*Getting the science right –* **ILRI’s Science Strategy, 2014-2019 (DRAFT 11 Feb 2015)**

**THE SCIENCE STRATEGY IN BRIEF**

**Needs to be re-written**

**INTRODUCTION**

In 2013 ILRI launched a new 10-year strategy, ‘ILRI Strategy 2013 -2022: Livestock Research for Food Security and Poverty Reduction.’ This has three strategic objectives through which the institute intends to achieve ‘better lives through livestock’:

1. developing, testing, and promoting science-based practices that—being sustainable and scalable—achieve better lives through livestock;
2. providing scientific evidence to persuade decision-makers—from farms to firms to governments—that better policies and better livestock investments can deliver economic, health and environmental benefits to poor nations and households, and
3. expanding capacity among stakeholders and within the institute itself to make better use of livestock science and investments.

The strategy was deliberately designed to provide overall institutional direction without all the operational details, recognising that the details of research operations may change within the timeframe of the strategy. The strategy further defines five Critical Success Factors (Box 1) needed to achieve those strategic objectives. This Science Strategy deals with the first of these factors, *get the science right*. It has been designed and developed within the broader context represented by the opportunities and challenges associated with livestock, especially among rural people in the developing world, the overall ILRI Strategy 2013-2022, the CGIAR Strategy and Results Framework 2016-2025 and taking into account national and regional priorities and capacities.

**Box 1 - ILRI’s Critical Success Factors**

* Get the science right
* Influence decision makers
* Grow capacity
* Unsure ILRI is fit for purpose
* Secure sustainable and appropriate funding

It provides details of the institute’s strategic research priorities over the next six years[[1]](#footnote-1), outlines theories of technical and institutional change, and impact pathways, all within the context of the global livestock and institutional and organisational landscape in which it operates.

**CGIAR STRATEGY**

As a member of the CGIAR Consortium, and part of the wider CGIAR System, ILRI operates under the CGIAR Strategy and Results Framework[[2]](#endnote-1)[[3]](#footnote-2) and our research contributes to all three goals of the CGIAR:

* Reduce poverty
* Improve food and nutrition security for health
* Improve natural resource management and ecosystem services

The CGIAR contributes to achieving these goals through undertaking research through a series of CGIAR Research Programs (CRPs).

**KEY LIVESTOCK OPPORTUNITIES AND CHALLENGES**

The livestock sector is crucial to poverty reduction, food and nutrition security and to environmental management and ecosystem services. The global livestock sector comprises 37 billion animals, representing an asset value of $1.5 trillion, employing 1.3 billion people and using one-third of the earth’s ice-free land area. Globally, four of the five highest value agricultural commodities are livestock products – milk, beef, pig meat and chicken meat with only rice making it to the top five. Four of the ten highest agricultural commodities in Africa are livestock commodities.

The livestock sector in developing countries is growing rapidly, driven by population growth, urbanization and economic growth. As incomes rise people consume a greater proportion of fruit, vegetables and livestock products in their diet. In many developing countries livestock now accounts for 30-40 percent of agricultural GDP and the sector is growing at 2.5 – 6 percent per year. Yet livestock generally receives 5-10 percent of agricultural investment.

The key opportunities and challenges in the livestock sector in the developing world related to the three goals of the CGIAR are discussed below.

**Reduce poverty (and create wealth)**

Livestock are a growing share of economic activity and rural incomes in developing countries. On average 33 percent of the income in mixed crop-livestock systems in developing countries comes from livestock, with higher incomes being associated with dairy and poultry production. Livestock also create employment, not only in production but in trading, processing and marketing. Depending on the value chain 100 litres of milk traded generates 0.3 to 2.0 jobs. Employment in the livestock sector is especially high in the informal sectors of Asia and Africa, where most meat, milk, and eggs are sold and where many of the people selling and buying livestock foods are themselves poor.

Livestock are particularly valuable assets for poor people. Livestock tends to be more equitably distributed than land and can be especially important to landless and those with very small land holdings. The share of income from livestock is often highest among the poorest although in some cases livestock ownership is a sign of wealth. Animal assets also act as a type of insurance and can be quickly sold to finance investments such as school fees or to maintain consumption during illness or drought.

Most meat and milk in the developing world comes from mixed systems and these mixed systems also produce close to 50 percent of the global cereal output. The importance of such mixed systems is likely to increase. TRACTION

Livestock create value from marginal lands. It is estimated that animals use 3.4 billion hectares of grazing and 0.5 billion hectares of cropland for feed production (one-third of the global ice-free land). Of the grazing areas, 2.3 billion hectares are in the developing world and much of it is unsuited to crop production.

