AVSF
AGRONOMES & VÉTÉRINAIRES SANS FRONTIÈRES
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TECHNICAL PAPER

Animal genetics

A factor contributing to the development of smallholder livestock farming?

Herd of goats selected for production of high-quality cashmere in Mongolia

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Preamble on terminology

Some people take issue with the phrase "genetic improvement". They see it more as an evolution towards a specialisation than actual improvement. In this document, we use the phrase "genetic improvement" to refer to **any intervention in animal genetics leading to increased performance in certain areas** (potentially to the detriment of performance in other areas).
The term "breed[1]" is commonly used and refers in this document to animals belonging to the same species with a similar genetic make-up and phenotypic characteristics.

[1] Breed is an informal taxonomic rank, below species. Breeds and sub-breeds are distinguished for the purposes of livestock farming and selection.

1. What is the purpose of genetic improvement?

Since the outset of livestock farming, humans have sought to reproduce and therefore "lock" what they believe to be the best performance characteristics into the genetics of their herd. ("It is a shame not to valorise a good cow"[2]).

The expected benefits of such an "intervention" include:

- **animals better adapted to their use** (longevity, size, resistance to environmental factors such as climate conditions, enzootic diseases, etc.) in order to preserve their role as a productive tool,
- **animals with a greater capacity** to provide the most useful "products" for farmers (food, labour, etc.), thus improving the living conditions of farmers and their families,
- preservation of **genetic diversity** on farms, thus avoiding "degeneration" of individuals.

Over the past 70 years, genetic improvement of animals has intensified in Europe and has led to greater productivity. But it has also resulted in hyper-specialisation of livestock farming, which has led to:

- disappearance or lesser use of other "services provided" by livestock (draught power, manure, variety of products: meat, milk, hide, etc.),
- deterioration in animal well-being (certain animals that become useless to the system, such as male chicks and dairy calves, are treated as by-products or simply killed at birth),
- animals and herds becoming less hardy and less capable of adapting to their environment,
- a change in the food requirements (quantity and quality) of animals genetically modified for greater production potential.

Genetic improvement also increases farmers' dependence on various techniques, such as artificial insemination and a form of genetic selection that is largely beyond their control.

Boosting milk production by crossing a local breed (Ndama) and an imported breed (Montbéliarde) in Velingara, southern Senegal.

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2. Genetic improvement of livestock in the Global South

There are a variety of situations in the countries of the Global South where AVSF carries out its projects:

- a certain number of livestock farmers want genetic improvement for their animals, in order to increase the productivity of their herd and boost their income;

- in some areas, livestock genetics have become extremely degraded as a result of considerable inbreeding (e.g. on farms in Mongolia because of isolation following the Soviet period). It is therefore necessary to reintroduce genetic diversity into those herds;

- on certain dairy farms (e.g. in southern Senegal), crosses were made with imported breeds, which has enabled farmers who have those animals to boost their income to a certain extent through increased production. Most of these farms, however, preserve animals of local "breeds", which enables them to respond to specific needs (draught power, in particular).

Genetic improvement may be pursued in a variety of ways:

1. "Externally": by cross-breeding with breeds imported from abroad, for example by crossing local breeds in Senegal with the Montbéliarde breed. In this case, genetic evolution and specialisation occur "rapidly". An alternative consists in using "creole" breeds that were established locally through cross-breeding, sometimes a very long time ago, with imported breeds and that have had time to adapt (e.g. Mexican black pig, which is considered to be indigenous with "improved" growth, but which were actually introduced by the Spanish during colonisation)[3].

2. "Internally": by cross-breeding with animals of a local breed from a different part of the country or sub-region, or simply by cross-breeding within a particular herd, giving preference to the best animals for use in reproduction. In this case, genetic evolution occurs more slowly.

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(2) Terres des Savoie, May 2016

(3) According to Gilberto Guttierrez, veterinarian for CCFD in Chiapas, 10/03/2018. Another example is AVSF's use in Mali of a stabilised mixed poultry breed called Wassa Chè, which was created by cross-breeding the local Kokochè breed with the Rhode Island breed (Habbanae no. 126, November 2017)

External genetic improvement is used to quickly boost production, but poses a significant risk (in addition to those already mentioned in the first part of this document) of creating animals that are poorly adapted to the local context[4]. The food resources or livestock-farming conditions may be inadequate for the cross-bred animals, which may make farmers more dependent on inputs and on the provision of gametes "for improvement", which are beyond their control. Or it may result in weaker cross-bred animals.

