



CGIAR Research Program on Livestock and Fish
2016 Performance monitoring report
supplement
Phase I program highlights

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CGIAR is a global partnership that unites organizations engaged in research for a food secure future. The CGIAR Research Program on Livestock and Fish aims to increase the productivity of small-scale livestock and fish systems in sustainable ways, making meat, milk and fish more available and affordable across the developing world. The Program brings together four CGIAR Centers: the International Livestock Research Institute (ILRI) with a mandate on livestock; WorldFish with a mandate on aquaculture; the International Center for Tropical Agriculture (CIAT), which works on forages; and the International Center for Research in the Dry Areas (ICARDA), which works on small ruminants. <http://livestockfish.cgiar.org>

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CGIAR Research Program on Livestock and Fish: highlights five-years on

This set of eight stories below highlight the achievements of the CGIAR research program on Livestock and Fish (L&F) over its five-year lifespan and demonstrate progress across the spectrum of upstream pipeline research and downstream work to adapt research outputs for going to scale.

1. Enabling the pig value chain to contribute to development in Uganda

Smallholder pig systems were not previously viewed as a viable livestock development option in Uganda. They were assigned a low priority, essentially ignored by the government beyond a few limited and unsuccessful project-based attempts to introduce modern commercial pig operations. Despite this, the pig population has risen rapidly driven by growing demand for pork. The CGIAR research program on Livestock and Fish (L&F) approach has focused on basic productivity-improving technologies, more efficient and inclusive market arrangements, and informing relevant policies, while tackling the more severe constraints, especially the risk of African swine fever (ASF).¹ Working with a broad range of research and development stakeholders, the program established multi-stakeholder platforms to address ASF and other challenges and raise the profile of the smallholder piggery sector for public policy and investment. The L&F team developed tools to analyse ASF risk factors to identify and generate evidence for prioritizing intervention points along the smallholder pig value chains. With no effective treatment or vaccine for ASF currently available, the team has focused on raising awareness and enhancing capacities of value chain actors to adopt better biosecurity practices, and on identifying incentives and barriers to adoption.² Training materials and strategies were developed and tested to support scaling out to the relevant value chain actors. By end of 2016, more than 1,150 pig producers, comprising 60% women, had benefited from the training. A cluster randomized controlled trial to assess the impact of this training (n=960 farmers) confirmed it had improved knowledge on ASF and biosecurity measures, and farmers implementing effective biosecurity were not severely affected during ASF outbreaks.³ This is just a first step, though, because the perceived benefits do not appear to sufficiently offset farmer investment required to adopt biosecurity measures. Strategies will need to be devised to create the necessary incentives.

2. Exploiting 'climate-smart' *Brachiaria* grasses

Global agriculture's dependency on nitrogen fertilizer continues to grow, with up to 70% of all the nitrogen in fertilizer leaking into the wider environment, a loss of USD 90 billion annually. Part of the problem is that soil microbes rapidly convert the nitrogen into the gas nitrous oxide in processes called nitrification and denitrification which allow valuable nitrogen to escape from the soil to the atmosphere and water before it can be utilized by crops. Worse still, nitrous oxide is a greenhouse gas 300-times more potent than CO² based on its global warming potential. To reduce nitrogen losses, research initiated before L&F sought to identify biological nitrification inhibitors (BNIs)—naturally occurring substances that slow down the rate at which soil microbes convert nitrogen into nitrate and nitrous oxide, and found them in the tropical forage *Brachiaria humidicola*. Research conducted under L&F began to quantify the benefits of BNIs and demonstrated that rotation systems using *Brachiaria* can increase crop yields, increase profits and deliver environmental benefits: pastures benefit from the residual fertilizer applied to the crop and the annual crops benefit from the reduced losses of nitrogen due to the BNI-residual activity of the *Brachiaria*.⁴ Moreover, it was shown that they reduce nitrous oxide emissions from livestock excreta.⁵ *Brachiaria* grasses, which are now the world's most widely planted tropical forage grasses, therefore have huge potential to increase fertilizer efficiency and reduce greenhouse gas. These species have a number of additional beneficial features, including resistance to biotic and abiotic stresses and, in well-managed pastures, they have a high capacity to accumulate soil carbon. The International Center for Tropical Agriculture (CIAT) has been breeding hybrids of *Brachiaria* since the late 1980s and has released a number of improved cultivars with high adoption at over 725,000 ha planted in Latin America and taking them to scale has already initiated in tropical Africa and Asia.

