Animal breeding and genetics in the Ethiopia livestock master plan

High population growth and rising living standards are putting pressure on Ethiopia's livestock owners to increase the productivity of their animals. Improving the genetic potential of the country's livestock is one of the keys – with better feeds and better health - to achieving food and nutrition security, and better lives through livestock. Quick-win genetic-based technologies—including artificial insemination (AI) with oestrous synchronization and community-based schemes to improve indigenous breeds as well - can significantly contribute to transformed value chains for cattle, small ruminants and poultry.

Genetic gains can be obtained by crossbreeding Ethiopia's local (generally hardy but low-yielding) animals with (high-yielding) exotic breeds and by improving local breeds through selection. Analyses by experts who developed Ethiopia's livestock master plan (LMP) argue that sustained support will be needed from all stakeholders, particularly the Government of Ethiopia, to achieve these gains. The plan further shows that programs to crossbreed all species of livestock—except for poultry – and to import and use pure exotic breeds, will make the greatest gains when they target commercial and market-oriented families in mixed crop-livestock systems. This applies in both rainfall-sufficient rural zones as well as in rainfall-deficient peri-urban areas and milk belts.

In regions that are remote from markets or with environments too harsh to support exotic or crossbred animals, genetics gains can be achieved be enhanced by selective breeding of local cattle, sheep, goats and camels and subsequent distribution of the best performing local animals where they are needed.

For poultry, crossbreeding and imports of exotic breeds are practical options for specialized and improved family poultry systems in all zones of the country. High priorities for improved family poultry farmers are importing of purebred tropical breeds and distribution of improved local birds. Disseminating local birds is the single best bet option for many of Ethiopia's smallholder households.

These genetic improvements, together with essential improvements in livestock feed, health and husbandry, can increase Ethiopia's cow milk production by 93%, poultry meat production by 270% and its egg production by more than 200% by 2020. National livestock genetic improvement programs can thus significantly help reduce poverty by helping millions of family farmers upgrade their traditional subsistence livestock production systems to market-oriented, profit-making, enterprises that directly improve livelihoods and reduce food insecurity. Transformation of the livestock sector will also benefit Ethiopia's growing urban consumers by offering them more, and more affordable, meat, milk and eggs.

Crossbreeding initiatives could increase the number of crossbred cattle by 793% in family dairy systems and by 163% in specialized dairy systems, with milk production by crossbreds increasing tenfold and parturition rates by 50% compared to local breeds (Table 1). The number of improved and crossbred birds would increase by 246% in improved family poultry systems and by almost 29,500% in specialized poultry systems. Crossbred birds raised in specialized production systems would increase their egg production sevenfold, with a 90% decrease in mortality (Table 2).


Table 1: Expected genetic gains from cattle in different production systems

<table>
<thead>
<tr>
<th>Description of parameters</th>
<th>Lowland grazing zone</th>
<th>Mixed crop-livestock rainfall-deficient zones</th>
<th>Mixed crop-livestock rainfall-sufficient zones</th>
<th>Specialized dairy (crossbred)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agro-pastoral</td>
<td>Pastoral small</td>
<td>Pastoral medium</td>
<td>Smart medium</td>
</tr>
<tr>
<td>Cattle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Live weight</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Juvenile</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>86</td>
</tr>
<tr>
<td>Sub-adult</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>170</td>
</tr>
<tr>
<td>Adult</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>255</td>
</tr>
<tr>
<td>Milk offtake litre per year per breeding female</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>279</td>
</tr>
<tr>
<td>Parturition rate (%)</td>
<td>56</td>
<td>56</td>
<td>58</td>
<td>57</td>
</tr>
</tbody>
</table>

Source: Livestock master plan, 2015.

