPI and IIM-Ahmedabad playing supporting roles in project design and supervision. In Vietnam, the Hanoi Agricultural University plays the key research role, with support from ILRI, IFPRI and FAO-PPLPI. Other Vietnamese partners that play roles either as stakeholders or collaborators are the Ministry of Agriculture and Rural Development, the National Institute of Animal Husbandry, the Rural Development Centre-IPSARD, the Department of Animal Health, the Women's Union of Nam Sach District, the Nam Sach Animal Production Cooperative and Long Co Company Limited. CIRAD-EMVT of France is a stakeholder in that work. In Cambodia, the market chain research is led by the Center for Livestock and Agricultural Development (CeLAgrID), with support from the Srah Takoun Farmer Association, the Lok Farmer Association and the Prash Punlear Slaughterhouse; Heifer Project International is a stakeholder in that project. Similar work is being conducted in Bangladesh led jointly by Bangabandhu Sheikh Mujibur Rahman Agricultural University and the Bangladesh Agricultural University, Mymensingh, with Bangladesh Livestock Research Institute, and the Department of Livestock Services (Ministry of Fisheries and Livestock) as stakeholders consulted on project design and dissemination of outcomes. A new three-year project (started in 2007) on Improving the Competitiveness of Pig Producers in an Adjusting Vietnam Market is funded by the ACIAR and designed jointly with the Institute of Policy and Strategy for Agricultural and Rural Development (IPSARD), the Ministry of Agriculture and Rural Development of Vietnam, IFPRI, Oxfam GB and the University of Queensland.

A relatively large project that forms a partnership node for the Market Opportunities Theme is based in Managua, Nicaragua, under the CFC-funded project on beef markets in Central America, implemented jointly by ILRI and CIAT. Each country has one lead organization that works with ILRI/CIAT: CORFOGA (Corporación Ganadera) in the case of Costa Rica, ICTA (Instituto de Ciencias y Tecnologías Agropecuarias) in Guatemala, DICTA (Dirección de Investigación y Tecnología Agropecuaria) in Honduras, and IDR (Instituto de Desarrollo Rural) in Nicaragua. IICA is responsible for the animal health and food safety component of the project. CIAT leads fieldwork on pasture technology and fodder preservation on the collaborative farms of the project and trains technicians in all four countries on the new technologies. SIDE (Servicios Internacionales para el Desarrollo Empresarial) is a private consultancy firm in charge of the meat quality and economics component of the project. The national public organizations DICTA, ICTA and IDR are leading the on-farm fieldwork on forage improvement and basic animal health. The private sector organizations FENAGH (Federación Nacional de Agricultores y Ganaderos de Honduras), FAGANIC (Federación de Agricultores y Ganaderos de Nicaragua) and FEGAGUATE (Federación de Ganaderos de Guatemala) are taking on responsibility for scaling the technologies up and out. In the case of Costa Rica, CORFOGA represents a special case. CORFOGA incorporates both public and private sectors (livestock producers and industry) and leads fieldwork and collaborates on value chain issues. Finally, at the regional level, the CAC, Consejo Agropecuario Centroamericano (Central American Agricultural Council) collaborates with the project on regional aspects of livestock policy, livestock trade and industry modernization.

Another important node for partnership in research is found in India, where much of the research attention is on smallholder dairy systems and where an NCAP staff member has been seconded to the ILRI team. Recent policy research on dairy development in India was led by ILRI but with research input and data from IIM-Ahmedabad and NDRI and with financial support from FAO-PPLPI. In Assam, ILRI is playing a different role, in the form of providing research support to the State Government of Assam Dairy Department, which will guide significant investment in dairy in that State for the next few years. Other local partners in Assam, such as the Centre for Humanistic Development, the Assam Institute of Management, the Indian Institute of Entrepreneurship, and the Assam Agricultural University, play key roles in implementing and disseminating the research, thus contributing to joint learning and capacity building. NDRI is also making input under the new ILRI-ICAR agreement. ILRI plays a similar facilitating role in analysis of small-scale milk markets in Andhra Pradesh with CALPI-India, an NGO. Other partners and stakeholders include NDRI and the Government of Andhra Pradesh. Besides dairy research, new links are being developed with IVRI and the Ministry of Agriculture and funding from the Government of India to support interventions in control of foot-and-mouth disease (FMD) among smallholder farms.

The Market Opportunities Theme has significant activities in dryland areas of the Near East and North Africa, where staff are studying the health and market constraints limiting smallholder access to higher end domestic markets and export markets in the Middle East for small ruminants. ILRI and ICARDA are jointly implementing the project with national partners in Sudan, Jordan, Syria and Tunisia. The role of ILRI/ICARDA is to provide methodological support for the research, facilitate cross-country exchange of experiences, synthesize lessons for wider relevance, and train to build local capacity in market research. In Sudan, the Ministry of Animal Resources and Fisheries and the University of Khartoum are jointly implementing the studies. In Jordan, the agencies involved in implementation include the Ministry of Agriculture, the National Center for Agricultural Research and Technology Transfer, and the Faculty of Veterinary Medicine, Jordanian University of Science and Technology. In Syria, the Ministry of Agriculture, General Commission for Scientific Agricultural Research and University of Damascus are jointly implementing the studies. In Tunisia, the Institute for Agriculture Research and Higher Education and the Institute for Veterinary Research, University of Tunisia, are jointly implementing the studies. Nine national staff are undertaking MSc studies on selected topics under the project and the joint supervision of ILRI and ICARDA scientists managing this project as well as professors of universities in the four countries mentioned above.

The new project in southern Africa on market participation of smallholder livestock producers funded by the European Union is being implemented jointly by ILRI and ICRISAT in collaboration with national partners in Mozambique, Zimbabwe and Namibia. The work will include diagnostic

studies on constraints for smallholder participation in livestock markets using a value chain approach and identifying and testing alternative input delivery and output marketing systems for enhancing smallholder participation in markets. National partners include the Agriculture Research Institute of Mozambique, an NGO, and private-sector partners to be identified; the Department of Agricultural Research and Extension, the Department of Livestock Development, Practical Action (an NGO) and private-sector partners in Zimbabwe, the Directorate of Agriculture Research and Training, the Directorate of Extension and Engineering Services, the Namibia National Farmers' Union, MeatCo (a private company) and DRFN (an NGO) in Namibia.

Finally, in East Africa we have many layered partnerships addressing a range of topics. There are a wide range of development partners, advocacy partners, governmental regulators, national research organizations, private-sector collaborators, regional partners, and other international and advanced research institutes based locally or elsewhere. Key development partners instrumental in implementing research outcomes continue to be both public (Ministry of Livestock and Fisheries Development, Kenya; Kenya Dairy Board; Kenya Bureau of Standards) and non-governmental (Land 'O Lakes, SITE, Terra Nuova). Some large-scale private-sector players have contributed to understanding market constraints and opportunities (Spin Knit Dairy, Farmers Choice), not to mention the many small-scale individual entrepreneurs who have contributed to pilot testing market options for raw milk markets. Key research partners are found at both national levels (KARI, NARO, Sokoine University and the Tanzania Bureau of Standards, the University of Nairobi, the Ethiopian Ministry of Agriculture, the Ethiopian Institute of Agricultural Research, and the Ethiopian Standards Authority, among many others) and regionally (ASARECA, ECAPAPA). These partners contribute to research inputs, provide a channel for capacity development and help to scale up research approaches and outcomes. There are a number of links to other CGIAR centres and international agricultural research centres, including IFPRI in the area of smallholder industrialization and competitiveness, IFPRI and Cornell providing methodological support in risk analysis in livestock product markets. The Market Opportunities Theme is also working with the Japan-based FASID in analyzing changes in dairy systems and technologies in several East African countries.

Improving Market Opportunities Logframe

	Outputs	Intended User	Outcome	Impact
(Market Opportunities) Output 1	<p>Technical, institutional and policy options identified and promoted, that increase the ability of smallholder livestock producers to sustain and expand viable livestock enterprises</p> <p>(3 – 5 years)</p>	<p>Development practitioners and investors, private sector and collective livestock processors and integrators, producer associations, for the technical and institutional options.</p> <p>Policymakers and analysts for the policy options to facilitate the uptake of the technical and institutional options by the actors above.</p> <p>Researchers in NARS, IARCs and ILRI working in smallholder dairy, pig and poultry systems.</p> <p>Policymakers, development practitioners and investors, and producer associations working in marginal areas and with indigenous livestock breeds</p>	<p>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.</p> <p>Increased awareness an uptake of best practices for market-oriented smallholder livestock and dairy development by development organizations and NGOs</p> <p>Increased participation in target countries of smallholder livestock farmers in vertically coordinated schemes for livestock production and sales</p> <p>Increased awareness and resources devoted to investment in appropriate promotion of indigenous livestock in target countries.</p> <p>Growth of market-oriented smallholder livestock production in targeted regions using practices and strategies advocated</p> <p>Increased activity in and capacity for research in pro-poor livestock competitiveness by research partners in target countries.</p>	<p>Increased productivity through uptake of best bet practices of smallholder livestock producers targeted by this research</p> <p>Higher and less variable incomes from livestock production of vertically coordinated small-scale livestock producers in targeted schemes</p> <p>More reliable access to higher quality livestock services in target sites.</p> <p>Increased investment in households livelihood assets, including livestock assets</p> <p>Higher and more reliable incomes to smallholder engaged in indigenous livestock production</p> <p>Decline in the rate of decrease in smallholder livestock producer market share in targeted countries</p>
Output 1 Targets 2008	<p>Benefits from and barriers to smallholder livestock producer participation in alternative producer-buyer contractual mechanisms in South Asia and Southeast Asia assessed and documented (targeted</p>			

	Outputs	Intended User	Outcome	Impact
	cases: Vietnam, Bangladesh)			
	Smallholder dairy competitiveness: Best bet technologies and strategies documented and promoted in North East India (Assam)			
	Strategies to enhance the competitiveness and sustainability of smallholder producers in selected countries of West Africa through increased production and sale of indigenous and other cattle, small ruminants and poultry comprehensively evaluated in the context of market incentives			

	Current smallholder pig production technologies and best practices for increased smallholder competitiveness and participation in markets identified and documented in South East Asia (Cambodia) and South West China.			
	Synthesis conducted of case studies of role of feed and fodder markets in smallholder livestock production systems, and capacity developed among partners for further analysis.			
Output 1 Targets 2009	Benefits from and barriers to smallholder livestock producer participation in alternative producer-buyer contractual mechanisms in selected countries of Sub Saharan Africa and South East Asia assessed and documented			
	The role of indigenous livestock in enhancing competitiveness and sustainability of smallholder producers evaluated in selected West African countries, and capacity supported among partners for further analysis.			
	Best practices for smallholder pig producer competitiveness and participation in markets, including access to genetic services, identified and promoted in South East Asia (Vietnam)			
Output 1 Targets 2010	Benefits from and barriers to smallholder livestock producer participation in alternative producer-buyer contractual mechanisms in selected countries of Sub Saharan Africa and South East Asia synthesised and lessons identified and disseminated from the various case studies,			

	and national capacity for this analysis demonstrated.			
	Best practices for enhancing women participation in appropriate institutional arrangements for improved market access identified and promoted in dairy systems in East Africa			
	Lessons from case studies on input and services delivery for smallholder pig producers synthesized (Cambodia, Vietnam and South West China)			
	Case studies of role of feed and fodder markets in smallholder livestock production systems in East Africa and South Asia synthesized			

<p>(Market Opportunities) Output 2</p>	<p>Technical, organizational and policy options identified and promoted for improved market institutions that serve small-scale, poor and disadvantaged producers, market actors and consumers, in the context of rising demand for reliable quality, food safety and increased openness to trade. (3 – 5 years)</p>	<p>Policymakers and policy analysts, regulatory authorities, development investors, public and private sector traders (wholesalers, processors and retailers) of livestock products, producer associations, for the technical and organizational options.</p> <p>Policymakers and policy advocacy partners (including regionally and internationally), consumer advocates and regulatory authorities for the policy options to facilitate the uptake of the technical and organizational options by the actors above.</p> <p>Business development services providers working with livestock markets, including credit, certification, disease control technology and strategies.</p> <p>Researchers in NARS, IARCs addressing livestock and agricultural market mechanisms, including the application of action research.</p>	<p>Increased sales by smallholders and disadvantaged producers (poor and women) to integrated formal sector outlets.</p> <p>Awareness increased among policymakers, producer associations and development investors of technical, institutional, and policy options for increasing the amount of smallholder livestock product sales.</p> <p>Increased recognition and uptake among market actors about options available to meet public and private sector food safety and quality requirements and regulations, based on the application of quantitative risk analysis.</p> <p>Changes in mind sets among policy makers and changes in written and implemented policies that facilitate improved performance of traditional and formal livestock markets serving smallholder producers.</p> <p>Increased awareness among small-scale producers, market operators, development agencies and policy makers for new market opportunities for selected products with different attributes</p>	<p>Improved livelihoods of small-scale producers and market-agents through greater participation 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, and lower prices for safe food to the urban poor</p> <p>Increase in the share of smallholder production going to higher priced markets in targeted countries leading to higher incomes</p> <p>Increased producer and market agent compliance with quality and safety requirements in stable urban high-value supply chains for livestock products leading to higher incomes</p> <p>Improved public health among poor livestock producers, market agents and consumers.</p>
<p>Output 2</p>	<p>Through risk-based approaches,</p>			

Targets 2008	appropriate levels of food safety in livestock product markets in selected Asian cases evaluated.			
	Policy and institutional options for increased market access through improved food safety and quality in traditional and formal milk and meat markets in selected countries in East Africa and South Asia identified.			
	Lessons learned from alternative organisational structures for smallholder access in meat markets in South East Asia documented.			
Output 2 Targets 2009	Demand for quality and safety, and tradeoffs between food safety and economic welfare of poor people in South Asia and East Africa documented			
	Impacts on poor consumers and producers of changes in domestic livestock market demand, quality and food safety standards, and regulatory policies analysed and documented for selected countries in Sub Saharan Africa and Asia			
	Institutional and policy options to overcome barriers to high value markets by smallholder pig producers in South East Asia identified and promoted, and national capacity for this work demonstrated.			
	Key interventions identified and tested to facilitate broad compliance of small-scale dairy systems to meet evolving societal demand for quality and safety in East Africa.			
Output 2	Results of case studies in Asia and Africa on methods for analysis of demand for			

Target 2010	quality and safety in animal products in the absence of official grades and standards documented, and national capacity for this analysis supported.			
	Results of case studies on methods and approaches to analyse livestock commodity value chains in Asia, East and Southern Africa documented			
	Cross-country experiences in action research on livestock market institutional innovation in South East Asia and East Africa documented.			
(Market Opportunities) Output 3	Strategies and policies identified and promoted for greater impact on poverty reduction through improved quality and safety of livestock commodities and products in national and international markets, through multi-disciplinary research in veterinary epidemiology, economics, and risk analysis (3 – 5 years)	Policymakers and policy analysts, animal health and regulatory authorities, development investors, public and private sector traders (wholesalers, processors and retailers) of livestock products, producer associations, for the technical and organizational options. Policymakers and policy advocacy partners (including regionally and internationally), and national and international animal health authorities for the policy options. Private sector exporters and processors of livestock products, producer associations Business development services providers working	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 Adoption of improved options for the delivery of animal health services to market-oriented small ruminant producers in targeted zones Improved procedures adopted for handling meat and other product exports that increase smallholder participation and value addition, though better SPS compliance Increased awareness by international regulatory and animal health organisations of impacts on smallholder producers of alternative SPS compliance strategies. Ministries of livestock and other health service providers in the target countries adopt new procedures for	Increased and more stable producer incomes through better access to high-value export supply chains for livestock products 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 Increased private sector compliance with improved animal health and safety standards, including small scale market actors

		with livestock markets, including credit, certification, disease control technologies and strategies. Researchers, including NARS and IARCs and other ILRI working in livestock market mechanism, including applying risk analysis, and trade impact implications.	health services provision, and for SPS compliance	
Output 3 Targets 2008	Priority animal health constraints to market access identified, and strategies and interventions for animal disease control identified and tested in selected countries in the Near East—North Africa.			
	Costs and poverty reduction implications of export of ruminant meat livestock products from Ethiopia identified and documented and the wider regional lessons and applicability documented and promoted.			
	Transmission patterns and the differential role of common poultry species and production systems in the maintenance of endemic HPAI described for Sub Saharan Africa and South East Asia			
Output 3 Targets 2009	Cost of compliance, sustainability and poverty reduction implications of improved international market access for livestock products from selected developing countries in Sub Saharan Africa and Asia identified and documented.			
	Impacts on smallholder welfare and public risks of alternative strategies for managing			

	Avian Flu threats in Sub Saharan Africa and South East Asia identified and documented and best-bet strategies promoted.			
	Strategies for more effective utilization of emergency funds as resources to address developmental and capacity building needs for enhanced access to markets identified and promoted in Sub Saharan Africa and South Asia.			
Output 3 Targets 2010	Results on win-win AI control strategies that safeguard human health and small-holder livelihoods and sharing of HPAI control decision-support tools promoted in Sub Saharan Africa and South East Asia, and national capacity for their application developed.			
	Equivalent SPS measures adapted to developing country contexts identified and tested to promote access to international markets particularly in regard to Sub Saharan Africa.			