On smallholder livestock farms in the Global South, it is essential for genetic improvement, when it is necessary, to be carried out gradually and at a pace that allows the animals to adapt to local conditions. Moreover, genetic improvement must not cause livestock farmers to become dependent. That is **why AVSF favours internal genetic improvement at local level in the areas where it carries out its projects.**

Internal genetic improvement requires evaluating the genetic potential of local breeds or breeds from nearby areas. The purpose of obtaining this knowledge is to understand how these local breeds may meet farmers' expectations in terms of **boosting production and strengthening resilience** to diseases and/or extreme external conditions, without destabilising the system and without specialising too much in production to the detriment of the other services provided by the animals. In the Global South, smallholder livestock farming is by nature multifunctional[5], and this **multifunctionality must absolutely be preserved** in order to meet farmers' needs, minimise their dependence and mitigate risks. It is important, in any case, to think about the suitability of and level of priority given to genetic improvement versus other supports, such as improving livestock feed and conditions, training farmers, access to services, access to land, etc.

3. Examples of genetic improvement driven by AVSF

1. Southern Madagascar: raising goats as a form of savings

The context corresponds to an area with very few resources where there was discussion of setting up a centre for the production of breeders stock. A consultant concluded that the farmers' resources and skills were insufficient for the creation of the centre. The project was reworked at local level taking into account the fact that, in this particular area, animals are raised more as a form of savings than for production. "Farmer field schools" were created. These correspond to a small group of livestock farmers (10 to 20) who come together to select a local production core group with the best animals. The objectives of these Farmer field schools are to avoid inbreeding (by exchanging breeders animals between the different educational farms), boost production (more meat and milk) and provide certain financial resources to the group by selling a few breeders animals. This project clearly involves "internal" genetic selection, over which farmers have full control.

2. Mongolia: raising goats for fibre production

The objective here was to improve fibre quality for the production of cashmere and to revitalise (provide "new blood") a livestock-farming system that had been inbred since the collapse of the structures set up by the Soviet bloc. The animals "providing genetic improvement" were introduced from a neighbouring district. This made it possible to improve and "refine" the local breed (more homogeneous). This is an example of external genetic improvement that is still relatively local.

Boosting production performance for goats through mass selection (selection of the best breeders animals) and dissemination via Farmer Field Schools. Southern Madagascar (Androy region)

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(4) Local constraints must be adapted to not only in terms of feed but also in terms of climate and health (resistance to certain diseases), and with regard to zootechnical aspects in general (e.g. ability to travel long distances on pastoral grazing lands).

(5) Refer to: "Smallholder livestock farming in the Global North and South! The right solution for our societies and the environment", position paper, AVSF, May 2021.

4. Specific case of poultry genetics

Selection for poultry production is somewhat different than for ruminants, insofar as several different livestock-farming systems coexist in the Global South. We can identify three different poultry-farming systems.

- **Traditional poultry farming/backyard poultry system** (for "bicycle chickens" in West Africa) where the poultry feed themselves autonomously and are, most of the time, able to wander wherever they like, without any housing structure. This type of farming is generally practised within mixed polyculture and livestock-farming systems. The poultry are local breeds with only minimal, and in most cases internal, genetic improvement.

- **Intermediate livestock farming:** these are medium to large farms (500 to 1,000 animals). The chicks (in most cases improved local breeds) are purchased and fed grains, which are also purchased, and the chickens are sold locally or in cities around the country.

- **Industrial livestock farming,** on the outskirts of cities. These farms closely resemble intensive livestock farms in the Global North, and their purpose is to supply poultry meat and eggs to neighbouring cities. These are often integrated farms where the farmers own only the livestock buildings and where grain feed and day-old chicks are purchased. The poultry are from a small number of highly selected breeds imported onto breeder farms, which themselves are dependent on a small number of farms specialising in genetic selection. The genetic-selection process is dependent on the upstream segment of the supply chain.

AVSF supports smallholder poultry farming in different countries. This support includes building improved traditional chicken coops, which reduce animal losses by preventing poultry and chicks from straying at night, and by reducing risks linked to predators, providing water and feed on a daily basis, and improving monitoring and the provision of veterinary care. In some cases, AVSF has helped farmers gain access to breeding roosters and day-old chicks.

AVSF supports smallholder poultry farming because of the important role it plays in terms of food security and income generation, particularly for women. It is important to help livestock farmers maintain control and autonomy over their farms by promoting local chick production (external genetic improvement at local level through the purchase of roosters) and, in contexts where livestock feed is purchased, by encouraging the use of feeds produced on the farm or promoting the development of and access to food resources other than purchased grains (e.g. agricultural and food by-products, or termites).

5. Questions to consider before implementing genetic improvement

Genetic improvement is necessary in certain contexts where the genetic decline of local breeds poses a threat to livestock farms that are too isolated and/or too precarious in certain regions in the countries where AVSF carries out its projects.

In some cases, however, genetic selection may appear to be the solution to weak production that is also – and sometimes predominantly – caused by other factors: housing, feeding, livestock management, disease. **Livestock-farming conditions must therefore be improved before or at the same time as the implementation of a genetic-improvement programme.** Such programmes may also provide a very good pretext for improving livestock-farming conditions and practices (separation by age and sex, castration, feeding, housing, etc.).