Despite the importance of livestock their contribution to poverty reduction and economic development could be even higher. Yield gaps are high, for example compared to industrialized countries milk yield per cow per year is only 6 per cent in Africa and 14% in South Asia. If the yield gap could be closed and if the efficiency of livestock value chains could be increased the poverty and economic impacts could be huge. Research to sustainably increase productivity through improved technology and policy, organizational and institutional arrangements is needed. Also increasing productivity coupled with lower prices could improve both availability and accessibility of animal source foods for poor consumers.

**Improve food and nutrition security for health**

The 2014 Global Hunger Index published by the International Food Policy Research Institute shows that 805 million people continue to go hungry, The highest hunger levels are in Africa south of the Sahara and South Asia. Livestock make significant contributions to food security. Globally livestock provide 12.9 percent of calories and 27.9 percent of protein consumed. In East Africa livestock provide on average 11 percent of energy and 26 percent of protein in poor people’s diets. For some vulnerable groups, such as the world’s 180 million pastoralists, the contribution of livestock products to diet is much higher; for example, among Nuer agro-pastoralists in Sudan, half of the total energy intake of children aged less than 5 years comes from milk.

While in affluent countries a reduction in consumption of animal source foods may bring about significant public health benefits the opposite is true for millions of people in the developing world. Animal source foods play a critical role in nutrition security because they are dense sources of energy and high-quality protein and they are important for vulnerable groups, such as infants, children, pregnant and nursing women, and people living with HIV. They also provide a variety of essential micronutrients, some of which, such as vitamin A, vitamin B12, riboflavin, calcium, iron, zinc and various essential fatty acids, are difficult to obtain in adequate amounts from plant-based foods alone. Consumption of even small amounts of animal source foods has been shown to contribute substantially to ensuring dietary adequacy, preventing under-nutrition and nutritional deficiencies and ensure physical and cognitive development in children.

However the contribution that livestock can make to food and nutrition security in developing countries is low compared to the potential because of low productivity leading to low availability and often high prices. Also the factors that influence accessibility and utilization of animal source foods by different groups are not well understood, limiting our ability to develop livestock value chains that can enhance nutrition. Research to sustainably increase productivity through improved technology and policy, organizational and institutional arrangements is needed. Also increasing productivity coupled with lower prices could improve both availability and accessibility for poor consumers.

While livestock products make an important contribution to food and nutritional security, they also pose threats to human health. Many human diseases are zoonotic (diseases transmissible between animals and man), and it is estimated that the annual global cost of zoonotic and emerging diseases is US$125 billion. Estimates of the costs of food borne disease in Nigeria were about 1.25 percent of its GDP in 2010. In the least-developed countries zoonoses and diseases recently emerged from animals make up 25 percent of the infectious disease burden and kill one in ten people, with the majority of infection transmitted to people from livestock hosts through consumption of animal source foods, vectors or direct contact. The greatest burden of livestock-associated disease falls on poor producers, traders and consumers.

With growing concern about the health externalities of agriculture especially emerging diseases, spillover of disease to wildlife, and antimicrobial resistance, assessment and control of zoonotic diseases and food safety will be a growth area for ILRI. Is this in the right place?

**Improve natural resource management and ecosystem services**

Livestock and livestock systems use resources such as land, biomass and water and therefore both impact and are impacted on the environment. In many cases they also compete with other sectors and uses for those resources.

The expansion of cropland to produce feed grains for monogastrics and intensive ruminant systems is one example of competition for land. One estimate is that 450 million tonnes of grain will be needed to meet human demand for animal products by 2050, some 20 percent of 2010 global grain production. Expansion of pastureland at the expense of natural habitats has been in the order of 330 million hectares in the past 40 years, mainly in Latin America. To reduce this pressure on land application of technologies to increase productivity per unit of feed are essential.

Livestock also compete for water. Land for animals is closely linked to water use: 90 percent of the water used by livestock is through grazing and feed production; global livestock feed production uses 9 percent of global evapotranspiration. Therefore lowering water use through improved feed and rangeland management can have a big impact on global water use.

In developed countries the link between livestock and crop production is largely broken with large scale intensive crop production sustained by synthetic fertilizers, while livestock consume high grain diets. Manure from intensive livestock production systems is waste material, often leading to pollution of soil and water. In most small holder systems of Africa and Asia, the links among feed production, animal production and crop production are maintained. Agricultural production and nutrient cycles are closely related to local-scale recycling of organic residues, with animal manures providing 25% of the crops’ nitrogen requirements. Meeting the demand for crop production requires managing nutrient cycles more efficiently.