Biotechnology

Rationale for the MTP Project and Changes

The overall goal of this Theme 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 and through the identification of, and improved access to, appropriate animal genotypes and better understanding and use of genetic diversity inherent in these livestock populations. The use of locally adapted and disease resistant livestock, of diagnostic tests for disease surveillance, food safety and market access and of vaccines for disease prevention are considered to be effective technologies through which the livestock assets of the poor can be secured and multiplied, and are at the core of the research in this Theme. Given the many areas these technologies embrace globally, the Theme focuses primarily on those areas in which ILRI has a comparative advantage and which attract little or no research investment from private and public bodies in the developed world.

Since 2001, ILRI has focused its vaccine research on developing a sub-unit vaccine for East Coast fever (ECF). In collaboration with several international partners, ILRI has identified parasite components that are believed to be responsible for immunity to ECF. The next phase of this research addresses the problem of how to administer the components in a manner which induces the correct immune response - a cytotoxic T cell response. Various systems are being evaluated to achieve this, an undertaking which ILRI recognizes as challenging. Because this problem is not limited to ECF and exists for several human diseases, notably HIV, malaria and cancer, ILRI will also explore the possibility of working with several vaccine research laboratories around the world to develop a coordinated approach to this challenge, in the expectation that a solution can be achieved more expeditiously. Nevertheless, the realistic expectation is that a sub-unit vaccine is still some years away. Hence, increased attention will be focused on the currently available infection and treatment method of vaccination (ITM). Although effective, ITM has considerable drawbacks, most importantly a complicated and expensive production process and the necessity for liquid nitrogen storage of the vaccine in the field. However, there is an increasing demand for this vaccine from livestock owners. ILRI will undertake a 'technology transfer' project, the main components of which will be to apply a production protocol (which has previously been used by ILRI) to manufacture a batch of the vaccine in a process designed to engage and train future producers of the vaccine, and to work to improve the robustness of the commercial-scale production process. Under the stewardship of AU-IBAR, ILRI will also work with several entities including PANVAC (Pan-African Vaccine Centre of AU) and an international non-for-profit organization, the Global Alliance for Livestock Vaccines (GALVmed), to develop a dossier that will underpin the registration of the vaccine. ILRI will also provide technological support for the widespread deployment of the vaccine in eastern and southern Africa. Current studies in this area will include an assessment of the immune responses generated by ITM vaccination in different cattle breeds. It is expected that these activities in ITM will have an impact in the immediate term in the control of ECF, while awaiting the development of a cheaper, more practical vaccine.

The expertise which has been generated by the long-standing ECF vaccine research effort has also attracted collaborative projects on bovine tuberculosis (BTB), contagious bovine pleuropneumonia (CBPP) and tropical theileriosis, where ILRI works with several consortia conducting multifaceted research projects. The BTB and CBPP projects will take advantage of ILRI's expertise in bovine immunology. Particular attention will be given to CBPP, due to its economic importance in Africa and lack of knowledge of the immunology of this disease. Work will also continue on identifying candidate antigens from the tick vector of ECF, *Rhipicephalus appendiculatus*, for use as a transmission blocking vaccine. ILRI's role in the tropical theileriosis project is to identify antigens recognized by immune cells and is a logical extension of the previous work on ECF. These projects

are in their nascent stages and future directions and scope will be examined as part of a broader assessment of our priorities in both vaccine and diagnostics research through partner consultations and a CCER that will be conducted in 2008. This process will involve close collaboration with ILRI's Targeting and Innovations Project.

In diagnostics research, previous work was aimed at the development of assays for use by NARS for sero-surveillance and as epidemiological tools, in particular for tick-borne diseases and trypanosomosis. Our work will now include the development of tests that can facilitate market access through the development and deployment of rapid diagnostic assays. This activity will be developed in collaboration with the Markets theme. ILRI's work in African Swine fever is aimed at identifying the extent of genetic diversity in East African isolates of the virus. Lack of knowledge of this diversity is believed to impair the performance of diagnostic assays developed using isolates from other regions. Important aspects of this project will use the new BL3 laboratory and the BecA genomics platform. The need for better diagnostic tools for CBPP, in particular for the latent 'carrier' animal, is hampering efforts to control this disease. ILRI is taking a genomics-based approach to address this problem, which will also benefit from the facilities of the BecA/ILRI shared research platform.

Work on AnGR characterization seeks to map and quantify the diversity in livestock populations in developing countries. A large body of information has been generated and made available through various publications and information system (e.g. Domestic Animal Genetic Resources Information System - DAGRIS), the development of which will continue in the current MTP. Substantial progress has been made on developing diversity assessment protocols, including for field sampling, lab and data analyses, and information on distribution of diversity in collaboration with national partners. These protocols are now widely used by NARS in Africa and Asia and form bases for capacity building initiatives to equip countries to undertake detailed studies of their priority local breeds. Attention has increasingly shifted to facilitating broader use of these products and tools by establishing systems to allow national partners to record and curate their own data and by completing the integration of DAGRIS with the complementary FAO DAD-IS database. This will provide an integrated, publicly-accessible system for measuring, documenting and evaluating genetic diversity, largely devolved to national partners as an important knowledge base to inform conservation and use. This will be an important source of research-based evidence for policy and decision makers. Our focus will now be on the really critical traits (e.g. disease resistance) for poor people facing high risks in marginal environments, including examination of likely implications of climate change. We will apply a two-pronged approach. One will be a **landscape genomics** approach to ask the questions: what genetics are where and how are they shaped by the dynamics on the 'landscape' in which they reside? This attempts to capture critical aspects of the production system in which they occur – including the physical environment, disease pressure and human selection interacting with market pressures and opportunities. Understanding this co-evolution will inform future conservation and use strategies and policies. The other will be a continuing focus on lab-based discovery of functional genes to try and unravel mechanisms of gene function (e.g. disease resistance/tolerance), the output of which has potentially diverse applications, including in vaccine, diagnostics and therapeutics research. This work which currently focuses on trypanotolerance in cattle and helminth parasite resistance in sheep will, resources being available, begin to look at other high priority diseases, Avian Influenza and Rift Valley fever. The work will be underpinned by progress to date on broad-scale genetic diversity mapping and ILRI's gene discovery research capacity. This research stream will provide insights into mechanisms of gene functions which will feed into vaccine and drug research for both livestock and humans.

Availability of working models for livestock genetic improvement for small-holders in developing countries remains a critical gap. At the same time, and in many cases because of this gap, introduction of inappropriate genotypes is a continuing problem. Even in situations where potential of specific germplasm has been demonstrated (e.g. dairy cattle crossbreds in medium potential areas), absence of appropriate technologies for delivery and institutional structures that can assure

sustainable supply present a major constraint. Work in this area will aim to identify appropriate genotypes for production systems in which smallholders predominate. In market led systems focusing on dairy production, we will undertake a synthesis of past successes and failures to learn lessons that can inform future strategies. This work will build on experiences of the market oriented smallholder dairy project in which ILRI has been involved for several years. Potential options for system improvements involving adaptation and tweaking the ways in which a range of 'off-the-shelf' technologies such as artificial insemination and other reproductive technologies and approaches can be better used will be assessed and pilot-tested. A major constraint to scaling out dairy improvement is the limited supply of appropriate quality animals of well defined genotypes. A 'proof of concept' study will be undertaken involving a combination of technologies - *in vitro* fertilization with sexed semen, followed by embryo transfer ('SIFET') to produce replacement heifers of well characterized genotypes for smallholder dairy systems. If successful, this technology could increase the proportion of female calves (or males depending on the system) and would provide an effective method for delivering first-cross (F1) replacement animals. It could also triple the rate of recovery from cattle losses following drought or other disasters. In the more marginal systems, analysis of the potential for community-based breeding approaches to deliver long-term genetic change using local breeds as base material, or to introduce genotypes which have proven successful in similar environments elsewhere, will be examined (e.g. through a GEF-funded project in West Africa). It had been considered that gene discovery work would identify genomic regions (QTLs) responsible for disease resistance, and that these would subsequently be introgressed into livestock populations to increase or introduce the resistance attribute. Significant progress has been made in QTL identification for both trypanotolerance in cattle and helminth resistance in sheep. This work is more advanced for trypanotolerance in cattle where several QTLs of relatively small effects have been identified. Although ongoing study of the mechanisms underlying these genomic regions is expected to reveal important insights into the biology of disease susceptibility, feasibility for application in breeding programs will be re-examined: Where a trait is controlled by many genes of large effects, technical and economic considerations make it less attractive to use DNA markers in breeding programs. This underscores the focus on adapting existing breeding technologies in the medium term. An analysis of the prospects and potential to use genetic information (including genetic markers) and/or conventional breeding approaches to select for disease resistance in developing countries will be undertaken during this MTP period. This work will facilitate the development of strategies/approaches for utilizing the rapidly cumulating AnGR information in breeding programmes.

Characterization and improved utilization of AnGR will contribute to CGIAR System **Priority 1** which aims at **sustaining biodiversity for current and future generations** and specifically to SP 1C which focuses on conservation of indigenous livestock. Given the large number of livestock populations of different species, ILRI's work will continue to focus on developing approaches in breed characterization, applying these in a broad geographical scale (e.g. continental levels) and supporting national programs, particularly by providing these tools and protocols in capacity building programs to support improved conservation and use. The gene discovery research is a special case of 1c and is in alignment with **Priority 2d** on '**Genetic enhancement of selected species to increase income generation by the poor**', more specifically to **goal 3** on '**smallholder livestock improvement for tolerance to biotic and abiotic stresses**'. Research in this Project is also linked to System **Priority 3**, '**opportunities for high-value commodities and products**', specifically to **3b**, '**income increases from livestock**', **goal 1** of which is 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. The last of these will receive increased attention in the course of this MTP through activities aimed at identification of appropriate genotypes for smallholder systems, and developing and pilot-testing potential options for sourcing and delivering genetic change. An important future trend in AnGR will be closer integration of work around these three priorities where new technologies provide an opportunity for synergy between research on quantifying diversity, function of diversity and response to threats to productivity. We see a clear link between priorities 1c,

2d and 3b. In many of the systems in which we are working, market forces are very important and influence decisions on breeding programs, requiring that market drivers be factored into both conservation and use programs.

In the 2008-9 period, there will be significant activities in the development of the physical infrastructure and in operationalizing the ***Biosciences eastern and central Africa*** (BecA) and ILRI shared research platform. The platform and the activities and partnerships it is catalyzing is increasing ILRI's reach and expanding the impact of its expertise - in such areas as immunology, molecular epidemiology and animal genetics - through collaborative projects involving NARS and ARIs. For example, since 2003 to date, using the current ILRI facilities and some new bioinformatics infrastructure and equipment, over 100 scientists have been hosted at the BecA hub for periods ranging from 3 months to 4 years. These have included research fellows on student attachments (a total of 45), MSc and PhD graduate fellows (53) undertaking projects with ILRI and other CG Centers based at the hub, and NARS scientists using the facilities to undertake their own research projects (11), many in collaboration with, or backstopped by ILRI scientists. The expanded genomics capacity, including sequencing/genotyping and additional bioinformatics infrastructure is facilitating ILRI's work as a key user/partner and also strengthening our capacity through interactions with other users of the platform. A dedicated management of research infrastructure of the shared platform will allow ILRI scientists to concentrate more on project execution, and less on logistics for technology acquisition and maintenance.

Description of Impact Pathways

The approaches being taken by this Theme to facilitate the translation of outputs to outcome and eventually to impacts are designed to:

- Engage all key stakeholders in the research continuum
- Use prototype approaches in the research process so as to generate generic lessons or methods/techniques that can be scaled out
- Put in place mechanisms to learn and document lessons
- Publish the results/lessons through appropriate avenues as one way of creating awareness and out-scaling
- Undertake group and individual training to build capacity that empowers countries and institutions to undertake their own research and/or apply available information and knowledge.

Outputs of research in this Theme are varied, ranging from intermediate outputs which serve as inputs into research and development work of other researchers (including ILRI) and technology developers, to those which are linked to development impacts. The Table below summarizes output categories of this Project, intended clients and examples of outputs.

Output category	User (Client)	Examples of outputs
1. Outputs that are inputs for other researchers	Other researchers and technology developers working on vaccines, diagnostics or applying genomics (in livestock or humans);	<ul style="list-style-type: none"> ▪ Basic understanding of host & parasite biology ▪ Generic protocols for antigen identification and formulation ▪ Candidate antigens ▪ Protocols for genetic diversity assessment ▪ Mechanisms of host resistance to disease ▪ Elucidation of gene functions
2. Research evidence for policy-formulation & decision-making	NARS, Government departments and other development agencies; private sector	<ul style="list-style-type: none"> ▪ Diversity maps, databases, publications as source of information for others to use ▪ Vaccine (e.g. ITM) production and quality control dossier to facilitate vaccine registration
3. Outputs linked to development impacts	Governments; Livestock breed societies/associations; farmers; traders; private sector companies	<ul style="list-style-type: none"> ▪ Point of transaction diagnostic tests applied to support trade ▪ Technologies for disease control ▪ improved protocols for vaccine production (e.g. ITM) ▪ Field evaluation of vaccines (e.g. CBPP or diagnostic kits) ▪ Breeding and reproductive technologies for delivering appropriate genetics to smallholder farmers

The major clients of the immunology outputs as well as the antigen discovery protocols are other vaccine researchers (in ARIs, NARS and the private sector), particularly those working on vaccines requiring the induction of cellular immunity as mentioned above. The ITM work will facilitate the African Union's Inter-Africa Bureau on Animal Resources (AU-IBAR) efforts to develop, with the Departments of Veterinary Services (DVS), a regulatory framework for the deployment of the vaccine in relevant countries.

