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Building gender considerations into livestock breeding in low- and middle-income countries

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Livestock breeding programs are important in low- and middle-income countries because of the large number of livestock systems that can benefit from improved genetics. Local gender norms and dynamics shape livestock management in households and communities. They influence the ways in which women and men provide inputs, such as labor, finance, time, and knowledge into their livestock systems. They shape the specific needs, preferences, and distribution of the benefits derived from improved genetics. Breeding strategies must consider such gender dynamics to effectively contribute to various livestock systems and ensure that their benefits are equally shared within households and communities. However, the scoping review and key informant interviews conducted in this study revealed a sparse body of knowledge on gender-responsive livestock breeding. The purpose of this study is to develop a framework that can inform gender-responsive livestock breeding programs and, in so doing, develop a comprehensive knowledge base. The framework builds on the following key steps of a breeding program: (i) targeting, (ii) operationalization of the genetic improvement strategy, (iii) marketing and dissemination of genetic material, and (iv) ensuring equitable benefits from improved genetics. In each step, key gender questions are set out to help breeders and gender scientists think through and assemble the gendered information they need. These questions are of two types: gender-accommodative (to respond to gendered needs and priorities while reflecting existing gender norms and dynamics) and gender-transformative (to respond to gendered needs and priorities while allowing women to work towards their aspirations in livestock systems by challenging the discrimination of gender norms). The primary target readership is livestock breeders and social researchers working in low- and middle-income countries to improve livelihoods through livestock, with a focus on genetic improvement.

KEYWORDS

gender, livestock breeding, women, genetic improvement, gender-transformative programs, gender accommodative programs

Introduction

Livestock breeding programs are important in low- and middle-income countries (LMIC) because of the large number of highly heterogeneous livestock systems that would benefit from improved genetics. However, diverse gender norms and dynamics influence the ways in which women and men provide inputs, such as labor, finance, time, and knowledge, into their livestock systems. As gender norms structure farmers' differing roles and responsibilities, women and men livestock keepers typically exhibit different capacities and knowledge, and express different needs and preferences. The benefits that they draw from their livestock systems are similarly influenced by gender norms and dynamics. Women¹ often have weaker access and control, compared to men, over the revenues livestock products generate and how animal source foods are used, despite the often considerable time, labor, and other resources they provide (FAO, 2023; Galiè et al., 2022).

Although statistics on the involvement of women and men in livestock are not available, they exist for agri-food systems overall. Figure 1 compares the overall employment of women and men in the agri-food systems in 2005 and 2019. Figure 2 shows the gender-based food insecurity worldwide. FAO, 2023 provides more gender disaggregated statistics related to agriculture. Oloo et al. (2023) show trends in feminization and masculinization of agriculture in South and South-East Asia.

This imbalance can discourage the effective adoption of more productive animal breeds, which require more input than local breeds, by resource-poor households. This is problematic in terms of development because women constitute a significant proportion of poor livestock keepers (Quisumbing et al., 2023), are deeply concerned with livestock management and care, and are significantly involved in providing animal source foods to their families (Quisumbing et al., 2023). However, when women are unable to provide the inputs required and obtain benefits, they can control commensurate with their work, and improved livestock systems may fail to achieve their full productive, livelihood, and nutritional potential. To respond effectively to the needs of all livestock keepers, enhance the effectiveness of livestock breeding interventions, and support the empowerment of women, livestock breeders need to know which issues they need to take into consideration to benefit women and men livestock keepers effectively and equitably.

Breeders consider their choice of genetic improvement strategy in breeding programs. Detailed research is frequently conducted to

understand farmer's preferences. However, sex analyses are uncommon. Case studies (Alemayehu et al., 2018; Haile et al., 2019; Ojango et al., 2019; Tada et al., 2013; Weldemariam and Mezgebe, 2021), show that efforts to involve smallholder livestock keepers in livestock breeding programs have been made, however, significant opportunities to develop sex-disaggregated data and gender analysis were missed. Lost opportunities like these appear to primarily relate to a lack of knowledge on the part of livestock breeding teams on how to conduct gender analyses and how to develop gender-responsive breeding programs accordingly.

The International Livestock Research Institute (ILRI), part of the CGIAR, aims to build breeder understanding and capacity regarding gender in livestock systems. Thus, the ILRI collaborates with several national governments in Sub-Saharan Africa (SSA) on projects that integrate gender-responsive breed preferences (Babigumira et al., 2019; Kariuki et al., 2022; Marshall et al., 2017; Ramasawmy et al., 2018). This study aimed to encourage breeders to develop gender-responsive livestock breeding programs. To achieve this, it expands a conceptual framework developed by Marshall et al. (2019). This highlights gender considerations in the four key steps of a livestock breeding program. In this study, we improved the framework based on wider literature and experience from the field to highlight gender issues that livestock breeders can reflect upon as they work to make their interventions more responsive to gender issues.

This study is structured as follows: i) a conceptual framework presenting the key steps of a livestock breeding program together with important principles for gender integration in livestock breeding; ii) specific gender considerations relevant to each step of the framework, highlighting relevant gender questions that breeders should pose; iii) research or published evidence for the different steps; and iv) the study concludes with reflections on the implications of the gender-responsive breeding framework for breeders and gender scientists.

Methodology

The methodology used in this study is as follows: (1) revision of the original framework developed in 2019 (Marshall et al., 2019); (2) A literature review to assess the state of knowledge on gender issues in each of the stages in a breeding program outlined in the 2019 framework; and (3) Interviews with geneticists who implement animal breeding programs with a gender lens to discuss their experiences.

These interrelated methodological components provide a clear pathway to shape a gender-responsive livestock breeding program by summarizing the recent evidence on gender-responsive livestock breeding, shedding light on the key gender considerations that a breeding program needs to consider, and exploring the constraints and successes of scientists attempting to ensure that their work is more gender-responsive.

Component 1 entailed in-person and virtual exchanges among the authors of this article (geneticists, gender scientists with expertise in animal genetics, and non-genetic gender experts) on how to expand and strengthen the 2019 framework.

¹ In this study, we limit our discussion to women and men (diversified by personal characteristics such as age, ethnicity, marital status, etc.) as the two main gender groups of interest, based on the extensive body of literature on inter-gender differences between these two groups, particularly with respect to agriculture and rural livelihoods. However, we acknowledge that gender-diverse individuals often experience specific forms of discrimination. We believe that the process of developing questions on gender as binary, as proposed in our framework, will encourage other researchers to explore gender-diverse options.