Livestock contribute 14.5% of the world’s human-induced greenhouse gases mainly from enteric fermentation and manure. Low levels of productivity lead to large level s of greenhouse gas emissions per unit of meat or milk. There are large environmental gains to be made from increasing productivity, leading to significant reductions on greenhouse gas emissions. One estimate shows that by doubling milk yield per animal in India greenhouse gas emission would be reduced by about 25%, while still maintaining total milk output from a reduced number of animals. Research on efficient manure management can not only help to reduce gaseous emissions but can improve crop productivity. Livestock production in the world’s rangelands provide a range of environmental benefits. For example Africa’s rangelands could sequester 8.6 million tons of carbon. So livestock systems can contribute to the solution to climate change.

It is critical to recognise that the impact of livestock on the environment varies widely across systems and geographies -too often simplistic statements are made regarding these impacts. The often quoted figure if one kilogram of beef needing 15,000 litres of water may hold for intensive systems in North America but is unlikely to hold for a smallholder system in Africa. However there is a paucity of good data on the environmental impact of livestock in the developing world.

**RESEARCH PRIORITIES**

ILRI’s overall strategy 2013-2022 identified three scenarios of livestock systems change. These were:

**Strong systems growth** where there is reasonably good resource endowment and good market access. These systems will become increasing market-oriented. The key research for development challenges are how to ensure and improve market access and to sustainably intensify productivity.

**Fragile growth systems** where growth in productivity is severely limited by remoteness, harsh climates or environments, or by poor institutions, infrastructure and market access. Here the needs are, where appropriate, to help achieve incremental growth and market engagement. In other situations the emphasis will be on enhancing the important role that livestock play in increasing resilience of people, communities and environments.

**High growth with externalities** where dynamic markets are already driving strong growth and rapid intensification that may be damaging the environment, exposing communities to increased public health risks and excluding participation of livestock keepers and sellers in deepest poverty. The research challenges are how to mitigate the health, environmental and social externalities of these systems.

To tackle the research for development challenges in the three growth scenarios and within the context of the global livestock challenges and opportunities described above, five major research priorities areas have been identified (Box 2). The first three of these will have a strong emphasis on increasing livestock productivity through developing and testing technical solutions to productivity constraints. Given the strong interactions between human and livestock health, the third area incorporates both aspects to enable research to be undertaken within a ‘One Health’ framework. The fourth theme on policies, institutions and markets recognises that market pull and an enabling environment are key factors in stimulating productivity increases and demand for new technology. The final theme takes account of the fact that livestock are part of wider systems at different scales – households, communities, farming systems, landscapes and global systems. Understanding the interactions between livestock and these social and environmental systems is critical to developing pathways to sustainable and equitable livestock development.

**Box 2 -ILRI’s Five Research Priority Areas**

1. Animal genetics and breeding
2. Feed resources
3. Livestock and human health
4. Policies, institutions and markets
5. Sustainable livestock systems

Table 1 shows the relationship and relative contribution of these five research areas to the different growth scenarios.

**Table 1. How the five research areas contribute to the different livestock development scenarios. The higher the number of Xs the greater the contribution and resource allocation within ILRI’s portfolio.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Strong growth | Fragile growth | High growth |
| Animal genetics and breeding | XXX | X | XX |
| Feed resources | XXX | XX |  |
| Livestock and human health | XXX | XX | XX |
| Policies, institutions and markets  | XXX | XX |  |
| Sustainable livestock systems | XXX | XX | X |

These research areas, in which ILRI and partners intend to provide global scientific leadership and generate and apply important new knowledge, are described below.

1. **Animal genetics and breeding - gene discovery, genetic improvement, breeding strategies and conservation and use of genetic resources**.

This area will be largely be delivered through ILRI’s **Global Livestock Genetics Initiative** (LiveGene), which is currently aligned to the CGIAR Research Program on Livestock and Fish which will provide some of the pathways to delivery, but also eventually contributing to livestock systems not targeted by Livestock and Fish. The LiveGene initiative will take advantage of recent developments in biosciences, such as genomics, embryo cloning and other reproductive technologies, in-vitro conservation technologies and marker and gene assisted selection techniques, to speed the identification of desirable traits. It will also exploit advances in information and communications technologies, such as those that enable cost effective phenotyping of targeted livestock species, to guide breeding and selection programs.