For the ECF sub-unit vaccine research, the strategy to realize the expected outcome involves early engagement of relevant stakeholders in the product development continuum. Demand for vaccine has been established through on-farm national assessments conducted in close collaboration with DVSs and NARS. Identification of vaccine candidates has been done in collaboration with ARIs (important source of new technology) and the private sector (providing vaccine formulation technology, and eventually product development, manufacture and distribution). Local NARS are engaged in early planning to secure their lead role in the field testing of the experimental vaccine when it becomes available. This would facilitate local licensing and registration. On-farm trials, closely involving farmers, is to ensure that technology uptake is based on farmers' understanding of its relevance and effectiveness (hence potential impact), and will facilitate rapid adoption. 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 analyzed. This approach can be generally applied to the development of vaccines and diagnostics against other diseases in a range of production systems.

Collaboration with international agencies such as IAEA/FAO Joint Division in AnGR has been instrumental in providing training for a large number of NARS scientists from Asia who have spent

time at the ILRI labs using standard protocols to analyze samples from their own countries. This has provided opportunity for these scientists to interact and initiate new regional activities in Asia. The Project has had extensive collaboration with the FAO AnGR group over many years. These include the development of the original global strategy for the sampling of the various species, conceptualization of activities in economic valuation of animal genetic resources and development of tools for on-farm phenotypic characterization of livestock. ILRI scientists have also participated in the initial planning and subsequently reporting of the global assessment of the status of animal genetic resources, *the State of the World's AnGR (SoW-AnGR)*. The Strategy we have adopted is one in which ILRI is contributing ideas on characterization, targeting, management of information and decision making at the global level and then seeks to influence national systems primarily through partnerships in research processes and capacity building programs and sharing of knowledge through various avenues. SOW-AnGR, the Convention on Biological Diversity and other international mechanisms help to get the global issues known while active partnerships with international organizations (e.g. IAEA) and ARIs (e.g. SLU) help to facilitate broader regional and national reach of our activities.

This process and the international partnerships have helped improve the understanding of the AnGR issues in different regions of the world, to identify gaps in policy and opportunities for sustainable use, especially at the national level. ILRI's strategic role in AnGR work and the global engagement we have pursued has provided us opportunities to influence important players – including national governments and donor agencies. For example, ILRI has been invited to lead the preparation of a key paper to be presented at the FAO-convened high-level International Conference on Animal Genetic Resources (Interlaken, Switzerland, September 2007) at which issues and global priorities for AnGR R & D will be discussed.

ILRI has made a major effort in recent years to build infrastructure and expertise to support developing country partners to take advantage of the opportunities to exploit frontier science through genomics, functional genomics and other biotechnologies. These include building ILRI capacity in humoral and cellular immunology of ruminants, sequencing and functional genomics and in bioinformatics. The establishment of broader biotechnology platforms, notably the *Bioscience eastern and central Africa (BeCA)* Hub (described above) on the ILRI campus in Nairobi and a joint lab to support livestock genetic resources work in collaboration with the Chinese Academy of Agricultural Sciences are initiatives intended to increase the generation of research outputs and facilitation of their application. Operations of these platforms which began in earnest in 2006 are expected to improve the capacity of both ILRI and partner institutions and individual scientists in undertaking biotechnology research that can lead to practical applications in developing countries. In addition, to strengthen the capacity of NARS in developing countries to develop strategies for sustainable use of animal genetic resources, group training courses for scientists who teach and supervise post-graduate students will continue to be conducted on this subject in a collaborative project (currently covering Africa and Asia) with the Swedish University of Agricultural Sciences (SLU). A multimedia electronic resource (Animal Genetics Training Resource (AGTR)) is being developed and optimized for use on CD-ROM and the internet as part of this project. These initiatives – shared research platforms, training resources and broad capacity building - represent ILRI's on-going efforts to influence technology development and application in ways intended to increase impact potential.

Establishment and extensive use of a network of collaborators is considered essential for the success of many of the components of this Project, 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 worldwide to ensure that the best of relevant science is assessed and, where appropriate, accessed and brought to bear on this research. In both the animal health (diagnostics and vaccines) work and in the genetics area, the approach involves working with consortia of strategic international collaborators (including advanced research institutes, the private sector, and non-governmental organizations (NGOs)) and national partners. The aim is to

ensure that the best practices, at both the technical and institutional levels, can be applied to a range of diseases, animal genetic resources and in several regions of the world under different settings.

Research Approach to deliver international public goods

ILRI's biotechnology research is deliberately designed to address issues of regional and global relevance and to generate public goods that have international application. The international public goods expected out of this research include: technologies/products (vaccines, diagnostics) that are applicable across multiple countries/regions, methods/approaches (breeding strategies, diversity assessment protocols, antigen identification protocols, institutional arrangements that work in delivering certain types of technologies and generic lessons learnt in engaging certain types of institutions), tools (e.g. databases such as DAGRIS and training resources such as AGTR as prototype tools that regions/countries can adapt and apply to manage AnGR information), knowledge/information (e.g. the unique characteristics, distribution and status of specific indigenous AnGR contained in the DAGRIS, genome sequences). Examples include the following:

While the animal health work in this Project currently has an African focus, the antigen screening protocols being developed and documented in the vaccine and diagnostics research are generic and can be applied in other disease systems

The ECF subunit research has led us to the challenge of how to consistently induce a cytotoxic T cell response. As noted above, this problem exists for other diseases including those of major importance in human health. ILRI and others are assessing the benefits to be gained by approaching this problem through a coordinated network of vaccine research laboratories to expedite the research work and to improve the dissemination of knowledge in this area. The insights gained from this research, and the lessons learned in establishing this network, will feed into more global research activities.

ILRI's involvement in the ITM vaccine production and deployment is part of a unique activity – delivering an extremely thermolabile, infective inoculum in regions of severely limited infrastructure. This also will help to inform the prospects of other, similar approaches, notably malaria, where the possibility of using attenuated or irradiated parasites to immunize humans is the subject of serious consideration and research.

Gene discovery work examining cattle-trypanosome interactions is revealing fundamental aspects of the inflammatory response and this understanding of mechanisms of resistance/susceptibility is already seeing direct application in human health and in other disease models. For example, results from this work have catalyzed a pilot project in human health in a hospital in Manchester (UK) which involves routine monitoring of patients for cholesterol, focusing in links to patient ability to handle infections.

The concept of BecA as a generic shared research platform and lessons learnt in its implementation is being taken up by NEPAD for use elsewhere – i.e. southern Africa, West Africa and North Africa. In the area of AnGR, diversity assessment protocols as well as results which provide quantitative data on extent of diversity and identify diversity hotspots for different livestock species are global public goods already being widely used (and cited) in many parts of the world.

The training resource on AnGR is, based on survey evidence to date, a highly demanded tool in developing regions and both the CD and web-based versions are already in use for graduate teaching in many countries. The tool is empowering university trainers to deliver more (developing country) context-relevant teaching of AnGR courses.

The planned synthesis of successes and failures of breeding programs and the evaluation and adaptation of alternative breeding options for smallholder systems is aimed at addressing a major global gap.

Deliberate engagement with NARS as partners/collaborators and as scholars is considered an effective means not only of helping mainstream the outcome of the research, but also as a conduit for effecting dissemination of knowledge. The research teams are supported by an institute Intellectual Property Unit that ensures that proactive defensive patenting and appropriate contracts with collaborators are used to safeguard/manage IPGs, ensuring that these become available for, and accessible to, those who need them.

Elaboration of partners' roles

The consortium that has been involved in driving the ECF vaccine research consists of: TIGR (provided the high throughput sequencing capacity that led to the complete sequence of the parasite genome and identification of candidate antigens); Ludwig Institute for Cancer Research (LICR), Belgium (cDNA library that was the source of additional candidate antigens), the private firm Merial and University of Oxford (provided proprietary vaccine delivery/formulation technologies) and the Kenya Department of Veterinary Services (DVS) of the Ministry of Livestock and Fisheries Development and Kenya Agricultural Research Institute (KARI) (backstopping of field trials expected to facilitate licensing).

In the diagnostics research, work towards the development of an ELISA test for African Swine fever diagnosis in East and Central Africa is being conducted in collaboration with the National Institute for Agriculture and Food Research and Technology of Spain (INIA); Validation and registration of the test will be carried out in partnership with the Kenya DVS. The optimization and conversion of an existing Trypanosome ELISA test to a particle gel immunoassay is through a partnership with the Swiss diagnostics company **Diamed**.

The main partners in the AnGR research have been: national governments who provide access to samples; national scientists who lead the sampling and are, in many cases, involved in the on-farm phenotypic characterization, genotyping/sequencing and data analysis. One example is the CAAS-ILRI Joint Laboratory hosted by Institute of Animal Science (IAS) of Chinese Academy of Agricultural Sciences (CAAS), which provides access to samples, research facility and national funding to work on economic valuation, phenotypic and genetic characterization of AnGR (in particular the chicken and small ruminants) in China and other countries in the region. Using its inter-governmental mechanisms (especially the Commission on Genetic Resources) as well as other opportunities, FAO has played an important role in raising awareness on AnGR issues, including priority research areas. IAEA/FAO Joint Division has partnered with ILRI in providing hands-on training for a large number of NARS scientists from Asia who, in this process, have analyzed samples of their (national) priority breeds at the ILRI labs. ARIs, especially universities in the North have played important roles in the gene discovery work. In the case of trypanotolerance research, a consortium comprising ILRI, Universities of Liverpool and Manchester (data management and analysis) and the Roslin Institute (expression analysis) has been developed and is funded by the Wellcome Trust. This has strengthened the capacity of all partners through regular exchange of personnel and development of novel means of electronic data exchange. A similar relationship through University of Nottingham has enhanced research on helminth resistance. In addition to these research consortia, close partnerships with Hebrew University of Jerusalem and University Iowa have enhanced our gene mapping and genome scanning capacity.

The development and pilot-testing of breeding strategies will involve close partnership with national governments (providing in-kind contribution in terms of local logistical support and access to government ranches/farms as initial locations of nucleus breeding flocks/herds and farmers in the pilot community-based projects in The GEF-funded project (in The Gambia, Guinea, Senegal and Mali). The International Trypanotolerance Centre (ITC) based in The Gambia will be an important collaborator in this activity (providing animals for the cattle and sheep nuclei and intellectual input as co-executing agency). The ILRI-BMZ project involves partnerships between national institutions in Benin, Ethiopia and Kenya and the Universities of Goettingen and Hohenheim in Germany, with the latter two contributing to project design and student supervision. A similar partnership between ILRI and Austria's BOKU University of Natural Resources and Applied Life Sciences and ICARDA involves farmer participatory breeding of cattle (with NARS in Uganda) and sheep (with NARS in Ethiopia). BOKU provides intellectual inputs (the research design, student supervision, and contribution to the analysis and publication of results), while Makerere University and the Uganda National Animal Breeding and Genetic Resources and Data Base (NAGRC&DB) provide local logistical and technical and field research supervisory support.

To enhance the capacity of NARS in sustainable use of Animal Genetic Resources, ILRI works in collaboration with the Swedish University of Agricultural Sciences (SLU) to "train trainers" in developing countries, and to produce an electronic training resource (Animal Genetics Training Resource, AGTR). SLU provides intellectual inputs in terms of subject matter content and as resource persons in group training courses.

Biotechnology Logframe

Output	Output Target	Intended User	Outcome	Impact
(Biotechnology) Output 1	New/improved vaccines and diagnostics (Africa and Asia) (3-5 years)	Livestock farmers; Departments of veterinary services; Private sector , NARs and ARI researchers	Increased use of new vaccines or diagnostics leading to reduced mortality and improved livestock productivity	Livestock assets of the poor secured
Output targets 2008	Recombinant candidate vaccine antigens of <i>R.appendiculatus</i> , the tick vector of <i>T.parva</i> for East and Central Africa region produced.	ILRI researchers	Use of data and antigens by private sector manufacturer to ascertain the prospects for an anti-tick vaccine to reduce the incidence of tick-borne diseases	
	Strategic assessment and prioritisation of novel approaches for East Coast fever vaccination for Eastern and Central Africa region completed and documented.	ILRI and other researchers; technology developers	ILRI vaccine research strategy for ECF	
	Strategic assessment and prioritisation of opportunities for vaccine and diagnostic assay development for other diseases around the globe completed and documented.	ILRI researchers, research donor community	Strategic priorities for vaccine and diagnostics research used to guide effective deployment of resources for development and production of vaccines and diagnostic assays.	
	Results of initial screening of <i>Mycoplasma mycoides</i> s.c. (cause of contagious bovine pleuropneumonia) antigens recognized by CD4+ T cells from recovered animals in Africa region available	ILRI and international researchers	Use of data by international researchers to better understand the immunological response to <i>M. mycoides</i> infection and to ascertain the prospects for better vaccines and diagnostics	

Output	Output Target	Intended User	Outcome	Impact
	Knowledge of the differences in the immune responses and pathology in <i>Bos indicus</i> and <i>Bos taurus</i> cattle following BCG vaccination documented.	ILRI and other members of the research consortium for bovine tuberculosis , and other researchers	Use of data by international researchers to better understand the immunological response to BCG vaccination and to assess the prospects for a better vaccine against bovine tuberculosis.	
	Knowledge of the differences in the immune responses to Infection and Treatment Method of vaccination against East Coast fever in Ankole, Tarime and Friesian cattle from the East and Central Africa region.	ILRI and other researchers	Use of data by international researchers to establish if there are any differences in cattle breeds in response to vaccination against East Coast fever.	
	Knowledge of molecular diversity of targeted genes of a specific subset of isolates of the African Swine fever virus (ASFV) from Tanzania and Kenya	ILRI and other researchers	Use of data by international researchers, manufacturers and standards bodies to design, make and certify improved serological and molecular diagnostic tools for ASFV for the East African region.	
Output targets 2009	An improved protocol for production of the East Coast fever Infection and Treatment Method vaccine documented.	Private sector manufacturers, NARs, NGOs and ILRI researchers	Adoption of a more robust method of manufacture of the ITM vaccine, and facilitation of the registration process	Livestock assets of the poor secured through reduction in effects of East Coast fever
	Knowledge of the efficacy of an adapted contagious bovine pleuropneumonia vaccine under field conditions documented.	NARS, Private sector manufacturers, NGOs, ARIs, ILRI	Use of data incorporated into recommendations for Veterinary Departments for delivery of the vaccine.	Livestock assets of the poor secured through reduction in effects of contagious bovine pleuropneumonia

Output	Output Target	Intended User	Outcome	Impact
	Knowledge of the efficacy of contagious bovine pleuropneumonia diagnostic antigens for detecting infected animals	Private sector manufacturers, NARs, ARI and ILRI researchers	Use of data by researchers and private sector manufacturers to ascertain the prospects of a new diagnostic assay for contagious bovine pleuropneumonia	Livestock assets of the poor secured through reduction in effects of contagious bovine pleuropneumonia
	Knowledge of antigens recognized by cells from cattle immune to infection with <i>Theileria annulata</i> (tropical theileriosis) documented.	ILRI and other researchers	Use of data by international researchers to better understand the immunological response to <i>T.annulata</i> infection and to ascertain the prospects for better vaccines.	
Output targets 2010	Knowledge of the efficacy of African Swine fever molecules to detect infected animals in Kenya and Tanzania.	Private sector manufacturers, NARs, ARI and ILRI researchers	Use of data by researchers and private sector manufacturers to ascertain the prospects of a new diagnostic assay for African Swine fever.	Livestock assets of the poor secured through reduction in the effects of African swine fever.
(Biotechnology) Output 2	Phenotypic, neutral and functional genetic molecular diversity of AnGR characterized, quantified and mapped to inform livestock conservation and utilisation strategies (Global, 5 – 10 years)	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility; NGOs; private sector (breeding companies and breed societies)	Use of livestock diversity information to guide conservation and utilisation programs	Diversity in livestock assets of the poor secured and livelihoods improved with conservation and improved use of promising breeds/traits
Output targets 2008	Maps of mitochondrial diversity of cattle, sheep, goat, chicken in Europe, Africa and Asia produced and made available for wider use	Researchers (NARS & ARIs); FAO; Global Environment Facility; private sector (breeding companies and breed societies)	Improved decision making on conservation and use of AnGR diversity	

