

# Using a value chain approach to focus animal genetic interventions

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## Key messages

- *The value chain analysis framework broadens livestock breeding perspectives and outlines the catalytic and transformational role of genetics and breeding for specific product lines in smallholder dairy and tilapia-producing aquaculture systems.*
- *Innovation platforms of value chain actors can help increase smallholder livelihoods and meet market demand in developing countries by facilitating the co-creation of solutions to livestock challenges and enhancing the quality of livestock and fish products.*
- *Strategic milk, meat and fish production across diverse systems are required; sustainability requires that these interventions are socially acceptable, productive, competitive and environmentally friendly.*

Genetic interventions in livestock populations are generally long term, resulting in changes in the characteristics of the production unit, the animal. In the process, trade-offs between breeding for production and resource-use efficiency, fertility, resilience and the environmental impact of the target livestock or fish species are important in order to improve performance while taking into account genotype by environment interactions. Information generated by analyzing product value chains helps identify intervention nodes to achieve improved productivity under specific environments. Value chain analysis highlights: trends in demand, key drivers of change in demand, the actors involved and their roles in the chain. With the livelihoods of livestock-keeping communities at the core, income and equity issues cannot be ignored. Interventions also need to take into account the constraints faced by livestock keepers given their existing asset base.

Using a value chain analysis framework, the Genetics flagship of the Livestock and Fish CGIAR Research Program (CRP) piloted integrated genetic interventions to catalyse the transformation of milk, meat and fish production in selected developing countries. This brief

presents some outcomes and lessons from applying a value chain approach to dairy production in three East African countries of Kenya, Uganda and Tanzania, and fish production in Egypt.

## Yield gaps in target product lines

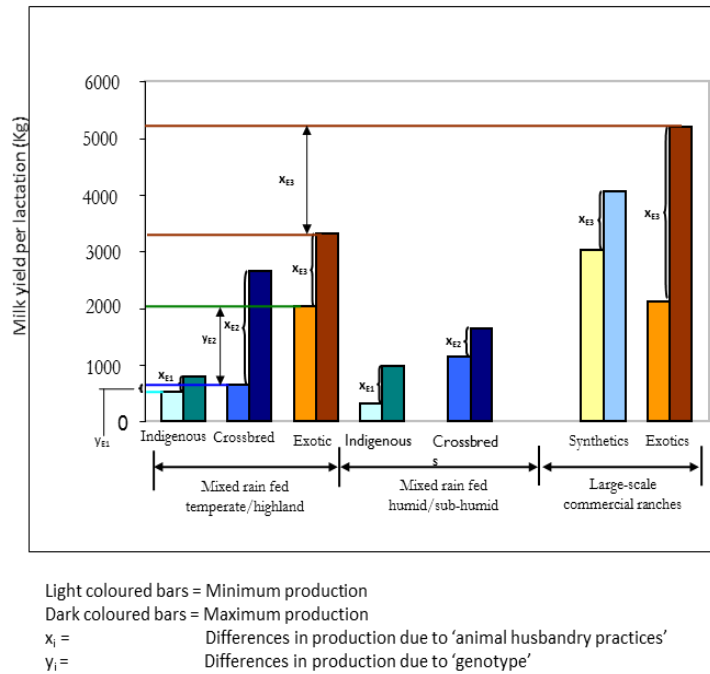
The demand for livestock products in developing countries has been increasing as projected by (Delgado et al. 2001). There are however significant differences in levels of production achieved by animals of the same genetic makeup, depending on their production system. Small-scale producers in developing countries have little control over the many environmental factors and stresses that affect and constrain the productivity of their livestock and fish. This results in lower levels of product output per animal.

This is illustrated in Figure 1 which shows that differences in milk production across dairy production systems of East Africa result from i) animal husbandry practices, ii) breeds of cattle used, and iii) production systems under which animals were reared (Mwacharo et al. 2008).

Statistics on milk production in East Africa show an increase in the total volume of milk produced over time (FAOSTAT 2014). This increased production was however mainly due to increases in the number of animals over the same period, rather than a change in productivity per animal. The environmental implications of this continued increase in livestock populations would definitely extend the 'long shadow of livestock' (Steinfeld et al. 2006).

Productivity variations among cattle breeds and the genetic potential for increased production under various systems remain largely unexploited. Understanding and addressing these variations has been addressed in the CRP by applying genetics to dairy in East Africa and fish in Egypt.