LiveGene will bring together ILRI’s scientists and their projects to create the critical mass in animal breeding and genetics to provide global scientific leadership and to undertake research that uses a more ‘joined up’ approach. This will see better integration of scientific disciplines across the biosciences and integrated sciences and development - from priority setting and targeting of genetics interventions, through to gene discovery, innovative ways to generate phenotypes, characterization and conservation, to delivery of improved breeds to small-scale livestock keepers, especially for dairy cattle, poultry, sheep and goats and, to a lesser extent, pigs. In this way it will be responsive to the needs of livestock keepers, the dynamic changes in the livestock sector, including those driven by climate change, and emerging market demands.

Through working with science and development partners, during the lifespan of this strategy, and beyond, LiveGene aims to:

* deliver improved genetics of priority species to the world’s small-scale livestock keepers
* become a trusted and valued partner of national breeding programs to increase productivity through improved genetics of the priority livestock species important to small-scale livestock keepers
* support national livestock breeding programs by providing regional breeding platforms for priority species, making available open source data bases to guide breeding programs in specific environments
* establish itself as a global leader in tropical animal genetics and a centre for excellence in animal biosciences
* host a livestock genomics platform for the genotyping and characterization of livestock and related wildlife biodiversity, and also host bio-repositories to conserve and make available the diversity of tropical livestock species and their associated microbes, pests and pathogens, as an open source scientific resource for research
* become the premier means of access to authoritative data on the distribution of livestock species and genotypes, and knowledge on the likely behaviour of genotypes in new environments, including those affected by climate change. This new knowledge will provides the evidence base to guide future investors in livestock development, amongst governments, private sector and international development agencies.

For cattle, targets for genetic improvement under this theme include tropical adaptation, heat tolerance, disease resistance (e.g. trypanosomasis) and feed conversion leading to more productive, sustainable tropical breeds of dairy cows. For pigs, African swine fever resistant pig breeds are in demand in countries such as Uganda and Vietnam where African swine fever is a major constraint to smallholder pig production. For poultry, low productivity in village level poultry production will be addressed through the genetic improvement of indigenous chickens, making use of the genetic diversity within indigenous chickens. For sheep and goats,breeding targets include tropical adaptation, disease resistance and heat tolerance with the aim of developing more productive breeds with increased hardiness to harsh environments.

There will be an increased emphasis on understanding the genetic control of animal disease. The teams will explore the genes that make some animals more resistant to diseases than others, as well as those that enable certain breeds to thrive in warmer, arid conditions. Researchers will also use genetic techniques to characterize new diseases that emerge and to track outbreaks

The characterization and conservation of livestock biodiversity will be enhanced, building on the existing biorepository at ILRI.

1. **Feeds resources– conservation and use of forage genetic resources, increasing feed production and improving feed utilization.**

ILRI’s research on feed resources has three main foci:

* Providing platforms and tools to support feed research across several CRPs (Livestock & Fish, Drylands, Humid Tropics and CCAFS) as well as some of the crop commodity CRPs, and also for non-CRP projects and partners.
* Designing and implementing research to use feed resources more efficiently, which entails application of tools to assess feeds, identify, and prioritize potential feed interventions, establish feed demand and supply scenarios, and develop processing and smart supplementation options for animal value chains that consider both productivity and environmental costs.
* Providing more feed biomass of higher quality from forages, food-feed crops, agricultural by-products and new ingredients. ILRI will not develop in house plant improvement programs but will collaborate with CGIAR centres and other partners on plant improvement programs using both conventional and molecular crop and forage breeding and by application of new science.

The objective of the feed resources research is to increase both livestock production (total output) and productivity (output per unit input). For example within Livestock & Fish CRP the target of to achieve an overall 50 percent increase in total factor productivity in at least half of the targeted value chains. This will be achieved through developing better feeds and more efficient feed and fodder value chains, while avoiding unacceptable environmental costs on land, water and atmospheric resources. The research will also include improving food-feed crops and making best use of existing forages, including crop residues, in the Livestock & Fish value chains and those for the Humid Tropics and the Drylands CRPs where livestock are important parts of production and environmental systems. We will extend collaboration with the crop Centers – CIMMYT on wheat and maize, IRRI on rice, ICRISAT on millet and sorghum, CIP on roots and tubers – where such crops are important feed sources. Modelling will explore productivity and crop-livestock interactions in value chains where crop residues are a major component of ruminant diets.