Output	Output Target	Intended User	Outcome	Impact
	Polymorphisms in two candidate genes for host resistance to Avian Influenza in Asian and African chicken populations characterized and documented	Chicken researchers and breeders (NARES and private sector)	Host resistance information incorporated into models of AI epidemiology and management.	
	Candidate mechanisms for trypanosome resistance evaluated in laboratory-based systems.	Scientists in NARS & ARIs studying physiology and genome function in a wide range of disease systems	Knowledge of mechanisms of pathology and role of gene polymorphisms in response to infectious disease used as input in vaccine and therapeutic research.	
Output targets 2009	DAGRIS Country Module, populated and tested with national partners, initially in Ethiopia and Kenya	Educators, livestock keepers and breeders, NARES, private sector in Kenya and Ethiopia	Informed decision making on conservation and use of AnGR	
	Regions of the cattle genome which have responded to selection by disease identified in West African indigenous taurine cattle	Researchers in NARS & ARIs studying livestock diversity and/or using molecular markers for breeding improvement	Informed decision making regarding selection for disease resistance in field populations	
	Set of genome wide single nucleotide polymorphic (SNP) markers available for indigenous sheep in Sub Saharan countries	Scientists in NARS & ARIs studying livestock diversity and/or using molecular markers for breeding improvement	More efficient molecular tools for genome mapping (disease resistance) and biodiversity studies in sheep	

Output	Output Target	Intended User	Outcome	Impact
	Continental survey of sheep and goat microsatellite diversity available for Africa and Asia and combined with European (ECONOGENE and MTT) datasets	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility; private sector (breeding companies and breed societies)	Informed decision-making on conservation and utilisation of AnGR diversity based on diversity evidence	Diversity in livestock assets of the poor secured through informed use of its components

Output	Output Target	Intended User	Outcome	Impact
	Knowledge of molecular mechanisms of resistance to trypanotolerance elucidated and documented.	Researchers (in NARS and ARIs), especially animal geneticists/breeders, private sector (drugs companies)	Knowledge used by other scientists and technology developers (e.g. in designing projects for novel therapeutics)	
Output targets 2010	Compendium on distribution of livestock diversity in Asia and Africa published including protocols on sampling strategies, genotyping/sequencing and data analysis	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility;	Informed decision making on conservation and utilisations of AnGR diversity	Diversity in livestock assets of the poor secured
	Development of DAGRIS completed and the tool handed over to appropriate stakeholders to manage	NARES; ARIs; policy makers; livestock keepers; FAO, Global Environment Facility	Informed decision making on conservation and utilisations of AnGR diversity based on publicly accessible databases	
	Biological role and function of genes involved in trypanotolerance evaluated in broad stress response and documented	Scientists in NARS & ARIs studying genome function in a wide range of disease systems	Improved understanding of mechanism of pathology and role of gene polymorphisms in response to infectious disease. Knowledge used by other scientists and technology developers	
(Biotechnology) Output 3	Livestock breeding and conservation programmes suitable for low-input systems established to enhance productivity and adaptation. (Sub Saharan Africa, South Asia and South East Asia, 3 – 5 years)	NARES, ARIs; policy makers; livestock keepers; FAO, Global Environment Facility; NGOs; private sector (breeding companies and breed societies).	Greater use of more appropriate indigenous breeds for enhanced health, productivity and profitability under specified local conditions.	Livestock diversity secured, and livelihoods of the poor sustainably improved

Output	Output Target	Intended User	Outcome	Impact
Output targets 2008	Results of breed comparisons on tolerance to Trypanosomes resistance within the Ghibe Valley, Ethiopia, documented	Educators, livestock keepers and breeders, NARES, development agencies, policy makers, NGOs	Greater use of more appropriate indigenous breeds selected for tolerance to trypanosomes; advisors give better recommendations concerning breeds and breeding policies	Livelihoods of the poor improved through more appropriate use of breeds in Tsetse infested areas
	A 'training of trainers' course for scientists at Universities and research institutes in Sub-Saharan Africa on sustainable use of AnGR as a mechanism to disseminate new knowledge through influence on curricula	University teachers; researchers in NARS	Improved quality and relevance of training and research on conservation and use of animal genetic resources; greater use of the more appropriate breeding strategies	Production systems where animal genetic resources are important sustainably improved, and animal genetic resources better used
	Prospects (under what circumstances and how) for use of DNA marker information for disease resistance in smallholder breeding programs documented	NARES, ARIs, policy makers, livestock keepers, FAO, private sector (breeding companies and breed societies)	Go/no go decision on when and how to use marker technology in breeding programs – by NARS and breeding companies	
Output targets 2009	Semen sexing-in vitro fertilization & embryo transfer (SIFET) pilot-tested as complementary technology to artificial insemination for delivery of improved animal genetics in smallholder dairy systems	Governments, breeding organisations, smallholders ;commercial farmers; breed societies	Go / no-go decision on whether and how to scale-up promising delivery systems for appropriate genotypes in smallholder dairy systems	
	Best-bet options for dairy cattle breeding programs for Sub Saharan Africa and South Asia assessed and documented based on analysis of past failures and successes	NARES, ARIs, policy makers, FAO, Global Environment Facility, private sector (breeding companies and breed societies)	Greater use of more appropriate breeding programs, and improved understanding of constraints to breed improvement; advisors give better recommendations concerning breeding strategies	

Output	Output Target	Intended User	Outcome	Impact
	Pros and cons of different options for ex situ conservation of AnGR evaluated for technical and economic feasibility	Governments, development agencies and regional organisations	Options for ex-situ conservation of animal genetic resources within Sub-Saharan Africa available to stake-holders, enabling informed decisions in relation to the need for, and type of, gene-banks	
Output targets 2010	Predicted response to selection for various breeding options in selected scenarios for West Africa reported and disseminated	ILRI researchers, development agencies, policy makers, NGOs, governments	Basis for decisions on breeding strategies under different scenarios available and used to inform investment decisions in breeding programs	
	Lessons learned on prospects and opportunities for community based breeding programs documented and disseminated for Sub Saharan Africa	Policy makers NARES, ILRI scientists, ARIs	Better designed breeding programmes for small-holders; advisors equipped with improved knowledge and tools	
	Capacity building needs and strategies in animal genetic resources in developing countries produced and disseminated for Sub Saharan Africa, South Asia and South East Asia.	Educators, livestock keepers and breeders, NARES, development agencies, policy markers, NGOs, donors	Improved quality and relevance of training on, and support services for, conservation and use of animal genetic resources	

Rationale for the MTP project and changes

Growing populations, increasing urbanization and changing markets—especially increased demand for livestock products—in the developing world present new challenges and opportunities for small-scale livestock farmers, herders and landless people. Meeting a doubling in demand for livestock—and doing so using the same resource base and in environmentally sustainable ways that do not exclude poor people—will be challenging. Research conducted in ILRI's People, Livestock and Environment Theme gives diverse stakeholders evidence of the likely environmental and livelihood costs of different interventions. The Theme works in intensifying crop-livestock systems as well as pastoral and agropastoral systems. Our products include improved livestock feeding strategies and access to relevant, high-quality information on feeds and forages as well as assessments of the environmental impacts of livestock enterprises, such as the hard trade-offs in use of water and other resources. In pastoral and agropastoral systems, ILRI works to raise adaptive capacity and environmental and social resilience, such as by developing ways to better manage land and to mitigate zoonoses.

Our research to mitigate livestock feed scarcity is broadening its focus from crops used to feed both people and livestock (food-feed crops) to a systems orientation in studies of intensifying crop-livestock (ruminant/pig) production. This expanded focus is helping research to balance optimal resource use with increasing demands for feed. Our agenda now includes research on feeding strategies, feed efficiencies and trade-offs between feed options and other demands for crop biomass (e.g. in conservation agriculture addressed in collaborative projects implemented through the SLP and led by IITA in West Africa and CIMMYT in South Asia). ILRI's Targeting and Innovation Theme uses this information in its syntheses. We are further integrating our work on livestock-water as a resource input for feed production. We are exploring use of biofuels (e.g. from sweet sorghum) and potential for the residual *bagasse* to contribute to livestock feed. Among our output targets for 2008 are methods that enable researchers to evaluate the feed quality of a range of crops. Towards the end of this planning period, we will apply innovation systems approaches to work to enhance access to, and use of, fodder resources, working with ILRI's Improving Market Opportunities Theme on initial studies of feed market issues. We will also work with ILRI's Targeting and Innovation Theme in feeds research targeting areas and systems undergoing intensification.

ILRI's forage genebank is an essential resource for identifying productive genotypes that can help mitigate feed scarcity. The forage resources maintained in the genebank have potential for use in livestock feed niches; use of such forages can enable farmers to meet the rising market demands for high-value livestock products such as dairy. In this MTP period (2008–2010), a new project will be implemented to address disease constraints in the use of Napier grass by the smallholder dairy sector in East Africa; this work, which involves some biotechnology components, is in line with a recommendation by ILRI's EPMR to enhance use of germplasm. Over the next three years, with BecA and others, we will investigate opportunities for employing functional genomics and gene discovery to find forage traits of importance to the poor using the rich source of forage diversity maintained at ILRI. In addition to our store of forage materials themselves, our data and knowledge bases on forage diversity are a global public good that gives our partners access to new and promising forage plants. During this MTP period, ILRI and its partners will work under the aegis of the CGIAR System-wide Genetic Resources Programme to develop a global forage registry—part of a global system for forage diversity information and access that can serve as a basis for future rationalization of CGIAR genebank collections. The focus of this work in the short-term will be to ensure high-quality, efficient and effective management of this *ex situ* forage collection. The streamlining of operations that results is also in line with ILRI's EPMR recommendations and will be reviewed internally during the MTP period.

Intensifying crop-livestock systems, as well as other non-agricultural uses of land, are leading to increased demands for water. A major use of water within cropping systems is to produce livestock feeds. Our research with ILRI's Targeting and Innovation Theme is developing tools,

such as spreadsheet models and GIS approaches, to assess feed and environmental management options that enhance livestock's contribution to water productivity. This research area was recently strengthened by a new position shared with IWMI that will allow us to explore a strategic joint water-livestock agenda initially focused on aspects of crop-livestock systems and feed issues in particular. The tools developed will also be applied to pastoral and agropastoral systems, where water scarcity is an increasing source of conflict and vulnerability.

Many of the developing world's pastoral and agropastoral systems are facing increasing land-use pressure and external shocks, the latter resulting, for example, from increased climate change, diseases, droughts and changes in livestock markets. Research on sustaining lands and livelihoods in this MTP period will advance understanding of how livestock keeping affects issues of sustainability and vulnerability. (Recognizing that sustainability and vulnerability are of import not only to pastoral and agropastoral systems, we intend to build on our current pastoral and agropastoral program while extending this research in future MTP periods to incorporate intensifying crop-livestock systems.) We will work with ILRI's Targeting and Innovation Theme, for example, to quantify how livestock, climate, land use, natural resources and governance are changing. Taking an integrated approach to these issues, our work will incorporate veterinary and medical aspects of the impacts of livestock-related disease threats, particularly zoonotic diseases, on vulnerable people. In this MTP period, we will streamline this research with ILRI's Improving Market Opportunities Theme. Research will be implemented in strategically selected rapidly evolving systems in East and West Africa. We will explore opportunities to apply research methodologies developed in these locations—such as community-based collections and use of data on land use, livestock, ecosystem services and biodiversity—to Southern Africa and South Asia. In South Asia we will focus on tropical areas to build on our current expertise; we will not implement research in Asia's temperate zones but rather share research information and methods with organizations working there. New research implemented in East and West Africa as part of the System-wide Livestock Programme (SLP), together with ICRISAT and ILRI's Targeting and Innovation Theme, will investigate livestock-related risk management options for vulnerable people and lands in pastoral and agropastoral systems. This work, which is placing environmental and veterinary public health research in the context of ecosystem and human vulnerability, will help development agents and policymakers improve the adaptive capacity of pastoral and agropastoral systems. This strategy responds to ILRI's EPMR recommendation for a more focused pastoral systems agenda. A centre-commissioned external review will be conducted towards the end of this MTP period to assess research in this area.

The People, Livestock and Environment Theme continues to apply greater systems orientation and integration of research disciplines and methods. In response to the recent EPMR recommendation, research on livestock and human health has been realigned for the current MTP period. New research on the public health aspects of food safety are being consolidated with ILRI's existing work on institutional issues in food safety within ILRI's Improving Market Opportunities Theme while veterinary and public health research on zoonoses is being integrated within the People, Livestock and Environment Theme to address biophysical aspects of the environmental and social vulnerability of pastoral/agropastoral systems. Future evaluations of the potential role of livestock-based interventions to improve nutritional security of the poor, especially in households afflicted with HIV/AIDS, will be informed by a major review to be published by ILRI in 2007. The next step in the reorientation of the theme research will be the integration of research to address productive and environmental aspects related to intensifying crop-livestock systems, and will be articulated in the next MTP period.

Alignment of the MTP with the CGIAR system priorities

Research to develop new feeding options and to mitigate feed scarcity contributes to system priority 3B by improving livestock productivity and therefore market competitiveness through feeds. This will increasingly be linked to resource management issues as elaborated in system priority 4, especially 4D in relation to intensifying systems. It is anticipated that resources will be allocated mostly to 3B with an increasing allocation to 4D.

Forage diversity work is at the core of SP1, with the allocation in line with SP1 on crop biodiversity. Research to enhance the availability and use of Napier grass in East Africa contributes to SP3B (10%).

Research on water-livestock interactions directly addresses SP4C; we anticipate that future work in this area will provide entry points for addressing other natural resource management issues (relating especially to SP4A and 4D) and that in the longer term our livestock-water research will balance work to optimize resource use with work to improve livestock productivity (SP4D, with contributions to SP3B). We anticipate that 50% of the resource allocation will continue to address 4C over the medium term, with the remaining 50% split equally between SP4A and 4D.

Research on sustaining lands and livelihoods relates especially to SP4D and 4A, with some research and communication strategies addressing SP5D. The latter will become increasingly important during this MTP period as research on environmental and human vulnerability becomes the focus. Assessing the impact of zoonoses addresses SP3B, whereas designing and evaluating mitigation strategies appears to fall outside the SP. An estimated 60% of resources will be allocated to 4A and 4D, 10% to SP3B, 20% to SP5D, with the remaining 10% falling outside the SP. As the project portfolio evolves, links in research on the role of livestock in low-productivity areas will also benefit from outputs generated by livestock-water productivity research, since water resources, and lack of them, are so often key to pastoral vulnerabilities.