Table 2: Key demographic and production parameters in current poultry production systems

<table>
<thead>
<tr>
<th>Description of parameters</th>
<th>Backyard (local breeds)</th>
<th>Layers (crossbreeds)</th>
<th>Broilers (crossbreeds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mortality rate before marketing (%)</td>
<td>50</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Mortality rate—young stock</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Adult mortality percentage per year</td>
<td>20</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Kg total feed/kg egg produced/kg live weight</td>
<td>NA</td>
<td>2.7kg/kg of egg</td>
<td>1.8 kg/kg live weight</td>
</tr>
<tr>
<td>Number animals sold per breeding female per year</td>
<td>1.61</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Average weight at slaughter (kg)</td>
<td>1.5</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Dressing percentage at slaughter (%)</td>
<td>65</td>
<td>64</td>
<td>65.2</td>
</tr>
</tbody>
</table>

Source: Livestock master plan, 2015.

Building on past progress

Despite the abundance of livestock resources in Ethiopia, the depth of its research and the quantity of available technologies, there have so far been few sustained attempts to improve indigenous breeds using between- and within-breed selection procedures. Despite campaigns to encourage crossbreeding between local and exotic breeds of almost all domestic livestock, the number of crossbreds is still negligible. Even in species crossbred in Ethiopia for several decades, such as cattle and poultry, numbers do not exceed 1% of the total national populations.

Early cattle genetic improvement activities in Ethiopia focused on improving milk production in local cattle through selection programs. As these efforts did not yield sufficient results, subsequent cattle improvement programs have focused on crossbreeding local with exotic breeds of almost all domestic livestock, the number of crossbreds is still negligible. Even in species crossbred in Ethiopia for several decades, such as cattle and poultry, numbers do not exceed 1% of the total national populations.

Some genetic improvement success has been reported in the poultry sector. Exotic chicken breeds are reared by small-, medium- and large-scale commercial producers in urban and peri-urban areas. Both crossbreds and purebred exotics are widely used in to increase meat and egg production. Many governmental and non-governmental organizations over the years have helped distribute purebred exotic pullets, cockerels and fertile eggs to farmers, as well as to poultry breeding and multiplication centres in the country. There is also some research on characterizing indigenous goats and crossbreeding them with exotic breeds; genetic improvement of equines, camels and bees is at a early stage.

Policies and strategies to promote genetic improvement

The government has supported Ethiopia’s dairy sector for many decades. But only recently, with regulations establishing the Ethiopian Meat and Dairy Industry Development Institute, has it sought to increase milk supply to processing industries, and to upgrade the capacity of milk processing companies in product development and processing.

A recent draft policy on livestock breeding covers all livestock species reared in Ethiopia or with good potential to be reared. Accompanied by a 2012 ‘Guideline on Import and Export of Animals and Animal Genetic Materials’, the draft breeding policy is expected to substantially advance the country’s genetic improvement activities.
The guideline presents the criteria, standards and procedures for importing and exporting animals and animal genetic materials, while the draft breeding policy focuses on local breed improvement through both within-breed selection of indigenous breeds and crossbreeding local with exotic breeds, giving due attention to biosecurity and genetic conservation.

As many breeds and species in Ethiopia are not well characterized, the LMP urges greater study of local breed production, reproduction and other important characteristics contributing to organized within-breed selection.

**Genetic gain challenges and strategies**

**Challenge: Lack of genetically-improved indigenous animals and genetic materials**

- Improve indigenous breeds by developing improvement strategies for each species; undertaking within-breed selection for best-performing breeds and crossing them with other indigenous breeds; creating ranches for genetic conservation, improvement, research and selection and multiplication of improved breeds; implementing community-based local breed improvement schemes; and providing training to farmers on genetic improvement activities and improved animal husbandry practices.

- Improve the genetic potential and productivity of indigenous breeds by producing synthetic or composite breeds; crossbreeding cattle using artificial insemination and bull services; encouraging and promoting commercial livestock multiplication ranches linked to research institutions and dairy farmers; training selected farmers as artificial inseminators to reduce shortages of AI technicians; testing and scaling up technologies to accelerate the genetic progress through such means as multiple ovulation and embryo transfer; and artificial insemination in small and large ruminants; strengthening public- and private-sector artificial insemination services, bull services, existing crossbreeding cattle ranches, and research centres to produce and distribute crossbreds to smallholder farmers; improving management systems to upgrade crossbred dairy cows to 62.5% exotic for market-oriented peri-urban farmers; and strengthening the skills of smallholder dairy farmers, development agents, etc., in dairy animal husbandry and improvement of the reproductive efficiency of dairy cattle.

