

MP3.7: Sustainable staple food productivity increase for global food security: Livestock and fish

OUR PROPOSITION

*“Malnutrition is the most serious consequence of food insecurity.”*¹

Milk, meat, eggs and fish – the animal source foods (ASFs) - are indispensable in achieving nutrition security² and enabling children to develop normally, reaching their full potential as healthy, productive adults. However, productivity of livestock and aquaculture in poor countries lags behind the rest of the world. Consumption rates of ASFs in the poorest countries remain low, exacerbated by recent upward pressure on food prices. Malnutrition therefore remains widespread amongst the poor and is implicated in the deaths of half of all children.

Women constitute a disproportionate share of the poor due to lack of access to assets, technologies and resources, and lower economic returns to labor. Moreover, gender disparities in intra-household food distribution prioritize men in the consumption of ASFs, depriving women of essential protein, calcium and iron during critical periods such as pregnancy and nursing. Due to their roles in the household, increasing women’s access to technologies, assets and services as well as targeting them with specific interventions can have positive consequences for household nutrition.

There is now a huge, unprecedented opportunity to mobilize livestock and aquaculture research-for-development to enable the poor to access adequate supplies of ASFs at affordable prices, at the same time as stimulating broad-based poverty reduction by involving the poor, especially women and other marginalized groups, in producing and marketing high-value meat, milk, eggs and fish. Factors converging to create this opportunity include increasing demand for ASFs, the growth of the private sector and increased dynamism of markets in developing countries, the recognition that technology development must go hand-in-hand with effective targeting and uptake pathways, recent advances in both the natural and social sciences, and new institutional flexibility provided by the CGIAR change process.

Mega Program 3.7 will therefore test the hypothesis: *The enduring productivity gap in poor country small-scale livestock and aquaculture systems can be sustainably reduced through new ways of working in which partnerships between research, development and private sector actors stimulate gender-equitable innovation in selected pro-poor value chains; enable uptake of existing appropriate technologies; and identify and communicate demand for new priority technologies that exploit scientific advances. Reducing the productivity gap for livestock and fish will lead to increased access to ASFs by the poor and increased incomes for producers and other value chain actors, thereby improving nutrition and food security.*

JUSTIFICATION: WHY MEAT, MILK, EGGS AND FISH MATTER

The total value of global meat, milk and egg production and farmed and wild-caught fish exceeds US\$ 730 billion annually – or about US\$ 109 each year for every man, woman and child on Earth. Animal source foods occupy four of the world’s top five agricultural commodities by value.

Demand for milk, meat, eggs and fish has increased rapidly in developing countries over the last few decades, especially in the rapidly growing economies, warranting the coining of the terms the *Livestock Revolution* and

¹ Bouis & Hunt 1999. Asian Development Review

² Nutrition security is defined as adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times.

the *Blue Revolution*. Although capture fisheries have plateaued, aquaculture has expanded steadily since the 1970s and now provides half the fish consumed in the world.

In poor countries livestock and fish make significant contributions to diets and are an important source of cash income, much of which is used to buy staple foods. Close to a billion poor people depend on livestock for their livelihoods. In East Africa, for example, livestock provide on average 11% of energy and 26% of protein in poor people's diets and almost half their incomes. Fish, meanwhile, account for at least half the animal protein intake for the 400 million poorest people in Africa and South Asia. Livestock and fish can make significant contributions to sustaining crop production, especially through nutrient cycling when manure and waste fishpond water is applied to farmers' fields. Livestock and fish can also produce ASFs from low-value and underused resources, such as fibrous crop residues, and land that is unsuited to crop production.

While livestock and fish clearly make important contributions to overall food security, arguably even more important is ASFs indispensable role in achieving nutrition security. This is especially important for vulnerable groups, such as infants, children, pregnant and nursing women, and people living with HIV-AIDS. Whilst ASFs are dense sources of energy and high-quality protein, they also provide 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. The impact of ASFs is amplified by the fact that the availability of some nutrients from plant-based foods is increased by the presence of ASFs in the diet.

Consumption of even small amounts of ASFs has been shown to contribute substantially to ensuring dietary adequacy and preventing malnutrition and nutritional deficiencies. Available evidence suggests that delivery of micronutrients through consumption of milk, meat, eggs and fish is more effective than delivery of individual micronutrients as dietary supplements. Extensive longitudinal studies in different developing countries have shown strong associations between intake of ASFs and better growth, cognitive function and physical activity of children, better pregnancy outcomes and reduced morbidity from illness. Consumption of ASFs is also associated with more competent immune systems and better immune responses.

Low levels of consumption of ASFs by the poor are due to limited supply in some regions, such as sub-Saharan Africa, and income constraints; consumption of ASFs take off when incomes start to rise. However, due to inequalities in intra-household consumption patterns, these income benefits do not necessarily translate into increased intake of AFS by women and children. Over recent decades there has been a significant increase in demand for ASFs, with the greatest increases occurring in rapidly emerging economies. The fast rate of growth in demand for ASFs has created challenges in continuing to provide adequate supply at affordable prices, equitably distributed among men, women and children. In the case of fish, this is compounded by the global crisis in capture fisheries.