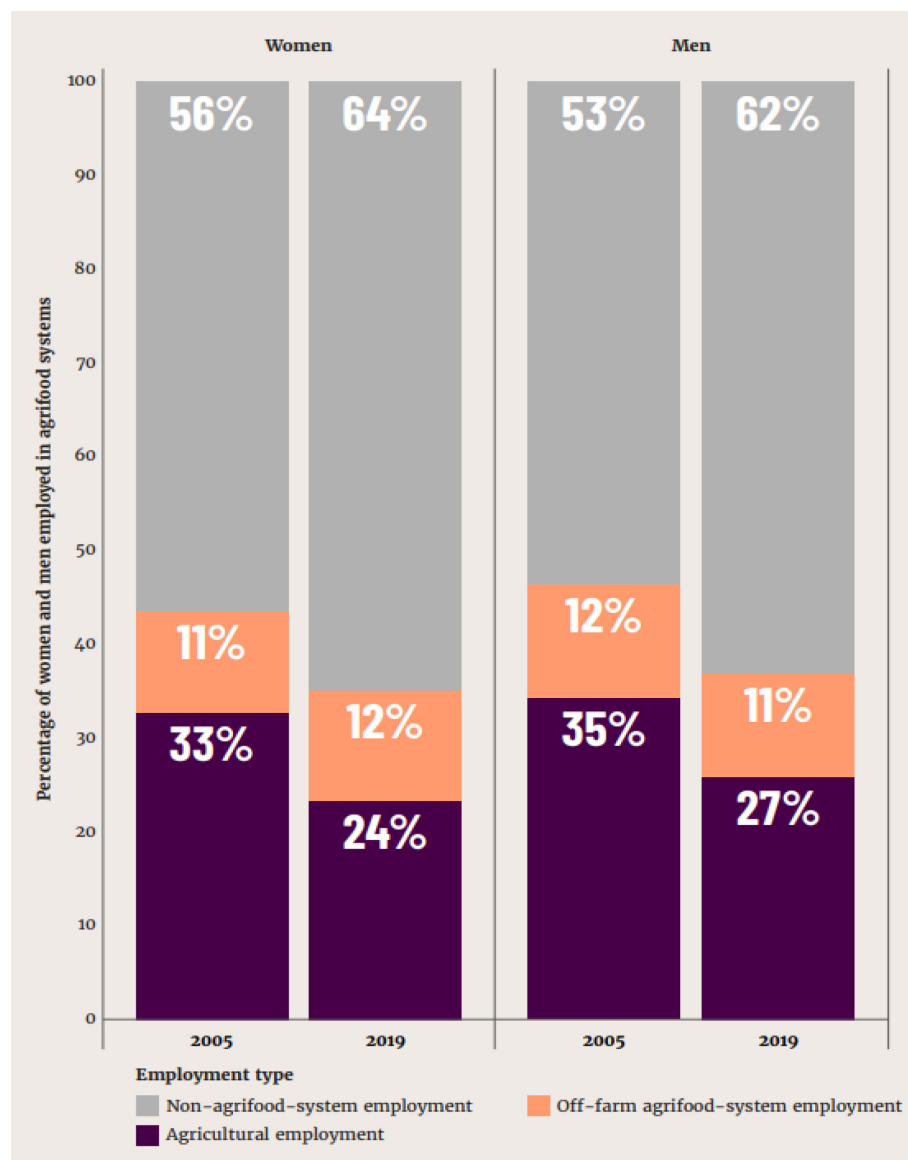


FIGURE 1

The share of agrifood-system employment in total employment in 2005 and 2019, by sex. Source: Reproduced from [FAO \(2023\)](#), licensed under [CC BY-NC-SA 3.0 IGO](#).

Component 2 was conducted by searching the Google Scholar database, ILRI archive (CGSpace), and project websites (e.g., Heifer International, FarmAfrica, CARE, TechnoServe, USAID, IFAD, BMGF), and by tracking key references in articles. The chief parameter was literature written in English between January 2005 and February 2022. Search terms related to the following themes were used: gender (e.g., women and gender), animal genetics, livestock, country (e.g., Tanzania), regions (Sub-Saharan Africa (SSA), Central and West Asia and North Africa (CWANA), East and South Asia and the Pacific (ESAP), Latin America and the Caribbean (LAC)), LMIC, and animal species (sheep, goat, cattle, pig, chicken, buffalo, and camel). The review included 36 sources, consisting of 25 journal articles, three book chapters, five working papers and reports, two doctoral dissertations, and one conference proceeding. The search terms yielded useful insights into gender

issues in relation to several livestock species but limited evidence of breeding programs that integrate gender issues.

For Component 3, the authors used purposeful selection criteria to select geneticists and gender scientists working on livestock (including the authors of this study and colleagues) who have implemented animal breeding programs using a gender lens to discuss both their positive and negative experiences. Dairy breeding is a widely adopted intervention with potentially significant opportunities for women and men in sub-Saharan Africa (SSA). Four articles that included gender considerations in dairy breeding in SSA were identified. Interviews were conducted with 10 (eight men and two women) of the article authors to explore the gender issues they encountered. Questions were sent via email with follow-up discussions held online to deepen their insights. The information obtained was analyzed to identify commonalities and outliers in