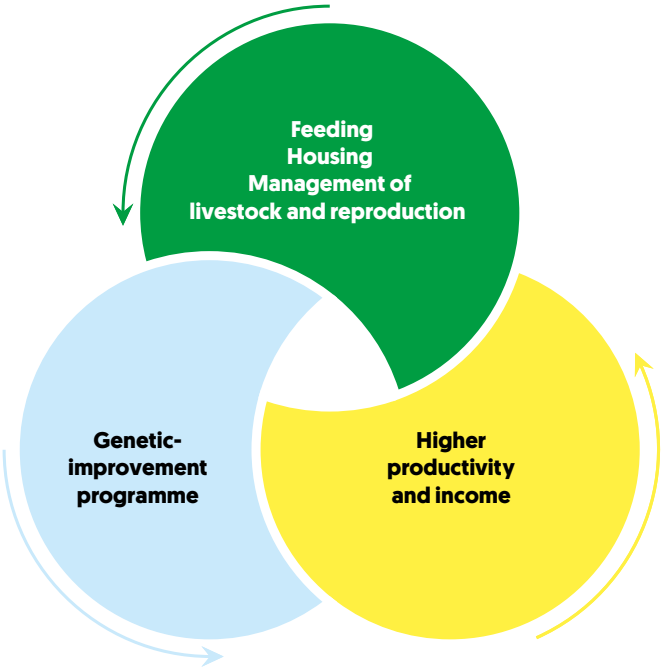

Figure:
Improvement in livestock-farming conditions and genetic programme: positive synergy for higher productivity and income

The risk (loss of hardiness) / benefit (higher production) ratio for genetic selection is assessed for each context in the areas where AVSF carries out its projects. Of course, making this assessment is not easy, as a large time interval is required to evaluate the consequences of the genetic modifications that are introduced. The ratio also needs to be assessed depending on the species (poultry, pig, ruminant), keeping in mind that it is genetic and species diversity that, in many cases, offers the greatest resilience to local risks in the Global South. To that end, it is important **to make the best use possible of existing local resources** by preserving and improving certain local breeds that are particularly useful and resilient. In addition, **genetic improvement requires a gradual pace and a particular rhythm** so that the animals can adapt gradually to local conditions.

How can livestock farmers maintain control over their genetic selection? This question of dependence, which comes up in certain genetic-improvement programmes, must also remain a core focus of AVSF's work. While externalising selection appears to quickly improve breeds and boost local production, it often goes hand in hand with **a loss of farmer control over genetic choices.** It also risks creating dependence on inputs to make up for insufficient local resources in cases where there are not enough local resources to feed the newly imported or created breeds.

Introduction of breeding roosters (here: "North Holland Blue" breed) on improved, traditional small-scale farms in southern Senegal.

6. Rules

After analysing the genetic-improvement programmes led by AVSF and the questions that remain for each project, certain recommendations may be made to help decide on actions to take in the field.

1. Take well-reasoned and coordinated action to address zootechnical and health factors that limit production (housing, feeding, management of livestock, health, etc.)

Before launching a genetic-selection programme, it is essential to thoroughly assess local constraints and any factors that may limit production. **The idea is to try to address these factors before or at the same time as a proposal for the genetic improvement of animals,** so that those animals may correctly express their potential (feeding, access to animal-health services, etc.).

2. Define specific and local objectives for the desired genetic improvement

It is essential for **farmers to define with precision the expected objectives of the genetic selection** they wish to undertake, so that the methods employed are tailored to the objectives, whose fulfilment must be measurable.

3. Maintain diversity of production through gradual selection

Genetic selection leads to specialisation (e.g. milk to the detriment of meat). Given the range of services that livestock provide for smallholders (meat, milk, draught power, manure, savings, etc.), the improved performance enabled by genetic selection must remain compatible with all of those services and with conditions in the field (feed, housing, health risks), so that the improved animals are still adapted to local conditions. **Selection must therefore be tailored and gradual.**

4. Maintaining control at local level

Farmers no longer have direct control over genetic selection in the Global North. Consequently, genetic selection has in most cases deprived farmers of their choices and subjected them to additional financial dependence. **Genetic-improvement programmes implemented by AVSF need to remain in the hands of farmers and farmers'** organisations in order to preserve their choices and minimise the risk of creating new dependencies, particularly in terms of livestock feed.

5. Promote internal genetic improvement at local level in the areas of AVSF action

Because of the need to preserve local diversity and the importance for farmers of maintaining control over genetic selection, **the methods of genetic selection implemented by AVSF must preferentially be oriented towards "internal" or external selection from nearby farms** in the areas where AVSF carries out its projects (internal selection of the best animals or introduction of animals from nearby areas that are therefore already adapted to local conditions).

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