An opportunity frontier

For livestock, the bulk of the increased global production of ASFs has been from poultry and pigs produced in industrial systems supplying formal marketing systems. Similarly for fish, explosive growth of aquaculture has occurred in Asia in larger-scale production systems. Industrial systems, however, are not well developed in poor countries: here local supply depends on smaller-scale mixed production systems and informal marketing systems. Such systems take advantage of the availability of relatively cheap labor, which favors labor-intensive production methods, and marginal and under or unused resources, such as land unsuited to crop production and crop by-products, which can be used to produce high-value ASFs. These smaller-scale systems are less able

Table 1. Projected increase in demand for ASFs to 2020 (% per year)

	Developed Countries	Developing Countries
Milk	0.2	1.8
Meat	0.5	1.7
Fish	0.0	0.6
Cereals	0.3	0.4

to respond rapidly to increased demand than industrial systems. This is due to a number of factors including lack of access to appropriate technologies and value chains: value chains encompass both backward linkages to input markets and services, including credit, institutional arrangements such as farmer co-ops, contract farming, micro, small and medium enterprises (MSME), and forward linkages to product markets. Limited understanding of gendered livelihood strategies of producers and gendered consumption preferences of consumers in developing countries is an additional constraint.

Productivity of livestock and fish in small-scale production systems in Africa, Asia and Tropical Latin America lags significantly behind that achieved in richer countries (Table 2) and rates of productivity gain are also low. This signals a systemic failure of many past investments in livestock and aquaculture research-for-development. The key challenge now is to enable smallholder livestock and MSME aquaculture to transform to become viable and sustainable market-oriented producers.

Table 2. Productivity of beef and milk in selected world regions (FAO 2006)

Year:	Beef (kg output/kg biomass/yr)		Milk (kg/cow/yr)	
	1980	2005	1980	2005
Sub-Saharan Africa	0.06	0.06	411	397
Latin America	0.08	0.11	1021	1380
West Asia & North Africa	0.07	0.10	998	1735
South Asia	0.03	0.04	517	904
Industrialized countries	0.17	0.20	4226	6350

Biomass is calculated as inventory x average liveweight. Output is given as carcass weight.

Case studies of past attempts to intensify small-scale livestock production systems demonstrate a range of reasons for failure. In some cases, such as promotion of high-maintenance and high-risk exotic breeds, the constraint was lack of suitability to the low-input systems, prevailing disease challenges and environmental stresses that characterize small-scale systems in developing countries. In other cases, poor uptake of available technologies was due to lack of supporting input markets and services, and poor access to market outlets, as well as insufficient early-stage consultation and priority setting with the intended beneficiaries. These deficiencies are particularly evident for women employed in fish and livestock production.

There are now real opportunities to make progress by exploiting new developments in science, especially the biosciences, combined with much improved systems-based understanding of the problems. Advances in social sciences and refinements in application of participatory processes have greatly improved our capacity for effective targeting and adoption of technologies. There is also a much improved understanding from systems perspectives that adoption of technologies requires an enabling value chain and a strategy for stimulating its development that aligns with local, national and regional priorities.

Increasing supply and availability of ASFs serves not only food security and nutrition objectives but also helps bring about broad-based poverty reduction. In many systems, livestock and fish serve dual functions: increasing household food security and assets as well as being a source of cash income. Women engage in small-scale livestock farming and provide much of the labor for commercial and subsistence aquaculture production. There are also associated employment and small business opportunities through MSMEs in fisheries and processing and marketing of livestock and fish products, and in supply of certain inputs and services, such as feeds and health services. In many developing countries this takes place largely in the informal sector, by and for the poor.

Despite the promise, it is also important to recognize and address risks associated with intensification³, such as pollution of water, greenhouse gas production, overuse of natural resources and catastrophic disease outbreaks, including those that can spread to people from animals or are associated with contaminated ASFs. Fortunately, we are becoming more aware of these risks, and are better able to identify, assess and mitigate them.

WHAT'S NEW IN THIS PROGRAM?

This program addresses the challenge of reducing the productivity gap in small-scale livestock and aquaculture systems so as to increase consumption of ASFs by the poor. It will do this by integrating and exploiting three ongoing revolutions – the Livestock Revolution, the Blue Revolution and the Gene Revolution. It will also better harness the growth of the private sector and increased dynamism of markets in developing countries; more explicitly recognize that technology development must go hand-in-hand with effective targeting and viable uptake pathways; take advantage of recent advances in both the natural and social sciences, especially the transformational potential of the biosciences, but also seek to apply appropriate existing technologies; and maximize the new institutional flexibility provided by the CGIAR change process – by, for example, bringing to bear the combined capacities and resources of a number of CG-centers. By developing partnerships between research, development and private sector actors it will stimulate gender-equitable innovation in selected pro-poor ASF value chains; enable uptake of existing appropriate technologies; and identify and communicate demand for new priority technologies that exploit scientific advances.