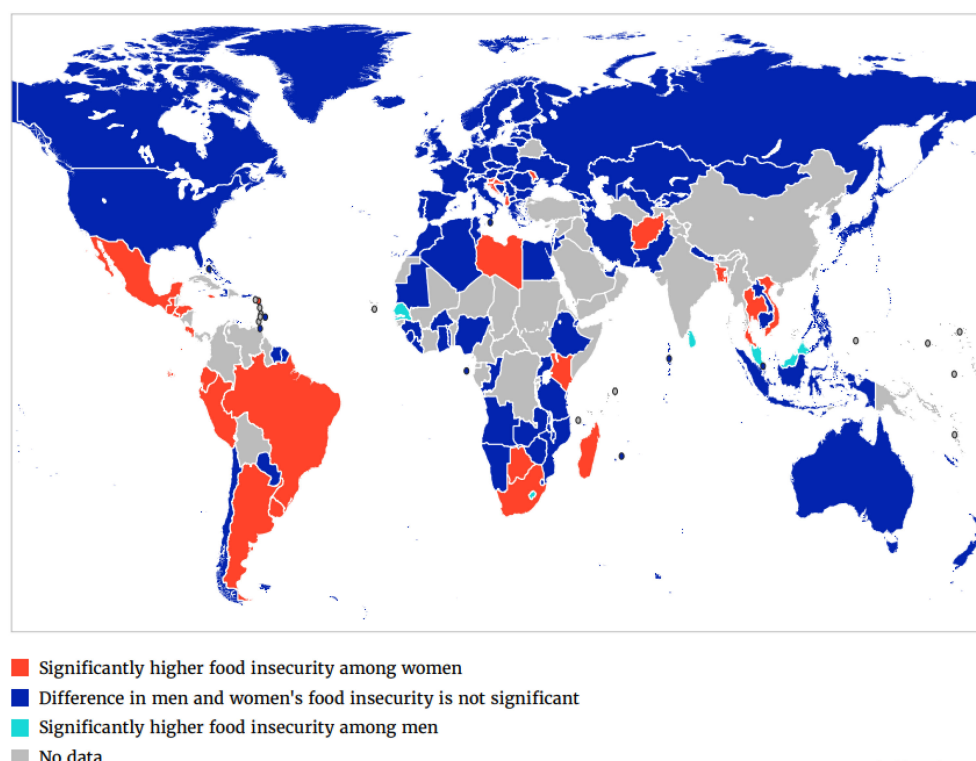


FIGURE 2

Food insecurity among men and women worldwide. Source: Reproduced from [FAO \(2023\)](#), licensed under [CC BY-NC-SA 3.0 IGO](#).

their experiences (e.g., difficulties faced in each stage of the breeding program, reasons for this, solutions identified, etc.). Overall, these discussions permitted the identification of some constraints and opportunities related to the inclusion of gender considerations in animal breeding programs.

Conceptual framework

The four steps of a livestock breeding program

The original framework proposed by [Marshall et al. \(2019\)](#) is a short thought-piece designed to identify key gender considerations in animal genetics programs. It aimed to stimulate breeders to think about how to become more gender-responsive when designing and implementing breeding projects in LMIC. The framework contains five steps: targeting, choice of genetic improvement strategy, implementation of genetic improvement strategy, adoption and use of improved genetics at scale, and ensuring equitable benefits from improved genetics. The new conceptual framework combines the original step 2 (choice) and step 3 (implementation) because of their similarity in practice. This results in four steps ([Figure 3](#)): (1) targeting, (2) operationalization, (3) marketing and dissemination, and (4) ensuring equitable benefits.

The flow from left to right was intended to mimic and respond to the thought flow in developing a breeding program, thus

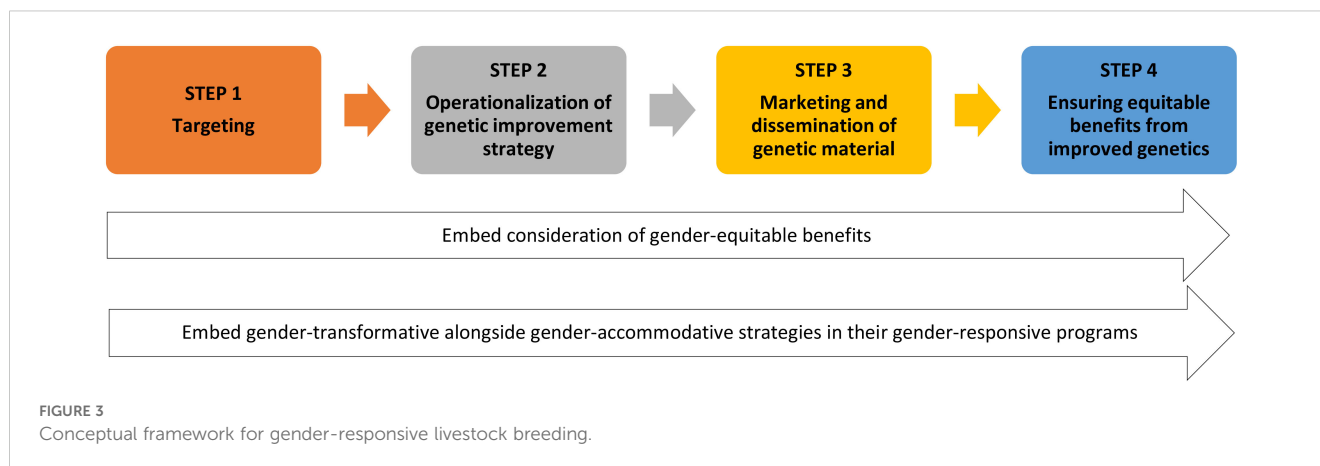
simplifying the understanding and use of breeders to. Currently, few breeding programs are built considering step 4 (equitable benefits). The revised framework considers that breeders need to incorporate gender considerations in all steps, and specifically considers that step 4 is essential to ensuring that breeding programs are gender-responsive and benefit diverse women and men livestock keepers. To achieve this goal, it is suggested that livestock breeders' partners closely interact with social and gender scientists to help them incorporate gender considerations across the framework.

[Table 1](#) highlights key general considerations for breeders at each step. Gender aspects are developed and expounded in subsequent sections.

Three propositions for a gender-responsive livestock breeding program

The new framework is structured in three propositions:

1. Gendered livestock breeding programs must consider the different capabilities, needs, preferences and aspirations of women and men (differentiated by social markers such as age, ethnicity, level of education, etc., as relevant) to participate in, and benefit from, livestock development.
2. Gender-responsive livestock breeding programs need to consider the ways in which gender norms and dynamics



may affect the adoption and impact of newly introduced livestock technologies on farms.

- To respond to the evidence produced in the two propositions above, decisions need to be made on whether to develop (i) gender-accommodative programs—to improve women’s and men’s gains within locally prevailing gender norms; (ii) gender-transformative programs—which expand the range of livestock options open to women and men by expanding the local normative framework; or (iii) create a continuum that integrates a solid gender-accommodative basis with a gender-transformative approach.

TABLE 1 Summarized considerations for each step.