There will be new emphasis on application of recent scientific tools within the newly created Feed and Forage Biosciences Program. We will apply molecular tools, for example, to the identification and development of better adapted, higher productivity and more disease resistant forages, and new opportunities for food-feed crops, or bio fortified feeds that better support livestock production. The platform will work at the gene discovery level, looking for better nutrition, digestibility, climate resilience, disease resistance and biofortification. Collaboration with CIAT and national partners on forage breeding programs will allow the exploitation of this knowledge. This research will rely heavily on the unique genetic resources (over 19,000 accessions) held in the forage genebank in Addis Ababa. We will invest in the construction of a new genebank and associated laboratory and office facilities to allow us to continue to conserve, catalogue and characterize these accessions. Collaboration with CIAT and national partners on forage breeding programs will allow the exploitation of this knowledge. New research will explore the option of using second generation bio-fuel technology developments to upgrade ligno-cellulose biomass for ruminants, making the boundaries between feed resources for ruminants and monogastrics more permeable, thereby increasing the choice of feed material for these species and reducing the competition between biomass use for food, feed and soil improvement.

1. **Livestock and human health – vaccine and diagnostic development, controlling zoonotic disease and food safety, and improving herd health.**

Vaccines can be a highly effective intervention for disease control, especially in under-resourced agricultural systems. Vaccine research will largely be delivered through the newly created ILRI Vaccine Platform (ILVAC), the objective of which is to build a hub of research excellence dedicated to developing vaccine-based solutions to reduce disease burdens that limit livestock productivity in smallholder and pastoral farming systems.

This research will take advantage of the paradigm shifts in science, underpinned by whole genome sequence information, high throughput screening methods and informatics which are accelerating the pace of basic and applied research enabling a holistic approach to vaccine, diagnostics and therapeutics development. Vaccine research is by nature risky but potentially a high-reward venture. The research is complex in nature and requires long-term investments.

Working with partners, ILVAC is initially focusing on a set of five priority diseases: African swine fever (ASF), contagious bo­vine pleuropneumonia (CBPP), East Coast fever (ECF), peste de petits ruminants (PPR) and Rift Valley fever (RVF). The creation of a vaccine research platform, where generic tech­niques and processes will be implemented, however, gives the ability to tackle other disease constraints. Disease prioritization will in future be guided by more rigorous ex-ante impact analysis requiring closer collaboration between the vaccine platform and staff working on the socio-economic impact of diseases.

To meet its objectives and achieve impact in the discovery to delivery pathway ILVAC will work with the BecA-ILRI Hub and through the CRPs, as well as with national and regional academic, public, private and development sectors.

ILRI has pioneered a model for improving food safety in informal markets where most of the poor buy and sell animal source foods. This model involves capacity building of informal actors, developing an enabling regulatory environment, and creating incentives for behaviour change. Developing, evaluating and bringing this approach to scale is a key element of future research. ILRI’s sites in developing countries and advanced laboratory facilities are an advantage in conducting research on diseases emerging in developing country ecosystems and this is another key area of work. Neglected zoonoses, antimicrobial resistance associated with drug use in livestock, are other areas of expertise and focus.

ILRI’s research onherd health will take an integrated approach. The focus will be on promotion of animal health through identification of animal health constraints and opportunities through field surveys, participatory methods and biological sampling, field testing interventions to improve animal health and developing and testing gender sensitive models of delivery of animal health services, including community-based health care in different livestock and farming systems. Initially this research will be carried out in the priority CRP Livestock & Fish value chains in West Africa, East Africa, South Asia and South East Asia; later it will be extended into the action areas of the Drylands (East and Southern Africa) and Humid Tropics (East Africa, West Africa and South East Asia) CRPs, and how herd health can contribute to sustainable intensification.

To date ILRI has not undertaken much research on human nutrition. Given the growing awareness that agricultural development does not necessarily lead to improved nutrition and the importance of animal source foods in the supply of important protein and micro-nutrients we will develop in collaboration with partners new research on the role of animal source foods in improving nutrition and the design of livestock value chains to improve nutrition through greater availability, accesibity and utilization of animal source foods . This will be done jointly through the CRPs Livestock and Fish and Agriculture for Nutrition and Health. Where should this section be? mNutrition

1. **Policies, institutions and markets – supporting livestock policy development and implementation (including foresight), livestock trade, value chains and impact of livestock research.**

Research in this area will focus on a) foresight analysis, examining the drivers of change in livestock systems and their evolution, b) livestock trade, with a particular emphasis on regional trade c) value chain development, especially to enable small-scale producers to be competitive and access input and output markets and d) ex-ante and ex-post impact analysis to provide evidence for justification of investment in livestock research and development

A small policy research unit will be established which will focus on livestock and related policy research and analysis at a range of scales, from global to regional to national. The unit will work closely with researchers in other ILRI programs, drawing on their specialist disciplinary knowledge and contribute to policy relevant research across the institue . It will undertake foresight analysis, modelling the trajectories of different livestock systems, and exploring the effects of technological, institutional and policy interventions. This will be done in close collaboration with other foresight research in the CGIAR and elsewhere, for example using the IFPRI IMPACT model, including strengthening and refining the livestock components of these models.