3. Bringing major improvements to smallholder aquaculture in Bangladesh

Traditional and evolving mixed aquaculture production systems—including multiple species of fish, prawn and shrimp—are widespread in Bangladesh, but poorly organized and supported. These systems do, however, offer a clear opportunity to improve productivity, increasing availability and access to fish and fish-based incomes for the poor, while paying attention to implications and opportunities for women⁶. L&F researchers worked across the aquaculture value chain in Bangladesh, undertaking sectoral-level analyses of aquaculture and poverty, and more technically focused interventions in fish genetics, feed and health. A key paper⁷ by WorldFish and partners at the Bangladesh Institute of Development Studies examined the link between aquaculture and poverty reduction. By analysing changes in fish consumption in Bangladesh between 2000 and 2010, the report provided compelling evidence that growth in aquaculture has led to greater fish consumption among the poorest consumers in Bangladesh. While it had previously been considered that the benefits of the growth in aquaculture were derived mainly from increased employment, the study demonstrated a stronger link to the health benefits of eating more fish. Research on improving the genetic potential of fish focused on major carps, and improvements to the national public–private system of sustainably delivering enhanced genetics for the fish produced for home and local consumption. This approach has been complemented by research and the delivery of a package of better management practices and technical support to the feed sector to supply better feed products accessible to lower-income producers. Through partnerships with large-scale development interventions in the sector, notably the United States Agency for International Development (USAID)-funded Aquaculture for Income and Nutrition project, the Bangladesh program was able to successfully deliver improvements, including improved fish seed, fish feed technologies and better management practices at scale to large numbers of smallholder aquaculture farmers in the country.

4. Scaling viable community-based sheep and goat breeding programs

Community-based breeding programs (CBBP) for sheep were first introduced in Ethiopia in 2009 by International Center for Research in the Dry Areas, International Livestock Research Institute (ILRI), University of Natural Resources and Life Sciences, Vienna (BOKU Austria) and scientists at the national agricultural research system, and their development continued under L&F. The CBBP model combines the selection of breeding rams/bucks based on careful recording of important production parameters—such as body weight at 6 months, lambing interval and lamb/kid bodyweight and conformation at 12 months—with expert local opinion as to what constitutes a good ram/buck and communal use of selected rams/bucks. Farmers who wished to participate were organized into sheep/goat breeding associations, many of which later evolved into formal cooperatives. After an initial phase of learning how it could work, CBBPs for sheep and goats were evaluated and are now being promoted for scaling.^{8,9} The L&F team is supporting existing CBBP groups in Ethiopia and backstopping new ones being established. An evaluation of the pilot CBBPs in Ethiopia identified a number of impacts.¹⁰ Sheep/goat farming—once a side activity for these farmers—is now their main business activity and the linchpin of their livelihoods. The best rams/bucks are now retained in the community for breeding, instead of being sold for slaughter as was previously the practice. The study found that more than 12,000 farming families have directly benefitted from CBBPs in Ethiopia. CBBP farmers showed improved performance, measured by lamb growth rate, lambing interval, reduced mortality, and ability to attract higher market prices compared to sheep/goat from farmers who are not members of breeding groups. In three sites in Ethiopia, incomes from sheep production had increased (average 20%). Mutton consumption has also risen; on average, three sheep per family per year are slaughtered compared to one when the project began. Most of the newly established cooperatives have demonstrated their financial viability by building up their capital base, such as the Boka-Shuta cooperative which now has capital of USD 60,000. Based on the Ethiopia experience, external organizations are investing in establishing CBBPs in Uganda, Malawi and Tanzania, while nine other countries have expressed intentions to introduce CBBPs.

5. Assessing and developing capacity to integrate gender into research and development

L&F set itself the objective of mainstreaming gender into all its work and has devoted considerable resources and effort into achieving this ambitious goal. A comprehensive coaching program led by KIT (Royal Tropical Institute) gender advisors integrated gender in the research cycle of 16 technical, value chain and systems research projects across L&F. The projects were led by non-gender specialist scientists and implemented by interdisciplinary research teams. The key lessons have been documented.¹¹ L&F also maintained a portfolio of strategic gender research. A 2015 study examined the concept of resource ownership from a gender perspective in three livestock value chains in Tanzania, Ethiopia, and Nicaragua.¹² A second paper exploring ownership in Bangladesh and Uganda is in preparation. Efforts have also been made to ensure that various assessment tools developed by L&F, for instance, those used to assess animal-source food value chains or livestock feed needs and opportunities (FEAST), effectively address the gender dimensions alongside the technical ones.¹³ To ensure stakeholders can implement gender-sensitive livestock and aquaculture interventions, the L&F commissioned Transition International to lead the design of comprehensive gender capacity assessment methodology and tools. The approach uses focus group discussions and questionnaires to assess six key competencies: gender analysis and strategic planning; gender responsive programming, budgeting and implementation; knowledge management and gender responsive M&E; effective partnerships and advocacy on promoting gender equality; gender and leadership; and innovation in gender responsive approaches. The tools were tested in Ethiopia and proved robust and easy to use, generating clear and comprehensive data at organizational, individual and environmental levels. They were also well received by partners, and their identification of capacity gaps prompted a set of organizations to establish a network to address them. L&F has developed a manual to guide gender capacity development in the key competences,¹⁴ and the approach has been applied by several other CGIAR research programs and country teams.