Step	Key considerations
Step 1. Targeting	Creating the parameters of the breeding program by responding to demand for improved (productive and adapted) livestock genetics: Which livestock system to address? Which species and breeds to focus on? Who is to be involved?
Step 2. Selection and operationalization of the genetic improvement strategy	Selecting and implementing a breeding strategy (e.g., breed substitution, crossbreeding, within-breed improvement, reproduction technologies such as artificial insemination and embryo transfer). Decisions include (for example): selection of key partners and agreement on their roles and responsibilities, including the livestock keepers, the breeding objective(s), and selection of multiplication strategies.
Step 3. Marketing and dissemination of genetic material produced and capitalizing on genetically improved animals	Making the new genetic material available to more livestock keepers. This involves i) ensuring that those who have accessed the improved genetics have access to the complementary technologies required to capitalize on it, e.g., herd-health and livestock nutrition; and ii) monitoring and supporting development of requisite policies and infrastructure to facilitate effective distribution and utilization of the improved germplasm.
Step 4. Ensuring equitable benefits of the genetic improvement strategy	Ensuring that engagement in breeding (management) practices, and the benefits from the improved breeds and practices, are distributed equitably within households and communities.

Proposition 1: gender-responsive breeding programs

From a gender perspective, a livestock breeding program needs to respond to the identified gendered needs and priorities. This requires program (1) to conduct a gender-sensitive study to identify gendered capabilities, preferences, and needs in animal rearing. In this regard, questions for step 1 should include: who in the households and communities are the ‘doers’ and decision-makers in animal rearing, what are their needs and preferences, and what constraints and opportunities do they face. The program then needs to (2) develop strategies and actions to respond to the gender issues the initial research has identified as they move towards program development and implementation (steps 2 and 3). Following this, the program should (3) conduct gender-sensitive monitoring and evaluation to learn what works on the ground to facilitate improvement in the project’s ability to deliver gender-equitable benefits (necessary for step 4).

Proposition 2: analyze gender dynamics and norms

Gender analysis involves moving beyond disaggregation of data by gender (e.g., the number of women and men involved in rearing the animals or marketing them) to an analysis of the gender dynamics and norms behind such numbers (e.g., why women mostly rear and men mostly sell livestock in a particular community). For example, gender dynamics reveal whether the roles of women and men in livestock management are complementary, overlapping, or conflicting in a household or community. Studying gender dynamics sheds light on the reasons behind gendered patterns and helps to better shape interventions.

The term gender norms designates the informal rules and shared social expectations that shape and assign the roles, behaviors, responsibilities, and expectations that women and men are expected to adopt in a particular community (Cialdini and Melanie, 1998). Gender norms are affected by intersectional characteristics such as caste, age, marital status, ethnicity, religion, race, educational level, income class, and previous experience of keeping livestock, producing a multilayered disadvantage in livestock systems (Cialdini and Melanie, 1998; Farnworth et al., 2023b; Galiè et al., 2022). In livestock breeding, gender norms

influence the perceptions of key actors—livestock extension services, business partners, community-level decision-makers, etc.—around who they consider to be livestock keepers. Gender norms further shape the perceptions of who owns livestock, who makes key decisions about livestock and livestock products, and whether these roles are combined (Bryan et al., 2018; Padmaja et al., 2020).

Gender norms held by actors developing policies and providing services in the livestock sector can strongly influence the outcomes of livestock breeding programs. A comparative study examining data from 13 countries found that although women in Bangladesh, Nepal, Pakistan, Rajasthan in India, Uzbekistan, Morocco, and Ethiopia are widely recognized in their community as livestock keepers, this recognition is much less common among external institutions in their environment, including researchers, rural advisory services (RAS), livestock breeders, private sector players, and policy makers. These actors fail to sufficiently recognize women as livestock keepers or involve them in breeding projects, and they do not address women's needs and preferences (Galiè et al., 2022).

Proposition 3: accommodative and/or transformative approaches

A core strategic question for gender-responsive breeding programs is whether to work within the existing situation, where normative structures may provide a specific but limited range of opportunities for women (and men) to engage with and benefit from breeding innovations, or to create situations that additionally support women to move into new areas of livestock engagement. This might involve women moving away from merely providing inputs, such as food and water, to livestock, marketing livestock and their products, and deciding how to spend their income.

Gender-accommodative programs work in the first situation. An example of a gender-accommodative program is one that works with a livestock species or breed that women manage and control with the goal of increasing and improving the efficacy of women's participation. An example could be a small-scale poultry project that introduces chicken breeds that respond to the existing gender preferences of both women and men. In a situation where women rear chickens for household consumption only and therefore do not engage in marketing, while men are engaged in marketing the chicken, a gender-accommodative approach could involve the provision of indigenous, disease-resistant chickens to women and the provision of improved highly productive exotic chickens for men. Indicators for success might include the numbers of indigenous/improved chickens provided to women and men, or evidence of women's improved participation in intrahousehold decision-making.

Gender-accommodative programs run the risk of reproducing and potentially exacerbating existing gender disparities, for example, by locking women into subsistence production and men into a cash economy. This may result in women lacking the money they need to achieve their goals (Galiè et al., 2022). However, in some situations, gender-accommodative programs may be the best way forward because they leverage the existing situation and are readily accepted by the community.

Gender-transformative programs aim to shift gender norms to create new operational spaces for women (and men) livestock keepers and provide them with a larger range of potential livestock enterprise(s) to engage with. A gender-transformative program may encourage women livestock keepers to own a new species of livestock or develop new livestock products and services if they wish to do so. An example is a poultry project that introduces more productive breeds for both women and men and then supports the involvement of women alongside men in chicken marketing. Such a program would need to engage the community in questioning the local gender norm that only men market for livestock. This was the case in the 'Women in Business' project implemented by ILRI in Tanzania (<https://www.ilri.org/research/projects/women-business-chicken-seed-dissemination-ethiopia-and-tanzania>). The project supported women veterinary service providers to sell improved chickens to women farmers, alongside animal health and marketing services. Using social media, the project challenged gender norms that discouraged women from engaging in business as vets or as chicken farmers (Galiè et al., 2025; Farnworth et al., 2024). Another example is the 'Women Rear' project (<https://www.ilri.org/research/projects/transforming-vaccine-delivery-system-ghana-identifying-approaches-benefit-women>) in northern Ghana, which addressed gender norms that hampered women from rearing and selling livestock. Both women and men appreciate the benefits of women contributing to household expenses and building their asset base by rearing livestock and controlling the income generated (Njiru et al., 2024). Thus, gender-transformative programs need to make strategic decisions around when and how to engage livestock keepers and managers, and the best ways to create avenues for women and men to move into new roles and responsibilities. Indicators for success might include the number of people who believe it is acceptable for women in their community to own a new species of livestock; increases in the number of women selling chicken in, and beyond, the community; women signing up for business training courses.