A critical requirement of the research on policies, institutions and markets is access to good quality data and statistics. There is a general paucity of data for the livestock sector in developing countries and the quality of existing data is often poor. Opportunities for developing more robust data collection and analysis of livestock and related data will be explored with research and development partners and investors.

Regional trade is expanding and becoming an important driver of the evolution of livestock systems. For example the trade in livestock from the Horn of Africa to the Middle East has expanded rapidly in the past five years, opening up new market opportunities for pastoral and other producers in the region. Large numbers of animal are moved from the Sahel to meet the growing demand in the large coastal cities in West Africa. These trends open up opportunities for small-medium sized producers, but at the same time posed challenges in, for example, disease control and product quality. Research on trade for livestock products will be strengthened, with a particular focus on regional trade.

Access to output markets and input services requires functioning, efficient and effective value chains. Research on value chains will explore institutional and policy measure to make value chains effective, especially in relation to the needs of small scale producers, but also identify and test ways of adding value along the chain. We will also identify and test new ways of bringing about innovation in livestock value chains, drawing lessons from different models, including from across the CRPs and testing and evaluating specific models which show promise.

Research investment needs to be justified on the basis of evidence of impact and informed through a process of iterative learning. More emphasis will be placed on both ex-ante and ex-post impact analysis and capturing lessons learned from past and existing projects. For example, more analysis is needed of the potential impact of new technologies such as animal heath interventions or the introduction of new genotypes of livestock into production systems of the adoption of integrated solutions. Also there is a lack of strong evidence for the impact of past livestock research because of a paucity of rigorous impact assessment studies.

1. **Sustainable livestock systems– sustainable and equitable intensification of livestock systems (including gender equity), adaptation to and mitigation of climate change, increasing resilience of livestock systems and the communities who depend on them.**

Within this area, ILRI will build on its long history of research on sustainable intensification of crop-livestock systems. New approaches to increasing productivity, based on technological, organizational, institutional and policy interventions, will be identified and tested, while taking account of the natural resource base, climate change and social equity, including gender. This research will be undertaken using a systems approach (e.g. farming system or value chain) in which the interaction and trade-offs among components are identified and quantified.

An integrated systems approach will be taken to analyzing the interactions among livestock and plant systems and the environment at a range of scales, from global to local, focusing on positive and negative impacts of livestock systems on the environment. A cornerstone of the program’s work will be combining empirical and modelling approaches with qualitative approaches.

A range of tools and models will be used for systems characterization, targeting and ex-ante impact assessment of interventions that seek to measure and reduce the environmental costs of agriculture. These models work across scales from household level to global. This research will help to identify entry points for innovations and interventions, and opportunities for appropriate scaling out of these, recognizing the interactions across systems. These models and tools will also provide direct decision support to a range of stakeholders. These tools are invaluable to understanding the linkages, and resolving the many trade-offs among factors like production, income, environmental and food security.

Another area of research will focus on building resilience to climate shocks and longer-term adaptation to climate change. This includes household, community and landscape level investigation of adaptations, including institutions and governance. New interventions aimed at enhancing adaptation or adaptive capacity will then be assessed within the local social and economic contexts. The same approach will be taken to interventions to enhance resilience. There is considerable interest in targeting and evaluating national interventions to build resilience to drought and this research will feed directly into supporting national partners.

Research on the environmental footprint of livestock systems will be expanded. One focus is measuring and modelling greenhouse gas emissions from livestock. A new research facility has been established to enable this work. A protocol will be developed for measuring GHG emissions from mixed systems with a focus on Africa. This will later be broadened to look at other nutrient cycles, including nitrogen and also water. Research on the environmental impacts of selected livestock value chains will be extended.

Research is ecosystem services from livestock systems will include developing an inventory and valuation of these services, especially in rangelands. Research will also be carried out on frameworks and processes for sustainable rangeland management. Work on incentives to foster greater provisioning of critical ecosystem services will focus on payment schemes that benefit small-scale livestock keeper.