New science for solving the productivity gap

Industrial livestock and fish production systems are able to achieve and sustain high productivity largely because they create and operate in a controlled environment; smaller-scale producers in the developing world, however, often have little control over the myriad of environmental factors and stresses that constrain the productivity of their livestock and fish. Research successes in the past have often had only modest impact in the South, in part because they have been difficult to adapt to the wide variation in environmental contexts faced by location-specific production systems. They have also often failed to account for the gendered needs, assets and preferences of the poor. Now, however, advances in the biosciences, particularly in the field of genomics, are creating unprecedented opportunities to accelerate this process of discovery and adaptation for production technologies tailored to location and evolving system-specific conditions, including social differentiation. This MP will build on efforts already underway to channel research advances, including those from the private sector and strong public institutions, to finding research solutions for the challenges faced by the poor in the developing world, while using participatory processes to ensure it is addressing needs and asset-levels of male and female beneficiaries.

Better strategies for getting the results to more people more directly

In recent years the CG-centers have been changing the way they do business - increasing the ability to develop practical solutions and work with partners who can immediately scale them up and out. MP 3.7 consolidates these lessons as the central theme for its delivery strategy, integrating the research process more directly into the impact pathway. This is the result of two trends: The first is the dynamic evolution and opening of markets in the developing world, which has encouraged external investment in the livestock and fish sectors, and local development of related business services. Increasingly, opportunities are being created to partner with the private sector, tapping into their research and business expertise to benefit target value chains, while at the same time providing a means to create market pull or ensure commercial provision of appropriately designed pro-poor, gender-responsive inputs and services that promote and support a more effective uptake of

³ It is important to stress that intensification in this context does not refer to industrialization of livestock and fish activities, but rather to the more intensive use of inputs and factors of production that allows, for example, a cow owner to increase milk output from 2 to 6 l/day.

productivity-enhancing technologies by target groups. The second trend relates to recent experiences across the CG-centers of working more closely with development actors as their knowledge partner on large development interventions and with the private and public sector on reaching end-users. This formula is proving extremely effective in giving urgency to our research, ensuring it is demand-led and providing a direct channel for wide impact. The MP builds on these innovations to build effective partnerships for impact.

PROGRAM GOAL AND OBJECTIVES

The over-arching goal of MP3.7 is to sustainably increase productivity of small-scale livestock and fish systems so as to increase availability and affordability of ASFs for poor consumers and, in doing so, to reduce poverty through greater participation by the poor along ASF value chains.

Program Objectives:

- Increase productivity in small-scale livestock and fish production and marketing systems.
- Increase access to affordable ASF to enhance food and nutrition security for the poor, especially women and children.
- Enable participation in and access to pro-poor production and marketing systems that promote uptake of productivity-enhancing technologies and increase value generation, with emphasis on addressing current gender disparities.
- Secure household and community livestock and fish assets for sustained livelihoods, and conserve livestock, fish and forage/fodder biodiversity as public good assets that will provide genetic diversity for continued growth and adaptation.
- Protect the natural resource base and its ability to continue providing ecosystem services.
- Strengthen capacity to enable public and private sector actors to support and exploit appropriate research and development efforts for sustainable intensification of small-scale livestock and fish production and marketing systems that provide equitable benefits to men and women.

THE FRAMEWORK FOR RESULTS

The Program will be a combination of focused research components and cross-cutting integrative processes. In this way, the Program is designed to allow both a) the critical concentration of appropriate scientific skills to generate new and appropriate science, and b) the joint learning, planning and outcome feedback processes needed to ensure that research priorities match the needs of beneficiaries, and that interventions are evaluated and grounded in real-world settings with partners. The Program will thus comprise a combination of more upstream, globally relevant research and targeted research-for-development designed to address the particular development challenges of a set of priority livestock and fish systems with tailored science-based solutions. Key partnerships, including the private sector at several levels, will be a focus in all components of the Program.

The Program will be implemented through a common Medium Term Plan (MTP), developed jointly by the implementing partners, that sets the strategy and intended outcomes and impact for an initial 6 year period. The primary components for managing research and delivering knowledge products and outcomes will be three MTP Projects covering the range of upstream and adaptive research agendas described above.

The research Projects proposed are:

1. Targeting and impact assessment
2. Improved technologies to sustainably increase productivity and efficiency of livestock and fish production
3. Development strategies for pro-poor, gender-equitable value chains for livestock and fish products

The Projects provide a means for communities of CGIAR researchers and their partners to work more effectively together, with clear focus on an agreed agenda and outputs and with a common vision and plan for how those

outputs will translate into development outcomes. While these Projects provide appropriate clustering of skills to deliver new science, they also benefit from an organizing methodological focus and community of practice for ensuring synergies, integration and joint learning, as well as relevance to target beneficiaries.

Project 1 Targeting: To highlight our commitment to ensuring relevance and appropriate focus, Project 1 will be devoted to working with the scientists and other stakeholders in Projects 2 and 3 in taking stock for priority setting, planning strategies for translating outputs into outcomes, and monitoring progress and assessing impact. While ensuring an internal M&E function, this Project will also be active in testing new approaches for mapping the relevant target domains, using experimental approaches for structuring interventions for learning, and scanning the horizon so that our research today is already addressing the challenges of tomorrow.

Project 2 Improved technologies: Much of the promising work in Project 2 is occurring at the level of upstream science, and will be enabled by facilitating interactions between researchers in the bio-physical science elements of the program and development and private sector partners. At the core of these synergies will be new opportunities through evolving genomics science, including livestock-fish synergies in genetics and genomics applied to crops/forage/fodders to improve animal feeds⁴ and their utilization. Important private sector players in life sciences will also participate, as well as appropriate co-investors. This Project will make use of existing crop and forage gene banks and biosciences platforms in the CGIAR, where scientists from several centers and their developing country partners can share expensive equipment and technologies and apply these to new challenges.