Gender considerations into the four steps of livestock breeding

Core gender-accommodative and transformative questions that need to be addressed in each of the four steps outlined in three are proposed. We then highlight findings from the literature to understand gender considerations related to each step and conclude each step by discussing breeding programs that have attempted to address gender considerations. Highlighting the key gender questions, the available literature, and experience from the ground in each step of a genetic program is expected to help animal geneticists prioritize future research agendas.

Step 1. Targeting

Women and men livestock-keepers may have different preferences, aspirations, and benefits from livestock species and

breeds (Marshall et al., 2019; Kariuki et al., 2022). Decisions taken during targeting matter enormously for the gender-responsiveness and ambition of the program. In locations where women control smaller species and men control larger ones, a decision to focus breeding efforts on beef cattle, for instance, is likely to benefit mostly male livestock keepers, because the men will only control the benefits from the improved livestock. In addition, because both women and men are often involved in the management of livestock in the household, such programs are likely to disadvantage women because the increased workload associated with improved breeds is likely to fall on women who will not, however, see commensurate benefits. A situation where all benefits acquired from improved livestock are equitably shared in a household is, unfortunately, only ideal, as the large majority of household members report inequitable sharing of intra-household resources. If the focus on cattle is retained, a gender-transformative approach may need to be developed to create a space for women who want to become beef cattle livestock keepers.

Developing gender-responsive breeding programs also require checking the assumptions. For instance, it is widely assumed that profit maximization is a core objective function for livestock keepers (Ouma, 2007). Indeed, in developed countries, improved productivity accounts for the bulk of the economic value of genetic improvement (Gibson and Bishop, 2005, in Janssen-Tapken, 2009). However, in LMIC, productivity is only one consideration among many livestock keepers. Functional traits such as disease resistance, traction, transport, nutrient recycling, and adaptability to the environment are widely considered important (Janssen-Tapken, 2009). All these considerations are likely to vary according to sex. For example, Kariuki et al. (2022) found that in Kenya, while sheep and goat trait preferences were similar for men and women, the order of trait prioritization was gendered according to divisions of labor and decision-making opportunities and constraints.

Gender-responsive interventions require diversity and flexibility to cater to the diversity in gender norms and practices. Adding a gender dimension at this early stage of a breeding program involves considering how gender dynamics and norms will interact with the newly introduced breeding innovation (and other associated innovations, such as forages or drugs) and how they may play out in terms of who engages and who benefits from the innovation. It involves considering how the project can help promote changes in gender roles, responsibilities, and benefits, and meet women's and men's aspirations. The core diagnostic questions to consider at this stage are as follows:

Gender-accommodative questions (focusing on existing gender roles and responsibilities):

- Who conducts which specific activities (provides labor, pays costs, makes decisions on animals, and derives income across all livestock activities) in the livestock enterprise/business. Why is it this person?
- What are the gendered reasons why women and men maintain specific species and breeds of livestock, and engage in specific livestock activities? How do they benefit, and why?

Gender-transformative questions (considering potential future roles and responsibilities that offer women and men an opportunity to change their lives more broadly through the livestock intervention):

- Do women and men aspire to change their current roles and activities in livestock enterprises/businesses in ways that can be supported by genetic intervention? How?

The literature review below focuses on why women and men prefer specific species and breeds, who help manage livestock at the household level, and their trait and characteristic preferences. We also explored the evidence of aspiration.

Evidence from the literature on gender considerations in targeting

Who conducts specific activities in the livestock enterprise, and why?

In livestock keeping societies in LMIC, women, men, and youth generally undertake different roles depending on the species. Women are more likely to manage smaller and less valuable species such as goats, sheep, and poultry, whereas men are more likely to manage larger species, although this association is not universal (Kristjanson et al., 2010; Saghir et al., 2012; Njuki and Sanginga, 2013; Galiè et al., 2015; Kariuki et al., 2022). Occasionally, men own smaller livestock, but if so, usually in larger numbers than women (Njuki et al., 2011). Across the species divide, women are often involved in looking after young and sick animals within their homesteads. Women typically ensure that animal enclosures or sheds are clean and provide food and water for animals reared within the vicinity of the homestead (Njuki and Sanginga, 2013; Jumba et al., 2020). A study in Burkina Faso reported that men generally dominate livestock-related interactions beyond the farm (purchase, sale, and veterinary services), whereas women are responsible for livestock care (Zoma-Traoré et al., 2021). However, this is not universally true. In the Maasai pastoral systems in Kenya, sheep are a key livestock asset over which women have strong control. They provide important input in the selection and mating of sheep to ensure that sufficient ewes are in milk at any one time, which is necessary to ensure that a regular supply of milk is available for household use. Only women milk ewes, as traditionally men do not milk sheep (Audho et al., 2015). Women manage poultry widely in village poultry production systems across Africa. Their roles include providing housing, feeding, and health care, making decisions on reproduction within flocks, and marketing different poultry products, although the precise blend of roles varies by location (Alemayehu et al., 2018).

Why women and men keep specific species and breeds and associated trait preferences

Livestock keepers raise livestock for food security, as a savings and insurance mechanism, to provide a regular or irregular source of income, and for use in civil and religious ceremonies, such as draught animals, for manure, among other reasons (Aronson et al., 2019). Achieving a pre-defined objective may rely on raising a specific species, for instance, sheep, in relation to Ramadan events and celebrations.

In some cases, livestock assets belong to the household head, with other household members having access rights to livestock or to particular products (Zoma-Traoré et al., 2021). Women and men may use different parts of an animal, have rights over specific parts, or keep livestock for various purposes. For example, for Somaliland pastoralists, women considered the use of camels to draw water as more important, whereas men considered keeping camels for meat consumption as more important. This reflects the gender division of roles and labor for camels in the study location, with women mainly responsible for fetching water and men who slaughter and eat camels (Marshall et al., 2014; Marshall, 2016). In Nigeria, women place higher emphasis on mutton than men for cultural and religious reasons (Yakubu et al., 2020). Wodajo et al. (2020) show that Ethiopian women own sheep and goats to provide animal source foods for the household and for sale.