**Complementary nature of the thematic areas**: The five priority research areas should not be seen in isolation. Transformational improvements in animal agriculture are unlikely to come about through application of one technology or approach, but require combined approaches: improved breeds require more feeds or different approaches to animal health care and other husbandry practices; removing a disease or nutritional constraint may open up opportunities for use of improved genetics, changes in feeding practices may have implications on environmental impacts ,introduction of a new technology may have implications for labour supplied by women and so on. For these technologies to succeed the right mix of policies, institutions and markets are also critical and they all need to sit within sustainable livestock systems. There will, therefore, be considerable collaboration, interaction and synergies amongst the research areas.

**OPERATIONALIZING THE SCIENCE STRATEGY**

In addition to the priority research areas, addressing some other strategic issues is critical to the operationalization of the Science Strategy. These are:

**Gender**

Protection and enhancement of women’s interests in agriculture and the livestock sector in particular is of special interest. Although women provide about 70 per cent of the labour in livestock husbandry in developing countries, often they do not have access to and sufficient control over and access to assets and services. Building on ILRI’s gender strategy we will (i) increase capacity in ILRI, partner organizations and value chain actors to diagnose and resolve gender constraints in livestock systems and value chains; (ii) develop and implement research and development approaches through which women and marginalized groups capture more value-addition from animal production and marketing; (iii) develop and implement approaches through which women and marginalized groups achieve more access to assets -- markets, land, animals, technologies, power; (iv) develop and implement approaches to increase level and equity of animal source food consumption in poor households; (v) ensure that all aspects of our research are cognisant of gender issues, i.e. mainstream gender into our programs and projects.

**Rebalancing the portfolio with increased emphasis on biosciences**

Long-term, costly upstream biological research that addresses the problems and opportunities of the poor is unlikely to be done by either the private sector because it is unlikely to be profitable and it is difficult to capture the benefits. It is also beyond the capacity of most national programs because it is costly, requires state of the art equipment and highly trained staff. During the past few years, however, the speed of discovery in bioscienceshas increased rapidly. For example, sequencing is now a standard tool and is making more effective and more rapid work possible on animal genomics and animal health. There is also a need to develop intermediate tools, such as mobile technologies, to accelerate the integration of the outputs of upstream research into the value chains and other technology transfer sites. A key feature of this strategy, therefore, is an increased emphasis on and new investments in biosciences research. During the lifetime of this strategy we expect the share of biosciences research to grow to about 40 per cent of our portfolio, while we continue to invest in integrated sciences, including field-based applied animal science, environmental science and socio-economic research.

**Better integration and collaboration among disciplines and programs**

ILRI has a unique mix of skills and disciplines to bring to bear on the challenges of livestock research for development, spanning the biosciences, applied animal science, environmental science, geography and the social sciences including from economics to social anthropology. Many of the research problems to be addresses are beyond the scope of one discipline and we will bring together multi-disciplinary teams to tackle these. This will include better integration of the biosciences and integrated sciences as well as closer collaboration within these areas so that we have a pipeline of research from laboratory to field and field activities inform laboratory research priorities.

**Partnerships for research**

To ensure that the most up to date techniques and knowledge can be brought to bear on the livestock research challenges in developing countries it is important that ILRI collaborates with research teams at the cutting edge of global science. We will develop strategic alliances with specialist advanced research organizations across the world where it is in the mutual interest of all.

ILRI values its collaboration and partnerships with NARS. We will seek to deepen the interaction with NARS and their regional organizations in the countries where we work to ensure that our research is relevant and contributes to the national research agenda. Where relevant this interaction will include capacity development initiatives.

**Partnerships for impact**

Interaction with development actors is important to a) help identify the key livestock development challenges and b) in translating research outputs into sustainable outcomes and impacts. ILRI has gained considerable experience in working with development partners (governments, international agencies, NGOs etc) over the past 6-8 years and we value these collaborations. We will continue to strengthen these links and especially deepen our engagement with a few strategic partners.

Although the private sector is unlikely to invest in pro-poor bioscience research, engagement with the private sector is essential in order to make the best use of enhanced bioscience research. While very few for-profit companies will be interested in the discovery process, ILRI will seek partnerships with appropriate businesses to transform research outputs into sustainable outcomes.

**Comparative advantage**

With limited resources, ILRI will focus on its areas of comparative advantage. This includes geographical areas, where ILRI and partners have worked in the past and enjoy strong linkages with local stakeholders and actors, and thematic areas, which have been outlined above and in which, in most cases, ILRI has considerable experience and a good track record.