Project 3 Delivering through value chains: The focus of Project 3 will be more downstream, and will provide a setting for integrating the technology generation and adaptation work, improving delivery systems, and developing value chains that promote sustainable intensification through new partnerships and innovation capacity – in the context of specific production systems and market settings (linked to MP1, MP2, MP5). The key component technologies for livestock and fish genetics, feed, and health each have their challenges and specificities as to how they can be delivered to their end users. This is where people with specific delivery and institutional skills from the science component in Project 2 will interact and work together to develop integrated approaches (e.g. those with skills in veterinary service delivery, forage and fodder innovation, animal breeding strategies) with specialists in value chain analysis, innovation systems, policy outcomes and livelihood/gender specialists, and knowledge management/capacity development professionals. Private sector and development agency partners in livestock and fish systems development will also be directly involved.

In addition to arrangements that allow CGIAR researchers in the Program to interact and work together and with key partners on these themes, we also propose a competitive grant mechanism be established along the following lines:

Competitive grant mechanism: Resources will be set aside and calls announced for delivery of specific focused research outputs on topics for which the Projects have identified clear need, yet for which there is evidence that other players have a comparative advantage to deliver (inspired by the InnoCentive model). This would allow strategic research input into the Program by key NARS, ARI and private sector researchers and agencies, and capacity building targeted at potential fail-points for uptake of Program outputs or achieving planned outcomes.

Research approaches and outputs

We describe the approach and outputs proposed for each Project over an initial 6-year planning horizon, but these will be subject to review and adjustment during an initial stocktaking and priority-setting exercise undertaken by the Program partners and led by Project 1.

⁴ Animal feeds include fodder and forages, as well as grains, by-products, and other feedstuffs.

Project 1 – Targeting

Project 1 will conduct complementary and cross-cutting research and provide support required to guide Program research by identifying target beneficiaries, prioritizing their needs and linking to regional and national strategies, monitoring and assessing the outcomes of the research and objectively assessing its impact. Given the increasingly result-oriented nature of the CGIAR, this is a critical element of the research portfolio. Not only will this help us understand whether, where and among whom research is having impact, but importantly the feedback process will improve Program design and implementation, including the explicit development of outcome and communication strategies that leverage partnerships to achieve innovation and impact among target communities.

Approach: A joint team will build on a particular strength of the CGIAR and its partners in advancing the macro-level characterization of the distribution of agricultural systems and poverty and how they are changing, as well as its expertise in M&E and impact assessment. Trend analysis and GIS-based systems characterization will be combined with field-based characterization studies of production and marketing constraints to guide prioritization and targeting of Program activities. M&E will rely on conventional techniques supplemented by the types of participatory approaches and outcome mapping that are proving increasingly useful in guiding research into use and into impact. Impact assessment will involve a mix of ex-ante and ex-post studies to capture learning. Gender disaggregated data collection and analysis, as well as assessment of gender indicators will be integral to the M&E system.

Example outputs from the Project will include:

- Mapping of priority livestock and fish systems to be addressed by the Program, based on presence of resource-poor communities dependent on livestock/fish, opportunities for impact and risks
- Targeting strategies for specific technology and policy interventions based on system analysis
- Gender analyses identifying constraints, needs and opportunities among resource-poor women and other strategic populations, and strengthened capacity to effectively address gender disparities in production and consumption and ensure impact that leads to gender equity
- Impact assessments of multiple types to guide research design and redesign.

Project 2 – Improved technologies to sustainably increase productivity and efficiency of livestock and fish production

Improved technologies for increasing the productivity of livestock and fish in the small-scale systems found in the developing world are necessary to increase supply of these products to poor consumers and to contribute both to nutritional outcomes of the global population and to incomes and welfare of producers. The market and institutional context in which these systems operate is dynamic and continuously evolving, creating new challenges and opportunities for ensuring technologies are appropriate and effective.

Approach: Livestock and fish productivity is driven primarily by three factors—breed, feed and health—and how they are combined and managed. Research will continue to focus on these areas, adapting available technologies and making new scientific discoveries in the context of small-scale systems in the developing world. A critical challenge is devising strategies to improve the ability of small-scale producers, differentiated by social categories, to access improved technologies, which has implications for the design of the technology as well as how it is delivered. At the same time, opportunities for new science to achieve additional major gains in the future will be explored by drawing on the rapid advances being made in genomics and biotechnology and applying these to improving genetics, feeds and health of targeted species and breeds.

Better performing breeds and breeding programs

Breeding remains a proven technique for steady improvement in livestock and fish. For example, selective breeding of fish and, more recently, shellfish has yielded sustained improvements in growth over many generations of 10-15% per generation. This has resulted in strains that perform much better in farm conditions

than their wild ancestors. Despite this, most farmers remain reliant on strains of fish that differ little from wild fish in terms of growth performance. Similarly, for livestock, crossing local and highly adapted genotypes with exotic and potentially highly productive cattle works well in some contexts, providing significant initial gains in productivity, while failing in others, and has rarely provided the sustained growth in productivity achieved in developed countries. Thus, we need to make smarter use of livestock and fish genetic diversity and that present in exotic breeds to enhance the productivity of animal agriculture under different farming systems and to conserve this biodiversity for future needs. This includes accounting for gendered preferences in species and traits, an underdeveloped area in livestock and fish breeding, and building on progress in crop breeding.