6. East Coast fever: scaling an existing vaccine, while developing an improved one

East Coast fever (ECF) is a devastating tick-transmitted disease of cattle caused by *Theileria parva*, a single-celled parasite. The disease occurs in 12 countries in sub-Saharan Africa and kills more than one million cattle every year, with 40 million cattle currently estimated to be at risk of the disease. L&F built on legacy work at ILRI and its predecessor, the International Laboratory for Research on Animal Diseases. The work has focused on two main opportunities to manage ECF: scaling-up the use of a live parasite-based licensed vaccine called Infection and treatment method (ITM), and the development of a new generation sub-unit vaccine that will be cheaper, safer, and easier to manufacture and use than the ITM vaccine. Both were critical to improving productivity in the L&F target dairy value chain in Tanzania where less than 5% of the cattle at risk were being vaccinated. Progress was achieved on both fronts over the course of the program. Work on ITM confirmed concerns that it does not always protect cattle in the field against infection with ECF-like parasites derived from wild African buffaloes, limiting its effectiveness and risking vaccination failures in areas where buffalo and cattle co-exist.¹⁵ It was also observed that natural infections with close relatives of the ECF parasite that do not cause disease in cattle could provide some protection against ECF, possibly offering opportunities to enhance vaccine effectiveness. L&F scientists tested models to improve access to the ITM vaccine by working with partners to ensure sustainable supply of the vaccine, and with vaccine distributors to overcome delivery constraints. They also sought to enhance opportunities for new actors and institutional linkages by streamlining training of more vaccinators and strengthening the quality control mechanisms—all necessary precursors to ensuring the vaccine can be taken up nationwide. Work towards developing a sub-unit vaccine, taking advantage of the latest advances in biotechnology and developing new and improved methods in vaccinology, provided a comparison of different methods of immunization with candidate vaccine antigens in laboratory trials. This has informed the prioritization of different approaches to target different stages of the ECF parasite's lifecycle.¹⁶ Several novel candidate vaccine antigens for ECF vaccine trials were also successfully identified.

7. Delivering the GIFT

In 1988, WorldFish started a pioneering selective fish breeding program in the Philippines. It sought to develop a more rapidly-growing improved strain of tilapia that was well adapted to a wide range of environments. Close to three decades and 20 tilapia generations later, the selective breeding program continues in Malaysia. Compared to the initial population, the GIFT strain (short for Genetically Improved Farmed Tilapia) now grows more than twice as fast and can thrive in a wide range of habitats. GIFT has been distributed to 16 countries and is farmed across Asia, the Pacific and the Americas. Under L&F, the multiplication and distribution of GIFT fry became a central component of improving aquaculture value chains in Bangladesh, the world's fifth largest aquaculture producer. This was successfully taken to scale by the USAID-funded Aquaculture for Income and Nutrition project that contributed to both L&F and the Aquatic Agricultural Systems CGIAR research program. Importantly, L&F was able to address the poor quality of the 'seed' tilapia farmers were buying from fish hatcheries. Due to poor breeding practices, inbreeding levels had increased leading to poor growth rates and appearance (e.g. undesirable colour) that did not attract good prices at market. WorldFish guided the establishment of eight new Tilapia Breeding Nucleuses (TBNs) stocked with broodstock from the eleventh GIFT generation. Good practices—such as mass selection and rotational breeding techniques—were applied in the TBNs to prevent inbreeding. A stable supply of quality tilapia seed is now supporting the rapid expansion of tilapia farming throughout the country. In 2015, the TBNs provided over 2.1 million GIFT fry to 59 mostly private-sector hatcheries for multiplication and seed dissemination throughout the country; this number is projected to increase to more than 10 million fry a year. At the same time, assessments of on-farm performance by researchers are providing new insights into interactions between genetics and environment, knowledge that is feeding back into the use of novel genetic traits for future fish breeding programs. Tilapia selective breeding programs have now been established in other countries, including Egypt, the other L&F aquaculture target country.

8. CLEANED: improving decision making for more sustainable livestock and aquaculture development

Before any interventions aimed at strengthening and scaling up livestock and aquaculture value chains are prioritized for implementation, it is highly desirable that the potential environmental implications—both negative and positive—are carefully considered. So, in 2013, with funding from the Bill & Melinda Gates Foundation, a team made up of researchers from ILRI, CIAT, the Stockholm Environment Institute (SEI) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, set out to develop a generic framework for evaluating environmental impacts. The result is a protocol called CLEANED—short for 'Comprehensive Livestock and Aquaculture Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Value Chains'.¹⁷ It is used for the rapid assessment of the baseline environmental impacts of a value chain in terms of water use, soil health, greenhouse gas emissions and biodiversity loss, and then compares this to the likely changes that would occur if various intervention scenarios were implemented. CLEANED complements other types of assessment, such as cost-benefit analyses and feasibility studies. The CLEANED framework was initially piloted on the L&F target smallholder dairy value chain in Tanzania. Subsequently, the tool has been applied to assess various scenarios in other L&F target value chains in Nicaragua and Uganda to help guide selection of 'best-bet' interventions with the smallest environmental footprint that can still contribute towards increased incomes and enhanced food security for poor value chain actors. Progress has been made in streamlining and automating CLEANED calculations so that the protocol is even easier to use. The ambition now is to integrate this assessment as part of a standard scoping toolkit applied across livestock and aquaculture value chains to guide research priorities in supporting value chain development.

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