Description of impact pathways

The People, Livestock and Environment Theme aims for impact by focusing on livestock systems undergoing dramatic changes. Our work responds to new opportunities and challenges that demand new knowledge about technical interventions as well as new tools to better understand the potential impacts of those interventions on people and their environments. Outcomes and impacts are achieved by providing diverse stakeholders—researchers, development agents and policymakers at all levels—access to interventions and tools that enable them to make informed choices that consider the probable impacts of those interventions on the environment, on equity, on productivity and on poverty. Engagement with the private sector, especially small-scale entrepreneurs in intensifying crop-livestock systems, will become increasingly important, as will working together with ILRI's other themes in these dynamic livestock systems.

Intensifying crop-livestock systems, especially in South Asia and sub-Saharan Africa, are requiring more and better livestock feed supplies as well as improved livestock management options to mitigate environmental degradation. Our work with partners in this area will be partly facilitated through the SLP, with specific partnerships with other CGIAR centres and corresponding NARS institutions mandated to research specific crops, notably centres of the Indian Council of Agricultural Research using ILRI's research platform to assess food-feed crops. The research outputs will provide crop breeders access to straightforward methods for quickly evaluating feed quality. This project ensures that superior genotypes are incorporated into national and other breeding programs and that these programs are appropriately linked to relevant private and public suppliers of germplasm so that the improved crops are made widely available to smallholder farmers. This stepwise approach to evaluating food-feed crops will be made available as a generic tool for researchers worldwide. ILRI's Targeting and Innovation Theme will build on this research and disseminate its information and products to areas of rapid intensification and rising demand for livestock feed. Related research projects will provide tools for assessing appropriate feeding strategies using the range of available resources. Innovation research to understand how these feed-based research outputs can be scaled out and up is being conducted with grassroots research and development organizations working with ILRI's Targeting and Innovation Theme in collaboration with SLP partners in West Asia, North Africa, South and Southeast Asia and sub-Saharan Africa, including the ILRI-led project on Improving the Productivity and Market Success of Ethiopian Farmers (IPMS).

To ensure that germplasm and germplasm information can easily be accessed by NARS and NGOs for livestock feed or natural resource management, this project is developing a system-wide web-based knowledge base on forages. The forage diversity for which ILRI has a global responsibility is saved, studied and used to help sustain smallholder farming systems. This Theme ensures that the ILRI-maintained material continues to be managed according to international genebank standards, that high-quality planting material is available for distribution on request, and that an appropriate duplicate collection is established for safekeeping. In January 2008, ILRI will begin placing duplicate samples of its forage germplasm in the long-term vault being established for conserving plant genetic resources at Svalbard, Norway. We will continue to share knowledge with national systems in forage seed production, germplasm health and characterization. We will continue to offer training courses in this area, especially on characterization and management of forage genetic resources.

Enabling livestock keepers to make the best use of available water becomes increasingly important as demand for water increases, especially where crop-livestock systems are intensifying. Our research provides ways of assessing trade offs in water use that can be used by researchers to test new technologies and by development agencies to determine the most appropriate interventions or policies in given areas and circumstances. This operating project is focusing initially on the Nile Basin and working with NARS in Uganda and Ethiopia as well as NGOs and development agents. The project involves local students in Uganda and Ethiopia in capacity building activities. This research is conducted within the CGIAR Challenge Program on Water and Food (CPWF) and the Comprehensive Assessment of Water Management and Agriculture (CA) and in close partnership with IWMI. This partnership is helping to ensure that knowledge of how to assess the livestock dimensions of water productivity is incorporated into research and development projects worldwide. New research is being conducted outside of the Nile Basin that will enable tools developed for the Basin to be applied elsewhere. The project engages postdoctoral and other young scientists from different areas where mixed crop-livestock systems are intensifying to work with the ILRI and IWMI teams, to learn how to use their tools and approaches, and then to return to their home institutions to apply and modify these in their own regions. These tools will also be applied to help address water and related environmental management problems facing pastoralists and agropastoralists. In addition, the recently completed CA highlights the importance of researching the role of livestock in irrigation systems.

To help reduce the vulnerability of pastoral and agropastoral communities to disease threats, we need reliable methodologies to assess the risks and impacts of zoonoses. A joint ILRI-STI project will lead research on this. This project will leverage needed expertise from research partners in the veterinary and health sectors and generate a knowledge base with national partners. We anticipate impacts from this project through provision of science-based information to stakeholders in the health sector; this information will enable the health workers to include livestock-related issues in their agendas. Other research in this Theme is assessing the trade offs between alleviating poverty through improved livestock livelihoods and conserving ecosystem services. In Kenya and Tanzania, our approach includes outcome mapping to identify key boundary partners and then working with these partners to influence decision-making through provision of outputs such as spatial and non-spatial databases for livestock, land use and vegetation. Involving national ministry representatives in meetings with such stakeholders provides policymakers with appropriate science-based information for decision-making. This stepwise approach of identifying and working with boundary partners first at the local level and then at the national (policymaking) level will be applicable in other areas of East and West Africa and Asia. Community-based training (e.g. in monitoring to assess the effects of landscape fragmentation, livestock and land use on biodiversity) and involvement of local students in the project's activities empower local communities, helping to turn research outputs into outcomes.

Research approach to deliver international public goods

Our research that identified improved food-feed crops, as well as methods allowing crop experts to include feed parameters in their breeding programs, focused initially on just a few crops. This work has evolved a robust strategy for enabling feed quality traits to be incorporated into almost

any crop breeding program. The IPGs of this work include specific crop-based NIRS (near-infrared spectroscopy) equations that can be globally shared and used to quickly and simply evaluate many samples for feed quality. Other IPGs include the stepwise approach to incorporating feed parameters into the research and working with crop and livestock scientists as well as seed producers in both the private and public sectors. Another IPG is the identification of ceiling values for the potential contribution of food-feed crops (such as pearl millet) to improved nutrition for improved animal breeds. It is important in much of the developing world to better understand the trade-offs in using crop residues for feed, soils, or fuel. Working with ILRI's Targeting and Innovation Theme is helping this Theme to identify where systems are intensifying most rapidly and to make macro-level feed-based assessments that will help ensure these studies have wide relevance.

The ILRI-maintained forage germplasm and related information are IPGs freely available for all users. ILRI has ensured the IPG in-trust status of its forage collections and related information by signing in 2006 an agreement with the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture. Access to this material supports current forage development while also providing a source of diversity for addressing diverse challenges in the future. This Theme has produced another IPG in the form of a 'forage collection knowledge base' that collates information on the diversity and adaptive traits represented in this collection with available phenotypic and genetic characterization. This information has been placed in the public domain through ILRI and the System-wide Information Network on Genetic Resources (SINGER) and will be continuously updated.

Our research-based tools (and implementation approach with partners) for assessing livestock-water productivity are now ready for application and testing in regions beyond the Nile Basin. Opportunities for broader application of these tools and approaches lie in new research led by IWMI in sub-Saharan Africa (Zimbabwe and Ethiopia) and the Indo-Gangetic Basin. Collaboration with ILRI's Targeting and Innovation Theme and the Basin Focal Projects of the CPWF for key river basins of sub-Saharan Africa will also be explored to enhance the potential IPG nature of outputs generated from cross-basin comparisons. ILRI's research in this area aims to provide tools that empower stakeholders to assess water management trade offs related to livestock-based technical options (notably feeds) and policies, especially in intensifying crop-livestock systems.

Our research to identify livestock-related options for improving environmental sustainability and reducing human vulnerability to zoonoses in pastoral and agropastoral systems applies two approaches to ensure that IPGs are generated. (1) Case studies in many countries are linked by a gradient, such as access to markets or demographic survey information, to test hypotheses and methodological approaches that can then be made more broadly applicable. (2) Global and regional analyses are conducted with ILRI's Targeting and Innovation Theme and presented to the public to influence policymakers; donors; authorities and practitioners from public health, medical, veterinary and other government ministries; and representatives from conservation and development communities. These outputs, placed in the public domain, provide IPGs applicable to fast-changing livestock-based agricultural production systems.

Elaboration of partners' roles

Given the prominent roles of livestock in so many agricultural production and marketing systems, our research necessitates working with diverse groups of partners in many diverse ways. Included here are approaches that build upon platforms such as challenge programs (e.g., Challenge Program on Water and Food) and system-wide programs (e.g. crop-livestock work with the System-wide Livestock Program; forage genetic resource research with the System-wide Program on Genetic Resources; conservation agriculture trade-offs with the Rice-Wheat Consortium for the Indo-Gangetic Plains). All these platforms provide opportunities for locally relevant research results to be shared and integrated into global agenda. At another level, communities of practice bring together diverse stakeholders with complementary areas of expertise; examples from our research include the interface of veterinary and medical practitioners (to address zoonoses) livestock and water scientists, and crop breeders and animal nutritionists. Locally and regionally,

we typically implement projects working with national researchers and their development partners and provide individual and group training to help strengthen the capacity of these partners to conduct effective mission-oriented livestock research.

Research to mitigate feed scarcity is carried out with NARS and CGIAR partners on specific food-feed crops and where intensifying systems are causing environmental problems. Food-feed crops under study are cowpea, sorghum, pearl millet, groundnut, rice, maize, pigeon pea and sweet potato. This research conducts strategic partnerships with the particular CGIAR Centre mandated for each crop, with the NARS collaborating with those Centres on the breeding and selection of the crop, as well as with the NARS mandated to release new crop cultivars in selected regions. For crops whose hybrids are important (such as sorghum, millet, maize and rice), the research project works with existing public-private partnerships with the seed industry. In India our work with ICRISAT on sorghum, pearl millet, groundnut and pigeon pea collaborates with the All India Coordinated Crop Improvement Programs for the specific crops. In India our work with IRRI on rice systems collaborates with the All India Coordinated Rice Improvement Program and the Indian Veterinary Research Institute. Food-feed research on maize is mainly conducted in Ethiopia, Kenya and Tanzania with CIMMYT, the umbrella organizations ECAMAW and ASARECA, the Ethiopian Institute of Agricultural Research, the Kenyan Agricultural Research Institute, and the Tanzanian Agricultural Research Institute. We are working with the SLP and Texas A&M University to develop platforms for easy and widely accessible analytical tools for fodder trait analysis in food-feed crops. With the Rice-Wheat Consortium, IITA and partners in West Africa, we are investigating the trade-offs and synergies between conservation agricultural practices and livestock; this project also works with a joint staff appointee from the Faculty of Life Sciences at the University of Copenhagen, Denmark. Together with NARS, NGOs and CGIAR and private-sector partners in India, opportunities are being explored in a new National Agricultural Innovation Project to help improve and sustain livelihoods in disadvantaged areas by improving production-to-consumption systems for livestock and livestock products.

ILRI's main partners in forage diversity work are the System-wide Genetic Resources Program (SGRP) and its participating Centres, especially CIAT, ICRAF and ICARDA for forages; IITA and ICRISAT for food-feed crops; and Bioversity International (formerly IPGRI) for general genetic resources. In eastern and southern Africa, ILRI will conduct research on forage diversity as part of a flagship project on conservation and enhancement of agricultural biodiversity within the Regional Plans for Collective Action in Africa. ILRI will also conduct research on tropical forage diversity under the umbrella of the Chinese Academy of Agricultural Sciences (CAAS)-ILRI Joint Laboratory on Livestock and Forage Genetic Resources, located in Beijing. Information and material from the forage diversity work contributes to other projects that involve farmers, community groups, NGOs, NARS, the private sector and donors, including the IPMS project in Ethiopia. Activities on forage selection are carried out jointly with Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) and with CIAT. Our principal NARS partners include the Ethiopian Institute for Agricultural Research (EIAR) and the Ministry of Agriculture and Rural Development, together with SG 2000, in Ethiopia; Rothamsted Research, UK; ICIPE and the Kenyan Agricultural Research Institute (KARI), in Kenya; the National Agricultural Research Organisation (NARO), Uganda; and the National Biological Control Program, Tanzania.

ILRI addresses research on the nexus of livestock and water resources through complementary partnerships. ILRI and IWMI have established a unique partnership centred in Ethiopia in which each contributes core competencies to address CGIAR SP4 issues in ways that neither alone could undertake. This partnership makes important contributions to projects in the Nile River Basin and extends more widely across sub-Saharan Africa and the world, especially through the CGIAR Challenge Program on Water and Food and the Comprehensive Assessment of Water Management and Agriculture. These partnerships are identifying and developing livestock-related options (technology, management, institutional relations, and policy) to promote, improve and sustain pro-poor water productivity. Uganda's Makerere University and the Ethiopian Institute for Agricultural Research are the prime national partners collaborating in this research in the Nile Basin; in Ethiopia we work with CARE and the IPMS project.

In our research on environmental sustainability and human vulnerability to zoonoses in pastoral and agropastoral systems, our principal partners include local community organizations at selected linked learning sites (like the Kitengela Landowners Association and the Monduli District Council in Kenya); national government ministries of lands, environment and livestock; the environmental and agricultural research systems of developing countries (such as the Institut National de Recherche Agronomiques du Niger [INRAN]); regional agricultural research institutions (such as the Centre Régional de formation et d'application en agrométéorologie et hydrologie opérationnelle [AGRHYMET], based in Niger); international development and conservation organizations such as FAO, the African Wildlife Foundation and UNEP; other CGIAR centres and related consortia such as the Desert Margins Programme (DMP) and the recently launched systemwide program on drylands, Oasis, convened by ICARDA and ICRISAT. Our research also links with universities in both the developing (Nairobi, Kenya; Dar es Salaam, Tanzania) and developed worlds (University College London; Louvain, Belgium; Hohenheim, Germany; Colorado State, USA). The Theme's engagement with national partners enhances systems-oriented research that highlights the trade-offs between short-term poverty alleviation and long-term sustainability. To address health risks associated with livestock, in sub-Saharan Africa and Asia, a joint research program has been established with the Swiss Tropical Institute on zoonoses. By involving advanced research institutes in developed countries, this Theme encourages those institutions to investigate sustainability issues impinging on the developing world's poor livestock keepers. For the international development community, we highlight facts that counter conventional wisdom (e.g., herders always degrade land). And with our local partners, we help empower marginalized communities by providing them with high-quality information, training and innovations as well as connections to people and organizations with the power to help them improve and sustain their livelihoods.