Outputs will center on: (i) characterization, conservation, and selective breeding; (ii) improved delivery of genetics; and (iii) exploring applications from new science. Examples include:

- Better understanding of the genetic attributes of various livestock breeds and the systems under which they can be raised
- Development of improved strains of farmed aquatic animal species, including micronutrient-rich small indigenous fish, preferred by women and children.
- More informed decision-making in terrestrial and aquatic animal conservation programs
- Develop bio-banking priorities, protocols and systems, including phenotypic descriptions of bio-banked material from indigenous livestock and fish populations
- Enhanced reproductive technologies and strategies to multiply and deliver appropriate livestock genotypes to smallholders
- Development of new and adapting existing genomic, bio-informatic and informatics tools to allow integration of genetic data with rich phenotypic data, including systems analysis
- Tools to exploit discoveries in functional genomics to improve livestock productivity under various production systems

Improving feed and forage resources and their use in livestock systems and aquaculture

Feed is at the very interface of the positive and negative effects of livestock on livelihoods and the environment. Lack of feed (quantity and quality) represents a major constraint to smallholder competitiveness and the overall profitability of livestock systems. Choice of feeds and feeding strategies has major implications for natural resource use, greenhouse gas emissions and carbon sequestration. Optimizing the contribution of feed and forage resources to the profitability and efficient natural resource use of livestock and livestock farming systems while minimizing their negative environmental impact will be at the core of livestock feed work in MP3. For fisheries, the major challenge is maintaining farmer access to affordable quality feeds that are essential for intensifying production, and is particularly acute for women who tend to choose low-input fish species for farming. However, access to key ingredients currently used – fishmeal and fish oil – is limited and in decline, signaling the need to shift increasingly to plant-based feeds.

Approach: A value chain framework will be used to define a set of research areas that include: (i) producing more and better feeds; (ii) making better use of the feeds that exist; (iii) supporting transfer of feed (and generally biomass) from surplus to deficit areas to provide additional farm income and employment in surplus areas and mitigate feed constraints in deficit areas; and (iv) examining the feed demand and supply aspects of different intensification scenarios with a view to enhancing the contribution of forage production and feeding strategies to livelihoods and natural resource use. Multidimensional crop improvement will detect and exploit available genetic variation for livestock feeding, and further target genetic enhancement towards dual-purpose traits using conventional and marker assisted crop breeding. Key outputs will be:

- Improved plant-based feeds for fish and monogastrics
- Improved dual-purpose varieties of food-feed crops for livestock
- Improved pastures, rangelands and other forage options

Making better use of available feeds will be achieved by harnessing spin-off technologies from second generation bio-fuel technologies to improve basal diets on a large scale, defining and allocating most limiting nutrients to basal diets, and allocating feed to the most responsive livestock. Example outputs:

- Enhanced utilization of cellulolytic biomass for environmentally-friendly livestock nutrition
- Strategic/smart supplementation strategies improving provision of forages and feeds through markets by linking all pertinent actors in feed and seed value chains
- By-product based feeds with under-exploited local ingredients for livestock and fish

To assess implications of feed system intensification, relevant scenarios about livelihoods aspects and natural resource usage and other environmental implications will be developed and livestock intensification options identified with evidence on livelihood and environmental consequences to inform policy and other stakeholders.

Animal health

Improved animal health can reduce poverty by securing assets and increasing productivity and profitability through decreased mortality and morbidity. Opportunities exist for immediate impact by modifying current interventions to make them more suitable for poor livestock owners, e.g. thermo-stable vaccines and rapid field diagnostics. Vaccines play a critical role in preventing mortality and in reducing morbidity and disease transmission rates. Diagnostic tools play a critical role in studying biodiversity, infection processes, the epidemiology of disease, in disease surveillance, pathogen discovery and developing disease control strategies. Rapid advances in the power of tools to understand basic biological processes will be applied to develop new and improved vaccines and diagnostics. This will encompass genomics-based approaches to understanding the diversity of both animals and pathogens by providing the ability to examine pathogen variants; new generation diagnostics allow pathogen tracking and evolution, important for both epidemiology and control, and taking us a step beyond simple detection. Advances in understanding gut health also offer opportunities to improve feed conversion and host resistance towards pathogenic bacteria and other environmental hazards.

We shall work within a systems approach to identify priority areas and achievable goals and to deliver appropriate technological solutions within institutional solutions to animal health problems. Our approach will be to use a needs assessment paradigm involving producers, service providers, policy makers and the private sector to identify where achievable solutions will have impact. Special attention will be paid to the needs of women producers, who are often neglected in the provision of animal health services. Research will also address the institutional arrangements required for the manufacture and effective deployment of vaccines and diagnostic tools, particularly public-private partnerships for diseases and products that the private pharmaceutical industry does not find sufficiently profitable for investment.