Figure 1. Differences in milk production by different genotypes in dairy production systems found in Eastern Africa



## Defining variation and transforming institutional support for dairy production

With the University of New England (Australia) and PICO East Africa, the ILRI genetics group implemented the Dairy Genetics East Africa (DGEA) project to answer the questions: 'which is the most suitable breed combination in the smallholder production systems?', and which business models could be adopted to propagate the best breeds identified? The project used a three-phased approach involving:

- i) adapting single nucleotide polymorphism (SNP) technologies to decipher existing breed diversity in smallholder dairy production systems;

- ii) Continuous phenotypic measurement of animal performance and the characteristics of the production environment in order to describe differences in smallholder management practices (Mujibi et al. 2014; Ojango et al. 2014);
- iii) Understanding organizational and institutional arrangements for dairy production.

It was clearly evident that the organization and institutional frameworks in the countries were too fragile to support sustainable changes in the dairy production systems. The DGEA project team, thus, adopted innovation platforms to drive active interaction and collaboration among different stakeholders in the dairy value chain. In the innovation platforms, complementary skills and competencies of different value chain actors were drawn on to facilitate co-creation of solutions to challenges in dairy production.

## DGEA innovation platforms

The Dairy Genetics East Africa (DGEA) project supported the creation of innovation platform groups and led discussions addressing the limited number of improved dairy animals available for farmers in East African smallholder production systems (Ouma et al. 2014). Actors in group discussions identified and demonstrated missed opportunities in the adoption and use of artificial insemination (AI) for delivery of improved dairy genetics. They outlined how provision of AI could best be sustained through a bundled service model as a public-private partnership.

The AI service delivery framework would involve relevant government department/ institutions teaming up with private AI companies linked to 'last-mile' service providers at farm level. The last-mile service providers should be skilled both in AI delivery, and in at least one other area such as animal health support, livestock management, business acumen for availing inputs for livestock production. To provide a holistic service for the farmers, last-mile service providers should additionally team up with other actors providing these additional services for the livestock value chain.

This model for AI delivery led to investment by the Bill & Melinda Gates Foundation in the [Private-Public-Partnership for Artificial Insemination Delivery](#) (PAID) project in Ethiopia and Tanzania aiming to revamp national AI centres and provide private AI and farmer extension bundled services.

# Transforming fish production practices in Egypt

Changing demand for livestock and fish products in terms of quantity and quality, and the need for alternative products requires that existing value chains for different markets are transformed. Using unimproved strains of Nile tilapia, Egypt has developed a highly successful aquaculture industry, and is now the second largest producer of farmed tilapia worldwide (FAO, 2014). With a limited area available for aquaculture, further production increases and economic sustainability of the industry need to come from increased productivity. It needs faster growing fish.

Generation 9 of the genetically improved Abbassa tilapia strain was released by WorldFish in 2012. Using a value chain perspective, surveys measured on-farm performance of the fish to test whether they achieved the intended goals and if there were unintended effects. The improved management practices introduced alongside the use of the Abbassa strain had a large effect on productivity, however, the general surveys suggested no measurable impact that could be attributed to the strain (Dickson et al. 2016).

Studies were also undertaken on a small set of farms where controlled performance measurements were made and the improved strain was directly compared with unimproved strains on the same farm at the same time. These studies showed 18% faster growth of the improved fish, with increased profitability of 60% (Henriksson et al. 2017). There was evidence that farmers were changing practices to stock fewer fish to take advantage of faster growth, and produce larger fish with higher market price to make more profit. While some farmers did not produce more fish, their operations were more profitable and their businesses more economically sustainable—key to the maintenance of the fish value chain.

Underpinning the need for a value chain approach to introducing technologies, this example illustrates the importance of measuring actual farm-level performance and the complex interactions that can occur. Further study is needed to disentangle these effects detected in early analyses on relatively small sample sizes.

## Lessons learned

- I. Understanding the magnitude and pivotal role of different nodes along the value chain provides valuable information to determine best-bet interventions with livestock genetic applications;
- II. Demonstrating change through actual measures of performance under farmer production environments more rapidly catalyses adoption and change than on-station performance measures;
- III. When anticipated outcomes have long-term horizons—as in genetic improvement programs—the phasing of activities and processes in delivery through short-term interventions with demonstrable outputs greatly enhances adoption of the advocated practices.

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