People, Livestock and the Environment Logframe

	Outputs	Intended User	Outcome	Impact
(People, Livestock & the Environment Theme) Output 1	Institutional, management, policy and technical options to enhance environmentally sustainable livestock-based livelihoods through more effective, efficient and equitable use of water resources available for SSA and South Asia. <u>Links:</u> CGIAR Challenge Program on Water and Food	Policy makers, investors, researchers and development agents in the global community involved in agricultural water research and development	Researchers, initially in SSA, but subsequently more widely able to assess livestock use of water when evaluating technical options. Development agents able to provide practical options for water management that increase the returns on investment through inclusion of livestock. Policy makers able to assess trade offs and benefits of water investment options and policies with respect to livestock management.	Improved livelihoods in key River Basins through availability of environmentally sustainable options for livestock and water management and use
Output targets 2008	Assessments of livestock water productivity for one example of each pastoral, irrigated and mixed rainfed crop livestock systems in the Nile Basin.			
	GIS and decision support tools applied to assess livestock–water interactions in the Nile Basin			
Output targets 2009	<i>A framework developed for identifying hotspots of water scarcity in crop-livestock systems used to set research priorities and identifying strategies for improving livestock-water productivity in the Nile River basin (led by Targeting & Innovation Theme)</i>			
	<i>GIS based analyses of livestock water productivity for selected livestock systems in SSA (with</i>			

	Outputs	Intended User	Outcome	Impact
	<i>Targeting & Innovation Theme)</i>			
	Synthesis of priority livestock related issues for water productivity in the Nile Basin available.			
Output targets 2010	In collaboration with the CPWF, characterization of livestock water productivity and other livestock-water interactions in priority benchmark river basins particularly in SSA and South Asia completed			
	A synthesis describing how and where livestock production can be best encouraged to make effective use of water resources in developing countries available.			
(People, Livestock & the Environment) Output 2	<p>Viable and sustainable livestock-related options (policies, strategies, practices, institutions) to improve environmental sustainability and reduce human vulnerability to zoonoses in pastoral and agropastoral systems available in sub-Saharan Africa and Asia</p> <p><u>Links:</u> Desert Margins Program (DMP)</p>	Policy makers, investment institutions, medical, development agencies, NARS, ARI and CG researchers; community organisations.	<p>More appropriate planning and funding scenarios for research and development to sustain pastoral lands and livelihoods</p> <p>Improved control efforts for key zoonoses in pastoral and agropastoral systems</p> <p>Livestock based interventions for pastoral and agro pastoral people targeted by researchers and development agents.</p>	<p>Improved pastoral and agro-pastoral livelihoods and better sustained ecosystem services because of more targeted and efficient strategies that balance livestock-environment-livelihood needs.</p> <p>Improved public health, and livelihoods as well as improved incomes for livestock producers through global promotion of integrated control measures resulting in reduced incidence of key</p>

	Outputs	Intended User	Outcome	Impact
				zoonoses
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 (Kenya, Tanzania) and west (Niger, Mali) Africa evaluated and documented in a publication	NARS, ARI and CG researchers. Community organizations, policy makers	Livestock-based interventions to contribute to strategies to mediate natural resource based conflicts.	Reduced conflict in smallholder livestock systems undergoing dynamic changes in east and west Africa
	Synthesis of changes in resilience and adaptive capacity and related land use and policy scenarios in a Sahelian agro-pastoral system in Niger			
	Synthesis of scientific methodologies to evaluate changes in pastoral livelihoods and livestock based ecosystem services in selected countries of south and central Asia			
Output targets 2009	Synthesis of interventions and approaches used for research on sustaining pastoral lands, balancing trade-offs and contributing to livelihoods in selected countries of west, east and southern Africa and south and central Asia			
	Livestock-based risk management and coping options to reduce vulnerability to droughts in agro-pastoral and pastoral systems in East and West Africa			

	Outputs	Intended User	Outcome	Impact
	An economic and epidemiological framework for integrated veterinary-medical zoonotic disease burden assessment			
	Economic impact on the poor of several priority zoonoses relevant to pastoral/agro pastoral systems in East and West Africa			
Output targets 2010	Synthesis of policy options to reduce vulnerability to droughts based on case studies of agro-pastoral and pastoral systems in East and West Africa			
	Review of case studies to determine lessons and options regarding adaptive capacity to reduce vulnerability and enhance resilience of pastoral and agro-pastoral households			
(People, Livestock & the Environment) Output 3	Approaches defined for balancing improved feeding and productivity with optimal resource use in intensifying crop-livestock systems in SSA and S.Asia. <u>Links:</u> SLP, RWC	Researchers, policy makers, extension agents and NGO's; Public and private crop seed industry	Crop improvement breeding and releasing programs will include crop residue fodder traits to ensure that food feed crop varieties are identified and available Appropriate feeding strategies based on available resources accessed, assessed and used to increase livestock productivity Environmental trade offs of different resource use options assessed in relation to livestock productivity demands	Sustainable and productive options enhance livelihoods of farmers in Asia and SSA through access to and adoption of appropriate feed resources and feeding strategies that do not damage the environment
Output targets 2008	Livestock feed value traits suitable for incorporation into release parameters for key food-feed crops			

	Outputs	Intended User	Outcome	Impact
	Synthesis of research methods and steps of engagement with appropriate stakeholders for key food feed crops			
Output targets 2009	Assessment of systems-based research approaches to optimizing resource use and improving livestock productivity in changing crop livestock systems in Asia and SSA			
	<i>Evaluation of global feed demand and supply to 2030 used to identify hotspots of potential feed scarcity and improved feeding strategies and options for specific livestock systems in S. Asia (led by Targeting & Innovation Theme)</i>			
Output targets 2010	Options for value addition in relation to the utilisation of crop biomass for biofuel and processing biogases for feed production			
	<i>Innovation system based strategies to address access to and use of fodder resources, especially in relation to new market opportunities (with Targeting & Innovation Theme)</i>			
(People, Livestock & the Environment) Output 4	Knowledge and germplasm for forage resources available as part of a rational global system of genetic resources conservation and sustainable use <u>Links:</u> SGRP, SLP	National genebanks, ARIs, NGOs and NARS forage research, development and extension workers	Research and development agents are able to use forage genetic resources because of access to information and to plant material Information and accessibility of national forage resources is improved through the increased ability of national research systems to manage information. The global community involved	Broad genetic base of forage diversity available to contribute to forage development to meet future challenges

	Outputs	Intended User	Outcome	Impact
			in forage resource management is better able to use available resources efficiently and to respond to demands for information and material	
Output targets 2008	Approaches for efficient characterisation and conservation of forage resources as global public goods based on stratification according to use			
	Enhanced access to forage diversity through securely conserved diverse CGIAR-wide forage collection and high quality related information (characterisation, availability, access) through a single entry point			
Output targets 2009	Comprehensive risk assessment of forage genebank used to improve operating procedures and practices			
	Knowledge base on diversity within and between key forage species for adaptive and production traits			
	Review of options for regional forage seed production with public and private stakeholders			
Output targets 2010	Global crop registry of tropical forages available on line			
	High throughput protocols using generic equations for predicting nutritional parameters developed, validated and applied for diversity assessment of key forage species			

Rationale for the MTP Project and Changes

The System-wide Livestock Program (SLP) is a coordinating mechanism for cross-centre CGIAR livestock initiatives. Twelve of the 15 CGIAR Centers are members of SLP: CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI, IWMI and WARDA. The SLP provides simple and flexible coordination and individual Centers lead and implement individual research projects with at least one other CGIAR Center partner. Thus, SLP serves as a platform for networking and coordination and as a platform for Centers to develop research projects that require expertise from a number of Centers.

SLP has had a relatively focused strategy over the past few years – to improve feed systems in mixed crop-livestock systems (small-scale and agro-pastoral). This is clearly a research area in which there are considerable benefits to coordinated actions among different CGIAR Centers.

The initial research focus in feed systems within SLP was on food-feed crops. This has been well described in previous MTPs and in the research program of the People, Livestock and Environment Theme. In previous years, methods for assessing nutritional traits have been established and found to be readily transferable across crops. The current status of this work is that methods are being consolidated and transferred for incorporation into breeding programs for some key staple crops such as sorghum. Some work is being done to expand the initial range of crops from sorghum, millet, maize, and cowpea to include pigeon pea and rice.

While this initial focus on food-feed crops has proved successful, the overall context of smallholder crop-livestock production systems has become more complex. SLP is responding to this complexity by broadening its research on feeding strategies to contribute research evidence to address these issues. With rapid increases in demand for livestock and livestock products, there is an opportunity for poor producers in smallholder crop-livestock systems to benefit if they can intensify and increase production using roughly the same natural resource base. Components of this research are to better integrate crop and livestock production for a more efficient use of resources and to consider other tradeoffs, initially whether crop residues should be fed to livestock or conserved using conservation agriculture methods. Initial joint research has been undertaken in these areas over the past two years and will continue, with some initial outputs expected in 2009. Over the next three years, there will be a greater emphasis on more integrated approaches. This integration will take two forms. The first is to better combine technical, policy and institutional options for improving feeding systems. The second is to consider, as appropriate, how natural resource and environmental sustainability perspectives can be included.

During 2006, SLP revised its strategy guided by this evolution. The SLP project narrative in the 2007-9 and the current MTPs reflect those strategic changes and define three broad research outputs:

- Defining and understanding drivers of changes in crop-livestock systems with a particular emphasis on how they influence feeding systems
- Identify key feed interventions (technical, institutional and policy) to improve the productivity and sustainability of small-scale crop-livestock systems and consider the trade-offs between these and non-feed interventions
- Target and test options and processes by which proposed interventions will be scaled up and out to have greater impact.

The first output area, research on dynamics of crop-livestock systems with a focus on feeding strategies, is lead by ILRI and links with ILRI's broader research into the evolution of livestock production and marketing systems under its Targeting and Innovation Theme. There are also important contributions of CIAT, CIMMYT, CIP, ICRAF, IFPRI, IITA and their partners. This research uses spatial modeling and geographical information systems that integrate demographic, socio-economic, agro-ecological and livestock markets data to analyze the dynamic evolution of crop-livestock systems in order to anticipate to their future development and research needs. As

the drivers of change of these systems are better understood, the knowledge gained will serve as the basis for refining future feed and feed-related interventions. In response to evolving trends, SLP is looking at two growing influences on crop-based feed systems. The first is the growing importance of bio-fuels which will be an important influence on feed use and markets. ICRISAT is leading a new seed grant to assess the potential role of sorghum in the bio-fuel industry. The second is on the better use of crop byproducts in livestock feeding systems. ILRI with IITA are leading a seed grant on how cassava by-products could be included in livestock feed systems.

In the second output area, SLP plans to build on the research conducted by CIMMYT, ICARDA, ICRISAT, IITA, ILRI (People, Livestock and Environment Theme) and their partners on improvement of staple crops as an entry-point for improving feed supply in mixed farming systems that developed new approaches for genetic enhancement of dual purpose cultivars, especially in millet, sorghum, maize, and legume crops. As these results are expanded to crops such as rice and cassava by IRRI, WARDA, CIAT, ILRI and their partners, there will be need to address broader issues on the impact of food-feed crop approaches and technologies on system productivity, sustainability and livelihoods and the requirements for their effective use in innovation systems. This involves national and international crop breeding programs, seed releasing agencies and both private and public seed systems (the latter covered by output area 3). This research is being expanded to address the tradeoffs and synergies between the need for livestock feed and resource conservation following two lines of work. The first line of work involves systems characterized by low soil fertility where soil and animals compete for the nutrients contained in crop residues. In these systems CIAT, CIMMYT, ICRISAT, IITA, ILRI and their partners will conduct research to assess the tradeoffs and synergies among animals, crops and soil in order to maximize the efficiency of nutrient use. The second is targeted on systems where water is the main constraint: the Programme has developed an initiative led by IWMI and with inputs of ILRI and ICRISAT and their partners, to minimize the competition for water between livestock and other uses and to maximize, at the farm and watershed level, the productivity of water in relation to feed production and drinking needs of animals. ICARDA leads a new initiative whose research aims at developing generic strategies and models of broad relevance and applicability to increase the productivity and sustainability of crop-livestock systems.

The third output area focuses on the development and successful adoption and use of feed technologies by smallholders. This will require contributions from current and new partners exploring new delivery systems. Within the SLP, and with the support of DFID and IFAD, ILRI, ICRISAT, IITA, CIAT, ICARDA, ICRAF and their partners will conduct research aimed at enhancing the capacity of networks of organizations involved in rural development to respond to the needs of small scale, poor farmers for feed. Lessons learned in India and Nigeria will be tested and adapted in Ethiopia, Syria and Vietnam to understand how providers of technologies, information and services, including the private and official sectors and civil society organizations can interact better to address the needs of the poor. These lessons will be shared internationally and options will be sought for their application to a broader international context. As this research will be reaching completion the end of this medium term, the SLP will increase its effort in better informing policy and decision makers in the development and research domains to increase institutional capacity to meet the needs for information, technology and services of poor crop-livestock producers.

Alignment of the MTP with the CGIAR System Priorities

As a whole, the SLP focuses on ways to reduce poverty in areas where small scale crop-livestock production sustains the livelihoods of rural people. In doing so the major focus of SLP is to contribute to the CGIAR System Priority 3, "reducing rural poverty through diversification and emerging opportunities for high value commodities and products", specifically area 3B (income increases from livestock).

Given its system-wide nature, SLP seeks to bring inputs from across CGIAR system priorities to contribute to its income and livelihood improvement through livestock. The food-feed crops research is clearly linked to SP2 (producing more and better food at lower costs through genetic improvements), and more specifically SP2A (maintaining and enhancing yields and yield potential

of food staples). Research on livestock feed and natural resource use aims at developing approaches to increase productivity and farm income through the sustainable use of land, water and soil nutrients. In doing so it contributes to SP4, "poverty alleviation and sustainable management of water, land and forest resources", specifically SP4C (improving water productivity) and 4D (sustainable agro-ecological intensification in low- and high-potential areas). Institutional and policy inputs will also be critical to SLP outcomes and impacts. These will be closely linked to SP 3B but draw on lessons from research under SP5 (Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger), specifically SP5D (improving research and development options to reduce rural poverty and vulnerability).

Description of Impact Pathways

SLP has a four-pronged strategy to improving the potential of its research to have important outcomes and impacts.

The first component, related to output one, is to carefully consider research priorities and how they are targeted to respond to the dynamic context of crop-livestock systems. The frameworks and models developed by the SLP and applied to set priorities for interventions to improve crop-livestock systems for poverty reduction result in better targeted research and development investments and thus enhance the likelihood of these efforts to have positive impacts on poverty alleviation and enhanced sustainability.

The second component is to improve the quality and relevance of technologies, methods and approaches from SLP research. The SLP partnership of Centers focusing on the priority of feed systems allows the combination of key contributions and lesson from a variety of disciplines and perspectives. This strengthens the relevance of the research outputs within and across crop-livestock systems by assessing potential tradeoffs as well as bringing in research perspectives on sustainable use of land, water and soil nutrients. It also allows the research to benefit from the important partnerships and impact pathways developed by individual Centers. For example, the research into food-feed crops allows important lessons to be drawn from research in different crops and benefits from the crop breeding partnerships and seed system networks of the different crop centers so that improved dual purpose varieties can be quickly delivered through existing seed systems.

The third component is that best-bet feeding options coming from research are then tested with key actors in the system using innovation system research approaches. Lessons are learned by analyzing the capacities of individual institutional actors and the ways in which these work with others. Actors in these feed systems 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-government organizations and policy/decision makers. As the principles that govern feed innovation systems are understood, opportunities to enhance the provision of high quality feed-related services to poor crop-livestock producers will be enhanced in a sustainable fashion.

The fourth component to achieving impact is to synthesize and share knowledge. Lessons learned and knowledge generated with the SLP and other programs are shared in a number of formats, both web and print based. The SLP website serves as a mechanism to share research results from SLP members and others.

Research Approach to deliver international public goods

The research approach outlined above promotes the generation and delivery of international public good research as follows:

1. SLP ensures broad relevance of its research through global analyses of crop-livestock systems and using those lessons to target research
2. There is a focus on general tools and approaches to livestock feeding that can be applied to a variety of staple crops across a number of regions.

3. Building on the strengths of multiple Centers and their partners improves research quality and the international perspective of the research. Centers and their partners are located in several countries across geographical regions covering the spectrum of the conditions that define the SLP research domain.
4. Global lessons are then applied in a range of crop-livestock production and marketing systems to enhance their relevance to a broader range of users and allowing output to outcome and impact lessons to be generated and shared.
5. Research results and knowledge generated and synthesized are pro-actively communicated by various media including the internet, research and policy briefs, research reports, publications and synthesis documents on key issues. SLP invests approximately 10% of its budget on communication.

Beyond its research program, the SLP also serves as a system-wide focus for information and knowledge exchange on crop-livestock systems through its website <http://www.vslp.org> and joint publications.