The outcome will be greater access of poor producers to novel or improved animal health inputs and services which will improve their wellbeing and enhance the resilience of their livelihoods. It is crucial to achieving impact that the Program champions and assumes stewardship for the whole development chain, from the identification of areas of need through development, manufacture, implementation and impact assessment of these solutions. Example outputs include:

- Vaccines for orphan viral, bacterial and protozoan diseases for which there are few or no other providers
- Maps of disease risk and response
- Strategies for delivery of improved health interventions to male and female farmers

Project 3 – Development strategies for pro-poor, gender-equitable value chains for livestock and fish products

Productivity-enhancing technologies are not taken up in isolation – they need the ‘pull’ of market demand and prices, the ‘push’ of the web of inputs and services to support it, as well as appropriate institutions and policies. Mechanisms are needed, however, that can offer benefits of scale to individual producers and market actors (e.g. producer organizations, business associations) to improve their access to markets on equitable terms. It is also important to recognize the nature of the technology and service needs: for example, delivery of genetics to

producers may require systems to manage frozen semen or certified fish fingerlings. Similarly, livestock and fish products are either live or highly perishable, and issues of food safety and disease transmission, including to humans, compound the management in marketing systems.

A range of players are involved in these markets and services, with the public sector largely ineffective in input and knowledge services, and private-sector providers of animal health, feeds or genetics focused primarily on the large producers. Livestock product and fish supply chains are also largely informal or traditional in nature in our target regions, although a strong duality in systems is emerging as increasingly affluent consumers, particularly in Asia and tropical Latin America, are driving demand for higher quality and more standardized products, in turn strengthening the position of vertically integrated supply systems, some of which largely exclude smallholder producers. Smallholder livestock and fish producers are thus faced not only with limited access to improved technologies and the sustained quality services they need to increase productivity, but are also facing a moving target in their product markets as rapidly changing demand drives changes in buyer expectations and condition, with women more disadvantaged than men due to their lower level of access and assets.

Approach: Value chain-specific strategies will be developed to cluster input and service provision as well as marketing services to create stronger incentives for farmers to intensify their production. A particularly promising approach being tested involves establishing local learning alliances for value chain actors and other stakeholders to grow pro-poor, gender-equitable value chains, identifying needed business services and stimulating their development. This will be done by partnering with both private and public-sector actors within large development interventions. Institutional economics and business development techniques are providing insights for designing delivery systems for animal genetics, forage and fodder crop seed, and animal health services to harder-to-reach small-scale livestock and fish producers. Methods and tools drawn from value chain analysis will guide upgrading of post-harvest components of value chains to generate added value for low-income actors.

Projected outputs include, for example:

- Systems for sustainable production and delivery of appropriate livestock and fish genetics with private and public partners
- Strategies for integrating feed, health and genetics technologies for sustained productivity increases
- New public-private partnerships, farmer groups and associations, contract farming and other institutional arrangements that facilitate the access of farmers and other value chain actors to knowledge, information and technologies, and increase capacity, with emphasis on opportunities for women and marginalized groups. These may include producer hubs and innovation platforms for innovation and brokering private-sector technical support and business service development, as well as micro-enterprises (including women-headed) in post-harvest services, such as in fisheries.
- Livestock and fish product and post-harvest process development, including food safety and certification systems that enhance smallholder access to high value markets.

IMPACT PATHWAYS

Two strategies are proposed for ensuring significant and meaningful impact of the Program during the current planning horizon and beyond. The first is to ensure focus by targeting activities to a selected set of priority livestock and fish value chains in Africa, Asia, and tropical Latin America and the Caribbean. Priority value chains for livestock in sub-Saharan Africa, South Asia and South East Asia were identified during a recent donor-commissioned review of investment priorities based on the potential for productivity increases and income gains for the poor. As an initial activity of the Targeting Project, these and other candidate value chains for fish and livestock from other CGIAR mandate regions will be reviewed and, based on a set of agreed criteria—which may include market demand growth, expected productivity gains, number of poor who could benefit, an

enabling environment, investor interest, among others—a limited number of 10-12 value chains will be selected as the focus for Project 3 activities. Candidate value chains might include, for example, small-scale production and marketing systems for indigenous pigs in Laos and Vietnam, aquaculture in India and Bangladesh, and dairy in East Africa.

The second strategy for ensuring that research translates into use and impact is explicitly incorporated into the design of the Program through the emphasis, first, on channeling research directly into improving value chains with development partners and, second, on working with the private sector at all levels. Serving as knowledge partner for development partners implementing large-scale interventions provides direct access to immediate promotion and uptake of best-bet strategies and technology packages. The current experience of CG centers within the East African Dairy Development project, which is working with 135,000 households comprising a million people under US\$2 a day, is demonstrating the benefits of this new mode of collaboration. Similarly, finding new ways to work with the private sector is yielding opportunities for more impact, mainly because the private sector is finding it in its own interest to supply new products and promote the growth of value chains, ensuring continued provision and promotion of our research products.

For selected candidate value chains, we foresee the following as indicative of potential impacts that might be achievable over a 10-year horizon.

