Annex 6. Zebu Dairy Breeding Programmes in Brazil, evaluation of their impacts, and prospects
(Interview of MGCD Peixoto, scientist at EMBRAPA – Embrapa Dairy Cattle)

Stakeholders motivations, breeding goals and strategy.

Dual-purpose Guzerá and Dairy Gir are both *Bos indicus* breeds originated from India, which are major for dairy production in tropical conditions of Brazil. In the ~ 80s, several initiatives took place in Brazil to improve milk production in tropical and subtropical areas where small and medium-sized farmers with pasture-based production systems predominate and in which is more obvious the lack of adaptation of the high-yield Holstein cows. Several breed compositions of Holstein x Gir (including the synthetic Girolando breed) or Holstein x Guzerá were then promoted to farmers to improve production in harsh environments, keeping in some cases dual production objectives (dairy and beef). This initiative opened the possibility to start breeding programmes (BPs) in these *Bos Indicus* breeds, with later great commercial impact to those breeds (Madalena et al, 2012).

The breeding organizations are breeders' associations. As such, the Brazilian Association of Zebu breeders (ABCZ) is responsible for data recording in purebred herds, Zebu breed promotion, and the Zebu Genetic Improvement Program, PMGZ). The Brazilian Association of Dairy Gir Breeders (ABCGIL), the Brazilian Center for the Genetic Improvement of Guzerá (CBMG^2) and the Brazilian Association of Girolando Breeders (ABCG) are responsible for collecting data from collaborating herds (usually crossbred herds) and for promoting each breed in particular. All of them are under the supervision of the Ministry of Agriculture, Livestock and Food Supply (MAPA), which initially funded the BP with the technical support of FAO.

Description of the breeding programmes.

The Brazilian Dairy Gir Breeding Programme (PNMGL) was established in 1985, based on a close partnership between the Brazilian Agricultural Research Corporation and the Brazilian Association of Dairy Gir Breeders. It was the first breeding program outlined with a progeny test for the improvement of an indicine breed for milk production in the world. The first Dairy Gir sire summary was released in 1993, and since then the results of accurate genetic evaluations of each battery of bulls have been annually published. PNMGL implemented the genomic evaluations in 2018, which has led to even more significant genetic gain. In 1994, the Brazilian Center for the Genetic Improvement of Guzerá, also in partnership with Embrapa Dairy Cattle, implemented the National Programme for the Improvement of Guzerá for Dairy Purpose (PNMGuL). This program was based on both a progeny test and a multiple ovulation and embryo transfer (MOET) nucleus schemes. The joint strategy aimed at promoting an initial genetic lift and rapid genetic progress in milk production traits, using accurate estimated breeding values. The first Guzerá sire summary containing the results of accurate genetic evaluations was made available in 2000, and an evaluation of the impact of the open MOET nucleus in the results achieved in the PNMGuL was only recently performed. In 2022, the MOET nucleus was closed and the program is now based solely on progeny test and, recently, genomic evaluations were implemented.

During the public presentation of the annual sire summaries (workshops dedicated to breeders), the technicians from the breeding associations and researchers from Embrapa Dairy Cattle and universities give presentations to facilitate knowledge transfer. The field technicians are usually trained every two years. The researchers also organize yearly workshops to talk about the BPs and to encourage new research demands.

Impact.

In the PNMGL, average milk yield of participating herds has considerably grown since the beginning of the BP, from 2000 kg in 1990 for the 305-day milk yield to over 4500 kg in 2021 (Panetto et al., 2022). In the PNMGuL, the annual phenotypic increase for milk yield revealed favourable improvements of 41kg/year and 98kg/year for the whole population and the MOET nucleus, respectively (Peixoto et al., 2022). The genetic trend for milk production for the whole population (5.27 kg/year) was positive, but notably lower than the genetic rate for the MOET nucleus population (9.39 kg/year). The average for the 305-day milk yield of participating herds increased from 2261 kg in 1994 when the Guzerá BP started to 2910 kg in 2022 (Frank T. Bruneli, personal communication, 2024).

In general, the breeding associations do not estimate the economic costs, gain and income of their breeding work. In the past, the economic instability of the Brazilian currency made it difficult to establish economic weights. Nowadays, the lack of economic records on farms brings difficulties to develop economic selection indices and, consequently, impacts the economic efficiency of these BPs. However, Embrapa analysts evaluate the costs and benefits of the BPs under its technical responsibility for internal usage, or only for the access of the MAPA. A sample of herds participating in each program is visited for data collection. The metric considered is the Economic Rate of Return (ERR), to show how a BP's economic benefits compare with its costs, looking at the impact of the use of "proven bulls" on the increment of herd productivity and the added value of commercialized animals considering all the benefits in the beef or dairy value chain. The last evaluation was carried out in 2021 for Nelore, Girolando and Guzerá breeds, estimating ERRs ranging from 13% for the Nelore beef BP and 78% for the Guzerá BP to an impressive ERR of 155% for the Girolando BP.

Due to the payment criteria, based mainly on volume, farmers prioritize milk production. But Brazilian legislation on milk quality as well as the pressure of dairy industry, also driven by the new consumer demands, is changing this scenario. As a result, many industries started to pay for milk solids content and quality, leading farmers to search for the improvement of fat and protein contents, as well as of the udder health. Other traits, such as those related to reproduction, growth and development, morphology, and disease occurrence (tick resistance), important in tropical and harsh environments with like-savannah and semiarid regions are beginning to be considered in BPs. However, data recording is hampered by the high costs of carrying it out in a country of such dimensions. They were not recorded in the Guzerá MOET Nucleus due to financial and logistic circumstances. Information on the beef traits of the Guzerá breed, for instance, is processed in specific genetic evaluations for beef cattle, carried out by beef improvement programs. However, as the database is genetically connected to the database of the milk program, the joint availability of genetic values for dual-purpose bulls is allowed. There are concerns about the necessity of not only enlarging the database for milk and beef traits in Zebu improvement programs, but also implementing phenotyping for adaptive traits such as feed efficiency, thermotolerance and disease resistance traits, to indirectly minimize environmental impacts in economically viable systems.

Breeding associations have access to media (TV channels, magazines, web etc.) aimed at the rural sector. They frequently use these channels to clarify questions not only to the sector but also to the population in general. Recently, it has been necessary to answer questions about animal welfare and environmental pollution. The research institutions also promote events with the same purpose.

The Low Carbon Agriculture Program (ABC Program) drawn up by MAPA was implemented in 2010 focusing on a sustainable animal production and mitigation of GHG. Beef farms are adopting many procedures, including intensification and welfare practices. Traceability protocols are also being developed. There is a growing concern about the importance of sustainable livestock to meet the global demands of society, consumers, and to be a player in the international market, but it has not yet reached all the Brazilian regions and farms. Nowadays, there are a lot of certifiers in Brazil to achieve the meat exportation rules/barriers, ensuring Brazil remains a leading player in the international meat market. Beef cattle is on the right track, boosted by exports. But there is a long way to go for dairy cattle: low levels of technology adoption and of good health and welfare practices, as well as lack of manpower and training resulted in low

productivity and income in the dairy sector. Besides, the Brazilian dairy chain is facing a conflict with government policies, with importation of cheaper milk from other countries.

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