Elaboration of Partners' Roles

The SLP benefits from a clear focus on feed systems that has stimulated the active participation and contribution of a majority of CGIAR Centers. During 2007, WARDA joined CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI and IWMI to become the 12th CGIAR Center member of the SLP.

ILRI supports the coordination, logistical and administrative backstopping for SLP by providing the Coordination Office and acting as its legal representative to establish letters of agreement with partners and donors. In addition, ILRI plays a strong leadership role in support of SLP priorities and targeting.

The ownership of SLP by other Centers is achieved through representation on the Livestock Program Group (LPG) of SLP. Each participating Center has one member, usually the Deputy Director General (DDG) of Research or a senior researcher. The LPG meets annually around the CGIAR annual general meeting and decisions in between meetings are made by email. The SLP coordinator is supported by a three member executive committee chaired by the DDG-Research of ILRI. LPG members contribute to and approve the SLP strategy and provide directly and indirectly key expertise to guide SLP implementation decisions (annual work plan and budget, approval of research and seed grants).

Participating Centers (either individually or in groups) manage SLP projects. They are responsible for bringing in key partners, either locally or internationally. The SLP Coordinator supports the implementation of projects and the networking and lesson sharing between Centers. The Coordinator also looks at broader partnership arrangements between SLP and other system-wide programs, challenge programs and other partners.

The CGIAR Center members of SLP are required to ensure the strong participation of their partners (e.g. NARS, civil society organizations, and private sector). These institutions, including decision makers, are key collaborators as they know best the realities of the countries where the activities are implemented and they are also the main target and elements of the change sought by the Program. National institutions from Bangladesh, Ghana, Ethiopia, India, Kenya, Mali, Niger, Nigeria, Syria, Tanzania and Vietnam are participating in the current MTP. They link either through other CGIAR Programs (RWC through CIMMYT and other partners, DMP through ICRISAT, SSA-CP through IITA and ILRI) or directly with Centers for project design and implementation. The RWC plays a key role in activities in the Indo-Gangetic Plains, whereas DMP and the SSA-CP are involved in work in Northern Nigeria and Southern Niger. Linkages with the Water and Food CP are being developed through collaboration with IWMI.

The SLP strives to increase the involvement of research organizations in developed countries in its projects. These organizations ensure that the best of frontier science plays an important role in SLP. Some of these partnerships are arranged through the SLP Coordinator but most are through

individual Centers. Cornell University (USA) participates in the development of a framework for ex-ante assessment of feed resources and in an initiative on dual-purpose rice, Hohenheim University (Germany) participates in a project on dual-purpose maize, Texas A&M University (USA) participates in enhancing the capacity of partners in near infrared reflectance spectroscopy, the Royal Veterinary and Agricultural University (Denmark) and the Swiss Federal Institute of Technology Zurich (ETH, through the Swiss Centre for International Agriculture – ZIL) participate in a project on livestock and soil conservation in West Africa; and the University of California-Davis participates in an initiative on dual-purpose rice.

CGIAR Systemwide Livestock Programme (SLP) Logframe

	Outputs	Intended User	Outcome	Impact
SLP Output 1	Defining and understanding drivers of changes in crop-livestock systems with a particular emphasis on how they influence feeding systems (ILRI, CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA IRRI, IWMI and their partners)	Researchers, research managers, CGIAR-SC, 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 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
Output targets 2008	Analytical framework developed to identify drivers of change in global crop-livestock systems (CIMMYT, CIP, ICRISAT, IFPRI, ILRI Targeting and Innovation and People Livestock and the Environment Themes)			
	Priority crop-livestock systems and research needs identified (CIMMYT, CIP, ICRISAT, IFPRI, ILRI Targeting and Innovation Theme)			
Output targets 2009	Potential role of sorghum in the bio-fuel versus feed production assessed (ICRISAT, ILRI People Livestock and the Environment Theme and partners)			
Output targets 2010	Assessment of the impact of the bio-fuel industry on small scale crop-livestock systems in developing countries (CIMMYT, ICRISAT, ILRI Targeting and Innovation Theme and partners)			
SLP Output 2	Identify key feed interventions (technical, institutional and policy) to improve the productivity and sustainability of small-scale crop-livestock systems and consider the trade-offs between these and non-feed interventions (ILRI, CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA IRRI, IWMI and their	Researchers, research managers, providers of services for small holder crop-livestock producers and development actors	Better equipped research and development systems to meet the needs of small scale crop-livestock producers	Increased crop-livestock productivity in equitable and sustainable ways

	Outputs	Intended User	Outcome	Impact
	partners)			
Output targets 2008	Sources of genetic variation for genetic improvement identified for dual-purpose pearl millet, sorghum, maize and groundnut (CIMMYT, ICRISAT, ILRI People Livestock and the Environment Theme)			
Output targets 2009	Options identified to enhance synergies and decrease tradeoffs between livestock and conservation agriculture strategies in the Indo-Gangetic Plains and West Africa (CIMMYT, ICRISAT, IRRI, ILRI People Livestock and the Environment Theme, IITA and partners)			
	Cross-country (India, Nigeria, Ethiopia, Syria, Vietnam) options to enhance the capacity of providers of feed related services and technologies for small scale crop-livestock producers synthesised (CIAT, ICARDA, ICRAF, ICRISAT, IITA and ILRI Targeting and Innovation and People Livestock and the Environment Themes and partners)			
	Recommendations on options to improve crop-livestock systems practicing conservation agriculture strategies made available to policy and decision makers in the Indo-Gangetic Plains, West Africa and Central America (CIAT, CIMMYT, IITA, ICRISAT, IRRI, ILRI People Livestock and the Environment Theme and partners)			
Output targets 2010	Institutional and policy options to reduce the vulnerability of pastoral and agro-pastoral producers in East and West Africa identified (ICRISAT, ILRI People Livestock and the Environment Theme and partners)			

	Outputs	Intended User	Outcome	Impact
SLP Output 3	Options and processes by which proposed interventions will be scaled up and out targeted and tested to have greater impact (ILRI, CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IFPRI, IITA IRRI, IWMI and their partners)	Policy and decision makers in research and development systems	Strengthened pro-rural poor policy and enabling institutional environment that support greater equity and promote practical options for poor people to participate in feed systems	More effective poverty reduction strategies and programs
Output targets 2008	Key actors involved in feed innovations and/or improvement of crop-livestock systems identified and their roles and potential for innovation assessed in five countries (ILRI Targeting and Innovation and People Livestock and the Environment Themes, CIAT, ICARDA, ICRISAT, IITA)			
Output targets 2009	Options for improving institutional capacity and enhancing institutional arrangements in feeding systems tested and documented in two livestock systems in Nigeria and India (ILRI Targeting and Innovation and People Livestock and the Environment Themes, CIAT, ICARDA, ICRISAT, IITA)			

Annex 1. Progress on the implementation of the 2nd ILRI EPMR recommendations

		Implementation			
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
1	Considering the competitive operating environment, the substantial assets of ILRI and the naturally long horizon for measuring results in livestock research, ILRI should expand its planning horizon to complement the MTP. The Panel recommends a planning cycle in which strategic vision and goals with ten year horizons yield strategic five-year business plans, operationalised annually.	Agreed – ILRI currently has a strategic vision and goals that were developed in 2002 and reviewed in 2005 prior to its 2nd EPMR. The 10-year strategy will be reviewed every 3 years. ILRI has begun developing 5-year implementation plans that bring together research, resource mobilization, staffing, partnership planning and communications and linking these to annual work plans and performance management. The 5-year horizon is appropriate for planning how research outputs lead to development outcomes. <i>See MTP overview: Strategic directions & implementation</i>	Develop 5-year rolling ILRI and theme implementation plans (linked with 3-year MTP) that are built on 5-year operating project implementation plans for each ILRI output. Strategic review process with the Board every three years (before and between EPMR)	OP Implementation Plans at Annual Planning Meeting linked to 2008-10 MTP (process refined in 2007 and fully operational in 2008 Strategy review was held at the November 2005 Board meeting	June 2008 - ILRI, Theme and OP implementation plans linked to 2009-11 MTP Next Strategy review at the November 2008 Board meeting
2	The ambition of global impact requires a more geographically distributed allocation of a critical mass of resources. Projects with global outcomes can beneficially be managed from locations other than East Africa. The Panel therefore recommends that ILRI redefine its physical location strategy (using CGIAR Centres wherever possible) and its <i>modus operandi</i> for each region. The Board should assess progress in three years through external review.	Agreed - ILRI accepts this recommendation, recognizing the major programmatic, partnership and financial challenges this acceptance implies. We see an expansion in geographic scope as an evolutionary process in which the Board and management will develop a plan to engage with key partners in different regions and through that mechanism develop strategies and resource mobilization opportunities. Our approach will be to focus on key global livestock issues backed up by a global knowledge management and communications strategy that takes account of the context, needs and opportunities in different regions. <i>See MTP overview: Strategic directions & implementation</i>	Develop strategic and Implementation Plans for regions, in consultation with stakeholders, linked to ILRI's global plan <ul style="list-style-type: none"> - Asia (South, South-East, China) - East Africa - West Africa - Southern Africa These plans will highlight areas of regional emphasis from the global plan and specificities for management, partnerships, resource mobilization, partnerships, communication and capacity building. Implementation of plan from late 2007 reviewed by a CCER in October 2009	Discussions on regional ILRI issues at Nov and March MC meetings (W. Africa, Southern Africa & Asia) Further Strategic discussions at Feb 2007 MC retreat and Annual Planning Meeting in March 2007	November 2007 - Global and regional plans discussed by the Board of Trustees Implementation to be reviewed by a CCER in October 2009.
3	Noting that the BecA network will offer ILRI and its partners opportunities to study a range of	Agreed – In vaccine and diagnostic research we plan to follow two approaches, one when ILRI plays the leadership role (such as for East Coast fever) and one in	In consultation with public and private partners, develop a Vaccine and Diagnostic Plan	Draft Vaccine Operating Project Implementation Plan	October 2007 - Vaccine and Diagnostic Plan developed

			Implementation		
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
	diseases, the panel recommends that ILRI maintains a clear focus in vaccine research, and that before ILRI enters any new disease for developing a vaccine or diagnostic, it clearly defines its role and that of its partners, and evaluates the viability of any new technology.	<p>which ILRI contributes a specific component to a larger initiative led by others. In vaccine projects that ILRI plans to lead, we will carefully consider our comparative advantage, research capacity and financial resources before committing to lead the project. When ILRI is requested to participate in vaccine projects led by NARS or ARI partners, we would agree to provide specific research inputs if we have the capacity and financial resources are made available.</p> <p>See MTP Biotechnology Project narrative and log frame</p>	<ul style="list-style-type: none"> - Principles and criteria for prioritization - Vaccine Operating Project Implementation Plan - Vaccine Network developed with research partners - Develop ILRI role of vaccines and diagnostics in BecA - Show linkages with other ILRI Themes <p>CCER review of vaccines, diagnostics and genomics work in late 2007 or early 2008</p>	Draft Business Plan- Vaccine Network	Late 2007 or early 2008 – CCER review of vaccines, diagnostics and genomics work at ILRI
4	As pastoralists are an ancient and continuing component of the livestock sector, and as they are increasingly marginalized by agricultural development, the Panel recommends that People, Livestock and the Environment Theme research related to transhumant livestock keeping be oriented to pro-pastoral policies globally and that knowledge developed to date be published in a global context as a priority.	<p>Partially agreed – Strengthening ILRI’s global contribution by publishing methods and practices for pro-poor pastoral research for development is a logical next step. This contribution to global fora will build initially on research results from studies in East and West Africa that have provided important insights such as sustainability, diversification and vulnerability issues for pastoral communities. ILRI’s contribution to global pastoral issues will focus on pastoral systems in the tropical zones, as others have comparative advantage in pastoral systems of temperate zones.</p> <p>See MTP People, livestock & environment project narrative and log frame</p>	<p>Global pastoral issues articulated and clarified in the 2009 -11 MTP. Establish links to pastoral partners globally, including ICARDA and ICRISAT. Field activities would be focused in Africa and South Asia</p> <p>CCER in 2009 to review implementation of pastoral activities</p>	Discussions of pastoral vulnerability and sustainability activities at Annual Planning Meeting 2007	<p>June 2008 - Clearer articulation of global pastoral issues and how implemented in 2009-11 MTP</p> <p>Mid-2009 – CCER to review implementation progress</p>
5	In view of the imminent new capacity for plant biosciences in BecA, the Panel recommends that ILRI maximize use of the facility for the forage genebank activities while also increasing research collaborations, particularly with the CGIAR Centers, that enhance the use of the germplasm.	<p>Agreed –Our plans for interactions between the forage genebank and BecA would focus on the identification and selection of traits for key abiotic and biotic stresses for a few selected forages. Broad-scale molecular characterization of forages is unlikely to be a priority. We see opportunities for other Centres to use the grass germplasm in the ILRI collection to look for genes of interest to their breeding programs. A critical short-term focus will be to work with CIAT and ICARDA to increase the efficiency of global forage genetic resources in the areas of genebank management and strategic utilization of conserved materials.</p> <p>See MTP People, livestock & environment project narrative and log frame</p>	<p>Discussions with SGRP on how ILRI’s activities in forage genetic resources can be better linked to those of other centres</p> <p>Activities to link conservation and use</p> <ul style="list-style-type: none"> - Make the ILRI collection more accessible by bar coding, stratifying the collection by function and making information more available to genomic and field users 	<p>ASARECA project on disease-resistant napier grass</p> <p>Initial discussions with CIAT and ICARDA</p>	<p>Discussion document to SGRP in January 2008</p> <p>Internal review of ILRI genebank improvements annually in 2007 and 2008 with a final review linked to overall review of GPG 2 project in 2009)</p>

			Implementation		
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
			- One major project using genebank materials for field application initiated		
6	The Panel views the People, Livestock and the Environment Theme as broad and uneven. To remedy this, the Panel recommends that OP2 be focused on pastoralists and INRM and a refocused OP3 be transferred to the Market Opportunities Theme.	Partially agreed – ILRI recognizes the need for greater focus and coherence within the People, Livestock and Environment Theme. We see the coherence coming from a focus on two main issues, sustainability of land and water resources in livestock production systems and the intensification of crop-livestock systems given the need for greater production from limited land and water. These issues will be considered and implemented through a number of strategic realignments of the theme portfolio over the next 18 months. Research on zoonotic diseases of importance to the poor is a priority for ILRI. We will review how to structure this between the People, Livestock and Environment and the Market Opportunities Themes. <i>See MTP People, Livestock & Environment and Market Opportunities project narratives and log frames</i>	Strategic alignment of the PLE Theme in 2007 with process documented in the MTP 2009-11 Re-alignment of zoonoses research discussed and implemented by the end of 2007	PLE Theme discussions at Annual Planning Meeting 2007 Discussions on zoonotic research alignment between PLE and Market Opportunities Theme on-going	June 2008 – articulation of revised framework for PLE in 2009-11 MTP Implementation of re-aligned zoonotic research by December 2007.
7	Following success of ILRI facilitating the creation of a large regional initiative (BecA), the Panel recommends that ILRI look at how it can generate adequately resourced, high impact initiatives for each Theme.	Agreed - ILRI will continue to improve its resource mobilization by strengthening the current strategy and how it is implemented. A selected number of livestock issues of global concern to which ILRI research can make a contribution have been identified as priorities for concerted resource mobilization efforts. <i>See MTP overview: Strategic directions & implementation</i>	Improved Resource mobilization efforts - Recruitment of Resource mobilization officer - Briefs on big global livestock issues for investors and partners developed - Revised Resource Mobilization plan with targets	Resource mobilization officer recruited Big issue briefs developed On-going MC actions on resource mobilization	Resource mobilization officer in place first half of 2007 Review of implementation and success with Board annually 2007-9
8	Given the risks to ILRI of being perceived as conducting development activities, the Panel recommends that the IPMS project be managed, budgeted and reported in two parts with research allocated to respective Themes and project management done by the DDG's office, and that ILRI decline management roles in future	Partially agreed – To have impact, ILRI research needs to actively engage with development projects and partners. We agree it is critical that ILRI constantly assess its research for development role. We also agree that in the management of large research – development projects, ILRI concentrates on its research role and partners with others who have expertise in development activities. ILRI believes it is important to manage the IPMS project as one entity. However, ILRI agrees to better link the research components and their reporting	Improved research performance within the IPMS - Research theme engagement - Specific expert support Guidelines for ILRI role in larger research for development projects developed and applied to decisions on individual	Inputs from Science Advisor and staff recruitment Link with development partners for large research-development projects (e.g. GEF AnGR West Africa)	Annual review of IPMS 2007-9 to assess research component Guidelines for ILRI's role in large research – development projects approved by ILRI MC in December 2007