- Dairy in South Asia: 5% of poor livestock keepers adopting technology packages and improved value chains for dairy will increase milk production by 7.5 million tonnes per year and 16 kg per capita consumption of milk for 480 million poor consumers.
- Dual-purpose cattle systems in tropical Latin America: 10% of poor livestock keepers adopting forage-based technologies and improved value chains will increase livestock production by 50%
- Beef and small ruminant value chains in Africa and Asia: 10% of poor livestock keepers adopting technology packages and improved value chains for beef and small ruminants in target countries will increase meat production by 1.1 million tonnes and will increase meat consumption by 2-5 kg per capita for 300 million poor consumers
- Fish value chains: annual production growth rates of 10% in priority countries generating 500,000 tonnes additional production, allowing 26 million people to consume WHO recommended levels of fish, contributing to reduced micronutrient deficiencies among these populations

GENDER STRATEGY

Gender analysis that leads to gender-equitable outcomes is a central concern of this program. The gender strategy will focus on three interrelated areas of interventions with potential for high impact: productivity, value chains and consumption. Women are often excluded from most parts of the research-development cycle of fish and livestock technologies. Their preferences in species and traits have been overlooked – this has, for example, resulted in neglecting the potential of micronutrient-rich small indigenous fish species and low investment livestock such as monogastrics. Analysis will be carried out to determine gendered preferences for species, traits, production models and markets. These results will be used to guide project implementation to ensure the participation of and benefits to women. Value chains are also gendered; although women engage substantially within these chains, as producers, gleaners, processors and traders, their contribution is undercounted and undervalued. Economic returns to women are disproportionately lower due to unequal ownership of assets and access to technologies and natural resources. Gendered value chain analysis will determine points of the chain where women are located, constraints to improve their economic benefits from livestock and fish and opportunities to build on. Moreover, gendered intra-household consumption patterns of livestock and fish products, considered high-value “prestige food” in many developing countries, favor men, thus depriving women and children of adequate proteins and micro-nutrients when they need them most. Increased awareness on nutrition and equity issues that relate to productivity choices will be a priority focus. Research on the variable dynamics of intra-household food allocation and its determinants, as well as interventions

implemented to increase the consumption of ASF especially by children, women and the vulnerable, such as people living with HIV/AIDS will be undertaken through linkages with MP4. Innovative gender-responsive social marketing and extension approaches will be piloted and expanded to engage women and men discursively in the equitable access to technologies, benefit-sharing from value chains and consumption of animal products. The effective implementation of the gender strategy will be monitored through gender-disaggregated data collection and development of a set of gender indicators. The Program will target 50% of project beneficiaries to be women.

RESEARCH AND DEVELOPMENT PARTNERS

MP3.7 will build on established partnerships among all CG-centers and their traditional collaborators, but will also seek new partnerships, especially in the private and development sectors:

Development partners will include:

- international agencies (FAO, OIE, WHO, IFAD)
- international and local NGOs and organizations, including farmer and business groups (e.g. Heifer Project International and Technoserve in East Africa, BIAF and Tata Trust in India, Aga Khan Foundation in Syria and Tajikistan)
- national and regional women's organizations and networks

Private sector partners will include:

- established CGIAR multinational partners, e.g. Nestlé, Pioneer, NOVUS, Novartis
- local business development services
- arrangements to leverage access to critical research technologies
- arrangements to foster public-private partnerships to speed up and extend the reach of scaling up and out proven technologies, e.g. with the private forage seed sector

National partners will include:

- NARS in focal countries, including the veterinary and livestock research institutes and universities
- advanced research institutions, e.g. CIRAD, The Institute for Genomic Research, European, Australian and North American universities and research institutes, EMBRAPA, CATIE

Regional partners will include:

- regional agricultural research associations (CORAF, ASARECA, CARDESA, CIALCA in Africa; FONTAGRO, IICA in Latin America; APAARI in Asia), regional economic communities (ECOWAS, COMESA, SADC), AU-IBAR and ALive
- AU NEPAD via the Biosciences Eastern and Central Africa (BeCA) facility managed by ILRI

Within the CGIAR:

- this will be the first major collaboration between ILRI, WorldFish, ICARDA, and CIAT
- the strong collaboration between ILRI and WorldFish is timely given synergies for applying animal-related scientific developments and addressing similar post-harvest issues
- ICARDA offers experience in dryland small ruminant, rangeland and forage systems research
- CIAT brings expertise in forage development through selection and breeding as well as forage-based crop-livestock systems and a regional biotechnology platform for Latin America and the Caribbean
- ILRI, CIAT and ICARDA together maintain the CGIAR forage collection

INTEGRATION WITH OTHER MPS

MP3.7 will focus on generating technologies and strategies to ensure their uptake in priority value chains. However, we recognize that this does not address the CGIAR's Strategic Objectives: Food for People, Environment for People and Policies for People. We therefore propose to forge close links with other MPs:

MP1	<p>Production systems in targeted value chains do not operate in isolation; changes in those systems will depend on & affect complex interdependencies between agricultural activities, eco-services & livelihood strategies MP3.7 will contribute its value chain perspective within MP1's system framework</p> <p>Drawing from MP1's assessment of the trade-offs associated with livestock & fish production—especially regarding forage & feed—and strategies for integrating livestock & fish production to optimize the overall system.</p>
MP2	<p>Contributing insights from Project 2 on the dynamics of livestock & fish commodity markets, drawing from the macro-economic, cross-commodity perspective of MP2</p> <p>Project 2 will also be actively working with MP2 in developing & applying innovative tools for value chain development</p>
MP3	<p>Development of dual-purpose food-feed crops will be pursued through links to specific crop components in MP3.</p>
MP4	<p>Animal health research undertaken by Project 1 is expected to have direct implications for diagnostics & control strategies that can contribute to MP4</p> <p>Research findings from MP4 will create opportunities for Project 2 for upgrading priority value chains & increasing their benefits to the poor</p>
MP5	<p>Livestock & fish production systems rely on, but also contribute to, ecosystem services, & the potential trade-offs associated with increasing productivity will need to be considered from this perspective. Assessment of these trade-offs will be achieved largely through links with MP5</p>
MP6	<p>Agro-forestry remains a largely under-exploited source of feed. The Program will explore opportunities to understand when this feed source could be integrated into livestock & fish production systems</p>
MP7	<p>Climate change will have direct implications for sustainability of existing small-scale livestock & fish production systems, & how strategies can be devised that will allow them to adapt & cope as needed. We will rely on findings from MP7 to guide research towards solutions that will be relevant in the context of climate change, & the Program's outputs are expected to help inform response strategies being devised by MP7.</p>

MANAGEMENT STRUCTURE

ILRI and WorldFish will establish an unincorporated joint venture to lead implementation of the Program under the joint oversight of both center boards, with strong involvement of ICARDA and CIAT in decision making. Project execution will be managed through a technical advisory committee comprising the four CGIAR centers and key partner organizations. In order to ensure clear focus on development outcomes at scale, key development partners (large NGOs, private sector agribusiness, and government officials in relevant fields) will be involved right from the initial design of the program. The program will have annual planning and review meetings when the technical advisory meeting will engage directly with Program partners.

A strong culture of communications (both internal to the program and with stakeholders), gender mainstreaming, participatory M&E, impact assessment and continuous learning will underpin the whole effort. Impact assessment will be addressed through a joint unit established under Project 1 and possibly engaging an external program monitor reporting to the senior leadership of the joint venture to enhance transparency and accountability of all program activities by all partners and playing a key role in the interaction of the Program with the Consortium Board.

The design of the specific management structure and instruments will be part of the overall initial design of the program, which will be developed in close consultation with the Consortium, partners and wider stakeholders.

RISKS

Key risks that could affect the ability of the Program to achieve its intended objectives and goal are described in the following table.

REALM	RISK	MITIGATION
Risk with HIGH likelihood of occurrence:		
Management	MPs increase transaction costs but fail to add value to existing efforts	Provide incentives to MPs for cross-centre & trans-disciplinary programs
Risk with MEDIUM likelihood of occurrence:		
Public policy	National policies not conducive to increasing private sector investments	Engage with governments when selecting focus countries so as to identify countries with pro-business policy environment
Public policy	National policies promote industrial livestock production & small producers squeezed out of markets	Identify combinations with pro-business/pro-poor policy environment; target relevant evidence of trade-offs; demonstrate & advocate pro-poor pro-business win-wins
Public policy	Strategy requires coordination across multiple sectors (livestock, feeds, fish, health & environment)	Engage with high level policy makers on need for integrated approach; include institutional capacity building component
Public policy	Regulatory environment limits scientific options	Select target countries with enabling regulatory environment
Investment	Negative environmental perceptions of livestock & fish lead donors not to invest in sector due to reputational risk	Articulate specificity of negative livestock externalities & importance of addressing these as public good; private sector unlikely to address these
Investment	Insufficient funds to implement MP holistically	2011 transition phase, using currently committed funds; design modular program which can be implemented as new funds become available
Technology	Tools not efficiently disseminated, with low adoption	Explicitly addressed by priority for collaboration with private sector & development partners, but must be attractive to them; design program with participation of partners

TIME FRAME

The first year of the program will be devoted to establishing governance and administration arrangements and bringing the research teams and other partners together to develop more detailed strategies and implementation plans. A consultative and evidence-based process will be undertaken to select focus value chains and countries. The implementation plan will comprise a set of activities structured to achieve measurable impacts in the focal value chains by Year 6.

BUDGET

The consolidated MP3.7 budget proposal for 2011-2013 for the four participating centers is based upon a 5-percent increase from the 2010 base, is projected to total US\$ 29.8 million in 2011, increasing to US\$ 32.8 million in 2013.

MP3.7 Costs

Description	2011	2012	2013
	(1,000 USD)		
Personnel cost	9,491	10,551	11,078
Travel	972	874	918
Operating expenses	7,969	7,782	8,171
Training / workshop	198	208	218
Partners / collaborator contracts	2,451	2,648	2,781
Capital and other equipment for project	656	689	723
Research support services	1,525	1,602	1,682
Regional office operating costs	1,494	1,569	1,647
Contingency	310	326	342
Institutional overhead	4,730	4,953	5,200
Total Project Cost	29,796	31,200	32,760

MP3.7 Funding

Description	2011	2012	2013
	(1,000 USD)		
CGIAR Fund	7,407	10,014	12,508
Billateral Donors	15,909	16,176	17,030
Billateral Donors "matching funds cofinanced by unrestricted funding"	4,403	2,922	1,303
Other Income	2,076	2,087	1,919
Total Project Funding	29,796	31,200	32,760