**A mixed portfolio of short term and long term research**

While ILRI will work with partners to develop short term solutions where appropriate, we will in addition undertake research that is more costly, with less certain outcomes and that requires longer timeframes than most NARS or the private sector can comfortably handle. Much of this work falls under the biosciences, such as vaccine development and genetics and breeding. Whether in short or long term research ILRI will bring the best global science to bear on livestock challenges and opportunities facing the rural poor in the tropics, in the process generating new knowledge and international public goods.

**THEORY OF CHANGE AND IMPACT PATHWAYS**

ILRI’s science must make a difference and contribute to the three high level objectives set for the CGIAR, viz. to reduce poverty, improve food and nutrition security for health and improve natural resource management and ecosystem services. But to turn good science into real life impacts, our innovations must navigate a complex terrain marked by ever shifting contexts and support factors. The dynamics of power, climate, society and economics fundamentally enable or disable the application of our technologies and innovations, so what works in one place and time, may not work in another.

The CGIAR Strategy and Results Framework (Figure 1) recognises a number of ‘intermediate development outcomes’ (IDOs) and sub-IDOs which serve to channel research towards the ultimate objectives as well as four cross cutting issues. ILRI’s research will contribute directly to all the IDOs and many of the sub IDOs, which are highlighted in Figure 1.

ILRI recognises two main impact pathways for its research. One is production of international public goods whereby there is targeted dissemination of results through publications, social and mass media to provide sufficient supporting evidence and platforms for widespread promotion and adoption of innovations. This also requires building the capacity of ‘next users’ such as the NARES, NGOs, civil society organizations and public and private service providers as a way of building and strengthening institutions for accelerated downstream testing, adaptation, and scaling up of research outputs.

The second impact pathway involves creating strong partnerships with research and development organisations in the targeted research sites and value chains in which we work. This collaboration provides the foundation on which to build an evidence base that demonstrates how the research intervention will lead to improved system or value chain performance, enhanced equity of the distribution of the benefits of improved performance, improved capacity of system and value chain actors, and greater uptake of innovations.

In both cases ILRI relies on the CRPs in which it works for the operationalization of the impact pathways. Each CRP is developing impact pathways and theories of change and we are active in that process. These vary, depending on the focus of the CRP. The Livestock and Fish CRP has identified target value chains, selected for their high potential for welfare gains for producers and consumers, while the systems CRPs, Water Land and Environment and CCAFS have selected action areas indifferent regions within which they work. In these cases the research is guided by the local context and priorities and researchers work closely with development partners and local communities using a range of platforms and approaches to identify test and then scale out and up promising innovations. Other CRPs which are less geographically focussed also have impact pathways which may be, for example, linking research to policy decisions at a range of scales.

Detailed theories of change are being developed by each CRP which identify the assumptions that are linked to the impact pathways. More broadly this science strategy is based on the premises that local and global research will generate knowledge embodied in new technologies and new institutions; research for development partnerships will reduce the costs of transferring those technical and institutional changes to small scale livestock keepers, allowing them to increase their productivity and incomes, while maintaining environment sustainability and allow scaling up and out; and targeting tools will focus on poor farmers, women and marginalized groups who have often excluded from technology transfer programs or whose participation in such programs is hindered by market failures.

****Figure 1. Include the diagram with the sub-IDOs that ILRI will work on highlighted.

**REGIONAL PRIORITIES**

ILRI currently has regional programs in, West Africa, East Africa, Southern Africa, South Asia and Southeast Asia, with limited presence in other regions. This regional focus will remain but the regional research programs will be strengthened through a combination of basing more staff in the regions and targeting resource mobilisation specific to the regional programs. Specific research priorities for each region will be determined by regional development needs and ILRI’s comparative advantage vis-à-vis other suppliers. Specific regional plans will be developed that reflect the development trajectories of each region’s livestock systems.

**SCIENCE STRATEGY DEVELOPMENT – A PROCESS**

Finally, developing ILRI’s Science Strategy is a process not an event. During the 6-year lifespan of this plan, new needs, opportunities and priorities will become apparent. The plan will be reviewed and revised to respond to emerging demands for livestock research for development,new scientific opportunities and the inherent unpredictably of research.

1. On the basis that scientific opportunities and challenges will change over the course of the overall ILRI startegy [↑](#footnote-ref-1)
2. [↑](#endnote-ref-1)
3. CGIAR Strategy and Results Framework 2016-2025 [↑](#footnote-ref-2)