Turning to milk, women and men may share or have different interests relating to beliefs about the efficacy of milk for medication, nutrition, and marketing. For instance, in Somaliland, both genders believe that camel and goat milk have medicinal properties when these animals graze on specific shrubs, although women place more value on this property (Marshall, 2016). In Rajasthan, women and men believed that goat milk can combat diabetes and dengue fever. Providing goat milk in cases of illness is a woman's responsibility (Galiè et al., 2022). In Rwanda, many parents know that milk is nutritious for their young children. However, some parents only provide cow milk when their children are ill, as they consider milk to provide energy to fight disease (Farnworth et al., 2023a). With the expansion of smallholder dairy production systems, an increasing number of women are raising dairy cows. Teat and udder size and condition, milk yield, fertility, temperament, and body condition are key considerations for women when buying dairy cows (Janssen-Tapken, 2009).

Cattle and buffaloes are used for traction in many farm systems. Frequently, plowing is a man's task in the local gender division of labor, although women plow in some locations. Consequently, male household heads in Kenya and Ethiopia are more likely than female household heads to prioritize bulls with good traction potential (Ouma, 2007; Janssen-Tapken, 2009).

An animal's appearance is important. For instance, in Ethiopia, women are more likely to value their appearance than men. They take pride in beautiful birds and emphasize the cultural and spiritual qualities of their poultry. Both women and men prefer red chickens and double combs, because black chickens and single combs are considered undesirable for sale and consumption. However, men are more likely to value how the appearance of a chicken relates to saleability (Ramasawmy et al., 2018). In South Africa, women prize specific coat colors of Nguni cattle more than men. Women use cattle hides to make carpets, seat covers, harness ropes, and hats for spirit mediums (Tada et al., 2013). In Eastern Africa, Ankole cattle are valued for their coat color and horn shape by both men and women (Wurzinger et al., 2006, 2008; Dessie and Mwai, 2019). Somali men tend to favor sheep with a black head or a black head with a black tongue and goats with a white coat color,

believing that these colors indicate animals better adapted to the local environment. In contrast, women ascribe little importance to coat color (Marshall et al., 2016). In Saudi Arabia, women, who tend sheep as do men, use their wool for various crafts, whereas men sell mutton (Aldosari, 2018).

Behavioral traits are important considerations because they relate to the manageability of livestock. For example, women in Ethiopia, who care primarily for chickens, are more often concerned about the potential for aggression among exotic poultry as exotic birds need to be confined to avoid theft. They also value hens with good mothering skills (Ramasawmy et al., 2018). Overall, in different communities, the preferences of women and men for different traits in their livestock may differ entirely or overlap (McDougall et al., 2022). Do women aspire to change their current roles and activities in livestock enterprises/businesses in ways that can be supported by genetic intervention?

Through gender analysis and a gender transformative lens, the Women Rear project (Njiru et al., 2024) identified a strong interest among respondent women farmers to engage in livestock rearing and controlling the income generated through the livestock; and of women vet graduates to practice their profession. This is in a context where women are strongly discouraged from engaging with livestock altogether (Omondi et al., 2022; Njiru et al., 2024).

Two case studies conducted in Rajasthan, India, showed that women have a strong interest in improving their livestock. Women in low-income households are primarily, though not exclusively, responsible for selecting goats, including improved breeds, while women in middle-income households select improved goats, cattle, and buffalo. Surprisingly, however, case studies show that women do not obtain support from rural advisory services in relation to any aspect of livestock management, including breeding, though they are recognized as livestock keepers at the community level (Galiè et al., 2022).

Maasai women interviewed in a study in Tanzania envisaged empowerment as a future in which they owned and made decisions on cattle and were able to use the revenues generated to send their children to school (Price et al., 2018). In Ethiopia, women livestock keepers desire more input in decisions about livestock management (Kinati et al., 2021). In Syria women farmers were interviewed about their wishes associated with barley cultivation for sheep fodder. They aspired to sell their barley seeds and to access agricultural information and training. These aspirations were articulated in a context in which women were not recognized as farmers and were not given such opportunities (Galiè et al., 2017). In Ethiopia, widowed women livestock keepers were asked if they wished to have more cattle and, if so, which breed. They stated that they did not wish for more or more improved cattle. Rather, they wanted to negotiate gender norms to be able to use oxen for activities locally considered appropriate for men only, such as plowing and taking produce to markets. These activities require oxen to draw plows and carts. Without the ability to use oxen, widowed women found it difficult to keep their farms running (Galiè et al., 2015).

Experiences of scientists undertaking gender analysis in targeting

Animal breeders working on the genetic improvement of dairy cattle in sub-Saharan Africa were interviewed. The results show that the authors who were interested in integrating a gender lens into their work faced challenges at four stages of research, which prevented them from conducting effective gender-sensitive studies. These stages included respondent selection criteria, data collection, data analysis, and discussion of findings. Most scientists interviewed breeders and social scientists but did not manage to interview women in the field because of the respondent selection criteria adopted by the studies. In some cases, teams adopted standard approaches to identify respondents such as ‘head of the household’ or ‘livestock owner.’ Attempts to change selection criteria to be more gender-responsive were rarely accepted by team members who did not see the value of gender analysis and reverted to ‘the usual’ selection criteria based on their belief that breeding is “gender neutral.” In attempting to explain how the data generated is typically biased towards men and excludes women’s gender interests, one woman scientist explained that nearly all scientists she worked with on the ground were men. This leads, she argued, almost inevitably to program biases towards engaging with other men stakeholders in implementing and evaluating breeding programs. Local gender norms frequently discourage male scientists from interacting with women farmers. These gender assumptions and norms in research, have resulted in a missed opportunity to obtain data on potential gender-based differences in task distribution, knowledge, and benefits within households.

In two cases, scientists managed to collect sex-disaggregated data. However, they did not conduct gender analysis of the data. One study reported gender-disaggregated data; however, the authors did not discuss the implications of their findings for gender-responsive breeding (Wurzinger et al., 2006). Other scientists cited a broader lack of interest in addressing gender considerations in livestock breeding to explain why gender analyses were not conducted. Some of the scientists interviewed claimed that they lacked a gender expert in their teams, which contributed to the lack of consideration of gender components in their breeding programs and projects. They added that they personally lacked the expertise of mainstream gender in their project, including the identification of needs and data analysis from a gender lens.