			Implementation		
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
	development projects.	to its research programme. See MTP overview: Strategic directions & implementation	projects		
9	In the interests of continuing to improve the quality of its research output, the Panel recommends that ILRI immediately and systematically invest in increasing its Internet capacity for research purposes.	Agreed - ILRI is committed to expand its internet capacity with increased expenditures in 2007. ILRI and ICRAF are establishing a common ICT unit which should improve our capacity for strategic investment. Currently we are undertaking an internally commissioned review on ICT to advise on practical approaches and the investment required to increase internet capacity, taking into account regulatory and infrastructure conditions. See MTP Finance section	MC to develop a plan for ICT improvement for Board approval guided by an internally commissioned review Review of internal system architecture to improve performance of the bioinformatics hub	Information on broadband service provision from ICT internally-commissioned external review discussed at Feb MC retreat Tender process for bandwidth service provision in March 2007 Optic fibre gateway expected in 2008	Board approval of ICT development plan in November 2007 Internal review of ICT performance to support bioinformatics conducted in mid-2008
10	As a critical component of ILRI's systems approach, the Panel recommends that ILRI management charge the research themes to conduct ex post impact studies on selected programs using methodologies developed by the new Innovation and Impact Unit, and using external inputs where needed.	Agreed - ILRI will take steps to strengthen its <i>ex-post</i> impact assessment capacity. These will include the participation of scientists who carried out the research, methodological support from impact assessment specialists in ILRI's Innovation Works Unit and review by outside experts to ensure objectivity. See MTP overview: Strategic directions & implementation	Establishment of innovation and Impact Unit Inclusion of plans for impact assessment in research projects and specific ex-post studies developed and implemented by Themes	Innovation and Impact Unit being established	June 2007 - Innovation and impact unit plans incorporated in 2008-10 MTP June 2008 – impact assessment plans in 2009-11 MTP
11	As part of ILRI's contribution to strengthening capacity, the Panel recommends that ILRI make this activity explicit and measurable in research program design and report results for Board training and follow up activities.	Agreed - ILRI has recently recruited a senior Capacity Strengthening Manager and is finalizing a capacity strengthening strategy for the institute. Procedures will be put in place so that capacity strengthening contributions are explicitly recognized in its program planning, implementation and reporting. See MTP overview: Strategic directions & implementation	New CaSt Manager and team to develop a Capacity Strengthening implementation plan taking into account recent CCER recommendations Establish procedures for incorporating capacity building into research programmes and documenting capacity building activities	New Capacity Strengthening Manager recruited	CaSt Implementation plan to be developed and reviewed in November 2007 Procedures for capacity building in research programmes reported in 2009-11 MTP and reviewed in November 2008.
12	The panel recommends that ILRI provide new members of the board with a thorough orientation to the financial issues and trends that shape ILRI's budget, strategy, and capacity as well as to the processes	Agreed - An orientation program is being developed and a financial briefing session was presented to the Board prior to its November 2006 meeting. This program will be updated to reflect the changing environment and the changes within ILRI's priorities and structure as well as the evolving requirements of the Finance & Audit	Board Financial orientation programme developed, revised and presented All Board members receive orientation during their first year	Orientation Nov 2006 Board meeting	Orientation programme documents prepared November 2006

			Implementation		
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
	that support the board's responsibilities for financial stewardship and oversight.	committee of the Board. See MTP Governance and Finance section	of tenure		
13	The Panel recommends that ILRI management and the board chair redefine the responsibilities and scope of work of the Board Secretary and improve ILRI's practices with respect to meeting preparation.	Agreed - A detailed checklist on Board meeting preparation and the conduct of Board affairs throughout the year is being developed by the Secretary and the Board Chair and will be implemented by ILRI management and Board. See MTP Governance and Finance section	Review TORs for Board Secretary Checklist of Board meeting preparation with deadlines developed and implemented by November 2007 Board meeting CCER on Board governance	Board agreed to a CCER on Board governance for late 2007	November 2007 - Approval of revised TORs for Board Secretary and checklist for Board meeting preparation
14	The panel recommends that the board increase the quality of its board recruitment process by developing a multi-year strategy for the recruitment of new board members, which supports the global mandate of ILRI and provides it with a board that is a sustained asset to the accomplishment of its work.	Agreed - The ILRI Board of Trustees will finalize a Board of Trustees Development Strategy which includes the recruitment of Board members based upon complementary skills to ensure continuity in providing oversight to the business of ILRI. See MTP Governance and Finance section	Board of Trustees Development strategy including Board recruitment plan	Board Development Strategy including a multi-year recruitment strategy approved in 2006 New Board member appointed with specific financial expertise	
15	ILRI having identified the weaknesses in key management proficiencies, the Panel recommends that the DG and DDG institute comprehensive training and development opportunities for all managers and hold themselves and managers responsible for improvements in performance.	Agreed – ILRI, with external consultants, has reviewed its human resource management and individual manager skills. Follow-up actions identified as part of this review have been agreed. These will be implemented in the next 12 months and their effect monitored and reviewed as part of a continuous management improvement program. See MTP Governance and Finance section	Follow-up management actions 1. Training of staff and coaching of managers 2. Recruitment of a learning and development officer in HR 3. Systematic follow-up of issues noted in staff and manager training 4. Survey by learning and development officer of improved management performance	Performance Management training in late 2006 and First level Development Programme learning and development programme in 2007 (90 staff trained) Coaching with individual managers in mid 2007	March 2007 – training of managers December 2007 – manager coaching February 2007 – recruitment of learning and development officer April 2008 – Survey to assess follow-up management performance
16	The Panel recommends that as part of overall improvements to the HR function, ILRI develop a staffing plan which is cognizant of geography, anticipated disciplinary expertise and gender, and is	Agreed – This recommendation will be implemented as part of the business planning and globalization of ILRI's activities (response to recommendations 1 and 2). See MTP Governance and Finance section	Development of a staff plan as part of the 5-year ILRI, Theme and OP implementation plans taking into account research requirements, regional locations and gender (relative to Board-	See recommendation 1	Plan prepared in June 2008 for discussion at the November 2008 Board meeting

			Implementation		
	EPMR Recommendation	ILRI Board and Management response	Milestones / Tasks	Progress achieved to-date	Target Dates
	consistent with the ILRI priorities.		approved G&D goals)		
17	The Panel recommends that ILRI undertake a comprehensive reassessment of its current sites in Kenya and Ethiopia, exploring all options with respect to the management and disposition of its properties.	Agreed – Within its evolving global strategy, a comprehensive review of ILRI properties and assets in Kenya and Ethiopia will be conducted with a view to assessing their relevance and increasing their effectiveness and efficiency. <i>See MTP Governance and Finance section</i>	Internal review of ILRI properties in East Africa as to their relevance to ILRI's present and future mission to be prepared by MC and discussed and approved by the Board	On-going discussions on the utilization of Debre Zeit and Kapiti	Review presented to the Board in April 2008
18	The Panel recommends that ILRI continue to improve its financial management through adoption of a new investment strategy, a more comprehensive resource mobilization plan, and more efficient grants management.	Agreed – An investment policy was approved at the November 2006 Board meeting. In line with recommendation 7, ILRI agrees that it needs to increase its skills and experience in resource mobilization and enhance coordination of resource mobilization activities within the institute. We also concur that, as far as possible, restricted fund raising should focus on large and medium-size and longer-term grants and should also attempt to recover staff costs and overhead to the largest extent possible. <i>See MTP Governance and Finance section</i>	Investment strategy developed and approved by the Board Resource Mobilization Officer recruited and updating of the ILRI resource mobilization plan New grants management system	Investment strategy approved by the Board Resource mobilization officer recruited; to begin in April 2007	November 2006 April 2007 – Recruitment; December 2007 - Resource mobilization plan revised April 2008 – New Grants System

Annex 2. List of acronyms

AGM	Annual General Meeting
AGRHYMET	Center Regional de Formation et d'application en Agrometeorologie et Hydrologie Operatinalle
AGTR	Animal Genetics Training Resource
AIDS	Acquired Immune Deficiency Syndrome
AnGR	Animal Genetic Resources
ARI	Advanced Research Institutes
ASARECA	Association for Strengthening Agricultural Research in Eastern and Southern Africa
AU-IBAR	The African Union/Inter-African Bureau for Animal Resources
BCG	Bacillus Calmette Guérin
BDS	Business Development Services
BecA	Biosciences east and central Africa
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (Germany's Ministry for Economic Cooperation)
BOKU	University of Natural Resources and Applied Life Sciences
BTB	Bovine Tuberculosis
CA	Comprehensive Assessment of Water Management and Agriculture
CAAS	Chinese Academy of Agricultural Sciences
CAADP	Comprehensive Africa Agriculture Development Program
CAAS	Chinese Academy of Agricultural Sciences
CAC	Consejo Agropecuario Centroamericano
CALPI	Capitalization of Livestock Programme Experiences India
CAPRI	Collective Action and Property Rights
CARE	Comité Americano de Remesas al Exterior, Honduras
CaSt	Capacity Strengthening
CBPP	Contagious bovine pleuropneumonia
CCER	Centre – Commissioned External Review
CD-ROM	Compact Disk-Read only Memory
CelAgriD	Centre for Livestock and Agricultural Development
CFC	Common Fund for Commodities
CGIAR	Consultative Group on International Agriculture
CIAT	Centro Internacional de Agricultura Tropical (International Centre for Tropical Agriculture)
CIDA	Canadian International Development Agency
CIP	Centro Internacional de la Papa
CIRAD-EMVT	Centre de Coopération Internationale en Recherche Agronomique pour le Développement: Département Élevage et médecine vétérinaire
COMESA	Common Market for Eastern and Southern Africa
CORAF	Conseil Ouest et Centrale Africain pour la Recherche et le Développement Agricole (Conference of the Agricultural Research Leaders in West and Central Africa)
CORGOFA	Corporacion Ganadera
CPWF	Challenge Program for Water and Food
CSO	Civil Society Organization
DAD-IS	Domestic Animal Diversity Information Service
DAGRIS	Domestic Animal Genetic Resources Information System
DFID	Department for International Development
DICTA	Direccion de Investigacion y Tecnologia Agropecuarias
DMP	Desert Margins Programme
DNA	Deoxyribonucleic Acid
DVS	Departments of Veterinary Services
ECAMAW	Eastern and Central Africa Maize and Wheat Research Network
ECAPAPA	Eastern and Central Africa Programme for Agricultural Policy Analysis
ECF	East Coast Fever
EIAR	Ethiopian Institute for Agricultural Research
ELISA	Enzyme – Linked Immunosorbent Assay
EPMR	External Programme and Management Review

ESA	Eastern and Southern Africa
ESSP	Earth System Science Partnership
ETH	Swiss Federal Institute of Technology, Zurich
EU	European Union
FAO-LEAD	Food and Agriculture Organization – Livestock, Environment and Development
FAO-PPLPI	Food and Agriculture Organization - Pro-Poor Livestock Policy Initiative
FARA	Forum for Agricultural Research in Africa
FASID	Foundation for Advanced Studies on International Development
FEGAGUATE	Federacion de Ganaderos de Guatemala
FENAGH	Federacion Nacional De Agricultores y Ganaderos de Nicaragua
G & D	Gender and Diversity
GALVmed	Global Alliance for Livestock Veterinary medicines
GEF	Global Environmental Facility
GIS	Geographic Information Systems
HIV	Human Immunodeficiency Virus
HPAI	Highly Pathogenic Avian Influenza
HR	Human Resources
IAEA	International Atomic Energy Agency
IARC	International Agricultural Research Centres
IAS	Institute of Animal Sciences
ICARDA	International Centre for Agricultural Research in the Dry Areas
ICRAF	World Agroforestry Centre (International Centre for Research in Agroforestry)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communications Technology
ICTA	International Center for Technology Assessment
IDR	Instituto de Desarrollo Rural
IDRC	International Development Research Centre
IFPRI	International Food Policy Research Institute
IICA	El 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
INIA	National Institute for Agriculture and Food Research & Technology of Spain
INRAN	Institut National de Recherche Agronomiques du Niger
IPGs	International Public Goods
IPMS	Improving Productivity and Market Success (of Ethiopian Farmers)
IPSARD	Institute of Policy and Strategy for Agriculture and Rural Development
IRRI	International Rice Research Institute
ITC	International Trypanotolerance Centre
ITM	Infection and Treatment Method
IWMI	International Water management Institute
KARI	Kenya Agricultural Research Institute
KILA	Kitengela Iparakuo Landowners Association
LICR	Ludwig Institute for Cancer Research
LIME	Learning-based Innovation Monitoring and Evaluation
MC	Management Committee
MTP	Medium Term Plan
NAGRC&DB	National Animal Breeding and Genetic Resources Data Base
NARES	National Agricultural Research and Extension Systems
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NDRI	National Dairy Research Institute
NE	North East
NEPAD	New Partnership for Africa's Development
NGO	Non – Governmental Organization
NIRS	Near Infra-Red Spectroscopy
OIE	Office International des Epizooties (World Animal Health Organization)
OP	Operating Project
PANVAC	Pan African Vaccine Centre of the AU
PLE	People, Livestock and the Environment

PRGA	Participatory Research and Gender Analysis Programme
QTL	Quantitative Trait Loci
R & D	Research and Development
RWC	Rice-Wheat Consortium
SADC	Southern African Development Community
SAKSS	Strategic Analysis and Knowledge Support Systems
SE	South East
SGRP	System wide Genetic Resources Programme
SIDE	Servicios Internacionales para el Desarrollo Empresarial
SIFET	Sexing In-Vitro Fertilization and Embryo Transfer
SINGER	System-wide Information Network on Genetic Resources
SLP	System-wide Livestock Programme
SLU	Swedish University of Agricultural Sciences
SoW	State of the World (for Animal Genetic Resources, AnGR)
SP	System Priorities
SPS	Sanitary and Phyto-Sanitary
SSA	Sub-Saharan Africa
SSA-CP	Sub-Saharan Africa Challenge Programme
STI	Sexually Transmitted Infection
TIGR	The Institute for Genomic Research
ToRs	Terms of Reference
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNU-MERIT	United Nations University/ Maastrich Economic and Social Research and Training Centre on Information and Technology
USA	United States of America
USD	United States Dollar
WARDA	West Africa Rice Development Association
WCA	West and Central Africa
WFP	World Food Programme
ZIL	Swiss Centre for International Agriculture