- Improve the efficiency of AI services by promoting and supporting private providers and animal health businesses by facilitating credit and business management training; improving the number and quality of public inseminators graduating from agricultural technical colleges; increasing the financial support provided to the Ethiopian National Artificial Insemination Center; and improving the feeding systems of animals undergoing AI.

**Challenge: No approved livestock breeding policies, regulations and strategies**

- Implement the draft livestock breeding policy to satisfy growing commercial demand, while ensuring animal importation and crossbreeding leads to improvements in the genetic pool and productivity increases.

**Challenge: Absence of accessible information for decision-makers**

- Develop resource maps of the country’s important livestock resources, indicating the potential of different regions to raise different kinds of livestock.

**Challenge: Lack of a national database on genetic improvement and progress**

- Establish a national database system, monitor genetic improvement and progress through monthly genetic evaluations and develop a feedback system for farmers, enabling selection of superior bulls.

**Policy agenda for genetic improvement**

Improving Ethiopia’s livestock genetics requires government to:

- Allocate adequate public funding to mobilize and strengthen AI and synchronization facilities, services and activities.

- Create additional AI infrastructure, including regional semen production and cold storage facilities.

- Ensure training is provided to public and private AI technicians and to farmers performing AI.

- Strengthen the focus of agricultural extension services in better management of crossbred cattle.

- Deliver effective technical and business training to all actors along Ethiopia’s livestock value chains.

- Guarantee well-functioning day-old chick production and distribution systems serving specialized and family-run poultry farms.

- Implement effective livestock extension and health services (public and private) to serve the increasing numbers of improved family dairy and poultry units.

- Engage producer cooperatives in livestock value chains.

- Encourage private-sector delivery of inputs and services to livestock smallholders.

**Research agenda for genetic improvement**

a. Short-term research should focus on developing a national livestock resource map; producing superior local purebred poultry for distribution or crossing; crossbreeding local birds with selected imported exotic breeds; and expanding community-based breeding programs for small ruminants.

b. Long-term research should focus on developing within-breed selection programs for indigenous breeds; crossbreeding superior indigenous breeds; developing synthetic indigenous breeds; evaluating indigenous breed potential for economically important traits; and designing a genetic improvement strategy and program for each major livestock breed.
Background to the LMP
Since 2014, the Livestock Resources Development Sector (or Livestock State Ministry) of the Ethiopian MoA and ILRI have been collaborating to develop a livestock master plan (LMP) to provide guidance to the government of Ethiopia on future priorities for livestock research and development activities.

The LMP project development process was funded by the Bill & Melinda Gates Foundation (BMGF). Beyond the plan itself, the project aims to build the capacity of the government to carry out data-driven, fact-based analytics and planning.

The LMP was developed by a joint team from ILRI and the MoA. Development was overseen by a high-level technical advisory committee (TAC) comprising directors of key MoA Livestock State Ministry departments and institutes, as well as representatives from the Food and Agriculture Organization of the United Nations (FAO), the Intergovernmental Authority on Development (IGAD), the Ethiopian Agricultural Transformation Agency (ATA) and the presidents of the relevant professional associations of livestock experts (the Ethiopian Society of Animal Production and the Ethiopian Veterinary Association).

This activity has been supported by the ALive group (African Partnership for Livestock Development) of the AU-IBAR (African Union Inter-African Bureau for Animal Resources), as well as the Agricultural Research Centre for International Development (CIRAD) and the World Bank which provided support to implement the Livestock Sector Investment and Policy Toolkit used to develop the sector model, including training in its use.