Step 2. Operationalization of the genetic improvement strategy

The goal of genetic improvement strategies is to produce the next generation of animals in line with the overall breeding goals. The options for improvement are listed in Table 1. There are many choices around the modalities of operationalization of the genetic improvement program. These include: (1) scale and scaling up

strategies: whether the program is implemented at community, national, regional, or other levels; (2) scope; how to embed the program within a larger value chain or livestock sector initiative to ensure optimal capitalization of the improved genetics; (3) key actors: who is involved and their specific roles, capabilities, as well as the required investment levels for involvement; (4) decision-making processes, breeding objective(s), selection criteria, and data collection, analysis, and feedback processes; (5) use of technologies including phenotyping, genomic, reproductive, and digital technologies; (6) how capacity is built and incentives for engagement; and (7) how to support more favorable institutional and policy environments. These choices should be guided by inputs from all stakeholders at various points. Questions should be designed to ensure that women and men can participate and benefit in ways commensurate with their investments.

For livestock keepers and agripreneurs (who sell services such as AI, vaccinations, and improved feeds, or engage in marketing on a large scale), gender considerations include: (1) who within the household (women, men, girls, and boys) will be involved, for instance, by providing financial or labor inputs or making decisions; and (2) who within the household will benefit and how, including by accessing income-generating opportunities provided through the livestock enterprise. Gender dynamics and norms shape these considerations and influence the incentives that women and men need to continue their involvement. Gender dynamics and norms also affect the type of information they need and the communication means they prefer.

Gender-accommodative questions (focusing on existing gender roles and responsibilities):

- Who in the household makes decisions related to breeding? This includes who determines which animals will be parents of the next generation and which sires should make a greater contribution.
- Who (which men, which women, which group of people) has the assets—land, money, time, information, and necessary skills—to allow them to participate in the genetic improvement strategy?
- What are the investment levels by gender (labor, payments of costs, etc.) vis-à-vis gendered benefits?
- What technical expertise is required to implement the genetic improvement strategy and who has this expertise? What capacities (knowledge, information, ICTs, productive assets, time, skills, decision-making, and support) are needed for women and men to participate effectively in breeding strategies? How can women and men (across other social identities) be supported in acquiring these capabilities?

Gender-transformative questions:

- Under what conditions will women and men benefit from the outputs produced through the selected genetic improvement strategy?
- How can the genetic improvement strategy create new opportunities for women and men to engage in and benefit from livestock enterprise/business?
- How can the breeding strategy support both household women and men to have control over different species and breeds, and the benefits derived through them in ways commensurate with their investment (in time, labor, finance, etc.)?

Evidence from the literature on gender considerations in operationalizing a genetic improvement strategy

Decisions related to breeding

The literature reported below indicates that men frequently make key decisions associated with breeding at the household level. A small-sample study conducted in Nepal on buffalo farming showed that decisions regarding buffalo breeding were mainly made by men (Devkota et al., 2015). In Somaliland, men dominate reproductive management decisions for camels (Marshall et al., 2016). Similarly, a small sample study conducted in Pakistan showed that women experience low participation in decisions about reproductive management (of any type of livestock), with men being key decision-makers (Arshad et al., 2010). A study conducted among livestock keepers in Assam showed that decisions about cattle breeding activities, such as the use of Artificial Insemination (AI) and bull selection, were mainly made by men. The authors suggest that this may be related to women's low mobility, as they have strong decision-making power in other domains related to cattle (Sarma and Payeng, 2012).

A study conducted in Nicaragua showed that although women, due to their strong role in caring for livestock, know when a cow is on heat, breeding decisions, including the selection of bulls and how many seasons to use a bull, were primarily made by men (Benard et al., 2016). Insemination often fails because men react too slowly to the window of opportunity and fail to inform inseminators on time (Benard et al., 2016). Due to women's silence around their knowledge, the authors recommend intentionally reaching out to and including women in breeding programs (Benard et al., 2016). In Vietnam, men make key decisions regarding pigs, particularly with respect to breed selection. This is attributed to the centrality of the decision for households because it affects livestock quality and productivity (Ninh et al., 2019). Selection is considered to require "decisiveness," an attribute culturally attributed to men. Even so, women participate in discussions on breed selection, with more engagement likely in younger couples (Ninh et al., 2019).

A study conducted in Telangana and Bihar states of India found that men dominate decisions around breeding because of gender and cultural norms that restrict women's mobility beyond their home and which frown upon women meeting and communicating with unknown and non-family men, coupled with the perception that breeding is a man's business (Ravichandran et al., 2021). This results in women's lack of awareness and motivation for matters associated with the breeding of dairy cattle (Ravichandran et al., 2021). However, a case study conducted in Rajasthan found that women selected improved goat breeds and requested that their husbands buy them on their behalf (Galiè et al., 2022).

Who has the assets?

In a small ruminant project in Ethiopia, improvements in women's social capital through cooperative membership and human capital through livestock training programs enabled them to argue successfully for improved breeds and greater support from

rural advisory services. Male out-migration in some locations in Nepal strengthens women's ability to manage livestock. For instance, young women in Ramnagar reported buffalo raising as a critical innovation. These are zero-grazed, and women can decide upon veterinary care and AI. Young women expressed strong agency and attributed this to their mothers, who participated in agricultural training courses and encouraged their daughters to do so (Galiè et al., 2022).

Who invests?

More productive breeds frequently require higher financial investments than do local breeds. This may have excluded poor farmers from participating in the study. However, there are global variations. A Vietnamese study indicated that men directly provide 5% of financial investments in smallholder pig businesses, while 95% of all investments in pig businesses were jointly agreed between women and men (Ninh et al., 2019). In Kenya, the increased adoption of improved dairy cattle has resulted in an increase in women's workload (time and labor investment) while simultaneously causing them to lose control over the increased income from milk sales to men (Jumba et al., 2020). Labor investment by women in livestock management has been shown to increase in almost all livestock interventions included in a scoping study of livestock and women's empowerment, particularly in the case of improved breeds that need more input (Baltenweck et al., 2024). In Kenya, women consider their investment in livestock labor to be the largest in the household (Dumas et al., 2018).

Technical expertise and capacities necessary for participation

The existing knowledge can be strengthened through gender-responsive interventions. In Kenya, CCAFS, World Neighbors, Vi Agroforestry, and Kenya's Ministry of Agriculture, Livestock and Fisheries implemented climate change adaptation, mitigation and risk management interventions for smallholders grouped into "Climate Smart Villages" in the Nyando Basin. Improved sheep and goat breeds were introduced, with women and men being trained in community groups, including women-headed households. Women took a lead in implementing planned rotational mating of the improved animals, monitoring their performance by recording details on their performance over time, and influencing the pricing and marketing of the improved animals. Improved productivity and market access for sheep and goats were evident, along with better management of the ecosystem. The demand for improved animals with performance records and the average selling price for sheep more than doubled (Ojango et al., 2018).

In Rajasthan, a study of women cattle owners already trained by extension workers in genetic management found that nearly half still felt they lacked sufficient knowledge, crossbred cows and bulls were too expensive, and one-third felt that AI was unnatural. Even so, over 90% of the women adopted some of the recommended practices. The authors found some correlation between caste and

other socioeconomic variables, with higher-caste women more likely to adopt recommended practices (Chaudhary et al., 2016).

Step 3. Marketing and dissemination of improved genetics

Marketing and dissemination (scaling out) strategies are needed to enable farmers beyond those involved in nuclear or initial breeding programs to access and adopt improved or new breeds. Access to improved genetics makes sense only if it results in benefits. This can be challenging at the smallholder level because improved genetics can result in improved productivity improvements in other aspects of animal husbandry, such as healthcare and nutrition, which often require additional investment.

Gender considerations at this stage include how women and men livestock keepers access improved genetics (via artificial insemination, sire services, live animal purchases), as well as complementary technologies (on herd-health, feeding), investment costs, and possible sources of credit to facilitate adoption. This entails considerations of, for example, where the material is available and who can reach such providers, who receives information about the material, who can liaise with the providers, who can decide to allocate the household budget to purchasing such material, who can utilize and benefit from the new material, and how. Gender norms need to be considered because they can affect engagement with AI and women's ability to access improved breeds.

These questions were designed to provide evidence to help ensure that women (and men) in the wider population can adopt and use improved genetics.

Gender-accommodative questions:

- Is the planned strategy to disseminate genetic material sufficient to ensure that it will be available, accessible, and affordable for both women and men livestock keepers (including across other intersectional characteristics that are most salient in each context. For example, in countries where caste is significant, men from the general castes may be better able to access genetic material than people in Scheduled Castes). What can be done to ensure inclusion?
- How can the program ensure that other complementary components of livestock rearing, such as feeding or animal health, and marketing, are equally accessible to women and men?
- Does the program have a strategy for gender-responsive scaling out of the interventions?

Gender-transformative questions:

- In what ways are women's and men's abilities to access and adopt improved breeds/engage in business affected by social gender norms?
- Which pathways (involving normative change) can be developed to ensure that diverse women and men can obtain and raise the improved breeds/engage in business?

- How can the program contribute towards securing control by household women and men over the new breeds and the benefits derived through them in ways commensurate with their investment (in time, labor, finance, etc.)?

Evidence from the literature on gender considerations in marketing and dissemination

Disseminating genetic material

Gender evidence on whether women access and use improved genetics is sparse; however, anecdotal evidence is striking. An ILRI researcher reported that the national breeding policies in India do not acknowledge women as livestock keepers; therefore, no activities have been undertaken to develop gender-responsive breeding programs (Ravichandran, pers. comm). Furthermore, breeding focuses on developing crossbred cows rather than buffalo to boost the volume of milk in the Indian market, in line with the government's dairy program Operation Flood. However, many women prefer buffalo because they are easy to handle and less prone to disease, and the fat content of their milk is considerably higher (average 6%) than that of dairy cows (average 3.5%). The high quality of buffalo milk means that it commands 30% more per liter than cow milk when sold. The ILRI researcher experienced several innovation platform meetings in Uttarakhand, where women livestock keepers successfully argued with government staff that they required subsidies or loans to purchase improved buffalo breeds to obtain higher-quality milk, whereas government staff had been trying to promote crossbred dairy cows (Ravichandran, pers. comm).

Evidence from Tanzania and Ghana indicates that it is easier to reach women farmers through women (rather than men) livestock service providers, given that in many places gender norms discourage the interaction between unrelated women and men (Omondi et al., 2022; Farnworth et al., 2024). Supporting women in becoming service providers is also a way to enhance their empowerment through livestock. However, gender norms can discourage women from engaging in livestock businesses, as in the case of Tanzania (Achandi et al., 2023; Farnworth et al., 2024) and livestock and business, as in the case of northern Ghana (Njiru et al., 2024; Omondi et al., 2022). Similar findings were reported in a study conducted in Warangal, Telangana, India, where women's participation in AI service provision was mainly hindered by insecurity linked to their mobility, especially during late hours. In addition, cultural gender norms have hindered women from discussing cattle breeding-related issues with men (Farnworth et al., 2023b). Transformative approaches can, in these cases, be necessary to address some of these gender-discriminating norms and support the involvement of women in livestock business as a means to support the empowerment of both women service providers and farmers (Njiru et al., 2024).

Making sure the feeding, animal health and marketing strategies are equally available to women

Gender norms discourage women from engaging in public spaces, including markets, to buy inputs and sell outputs (Tufan et al., 2018). Women in many LMICs tend to purchase and sell in informal markets, whereas men rely more on formal systems (e.g., agro-vet shops and government service providers) (Kramer and Galiè, 2020). However, the informal seed sector (whether for livestock and related products such as forage seeds) is often seen as problematic in terms of safety regulations and licenses and is neglected by many governments that prefer to invest in the formal sector (Alonso et al., 2023).

Gender-responsive scaling

Targeting women during implementation can be successful, but sustainable gains can be limited by failures of program management to envisage and cater to the scaling requirements of a successful intervention. When FARM Africa introduced dairy goats for smallholder farmers through community groups in Kenya, designated households were selected to be “buck breeders” while other households reared does. Since goats were considered a resource mainly managed by women in the community targeted, women made decisions on when to take their does for mating, and they were taught to select the best sires. With selective breeding and improved management, communities have successfully transformed goat productivity (Ahuya et al., 2009; Peacock et al., 2011). However, the small scale of the project meant that the demand and price offered for the improved goats soon outstripped supply (Ojango et al., 2010; Peacock et al., 2011).

The experience of the ‘Women Rear’ project scaling in north Ghana to provide women farmers with access to animal vaccines for goats and chickens, shows the importance of combining both a gender transformative approach and a technical vaccine approach, and of involving policy makers at higher levels (e.g., regional rather than community only) to be successful. The transformative approach was necessary to create the conditions necessary for a) women farmers to be able to publicly control their animals and consequently purchase vaccines, and b) women vets to work as animal health service providers (mostly men practice the vet profession, although both women and men graduate from vet school) and support women farmers. Strengthening the vaccine cold chain and delivery mechanism is necessary to reach more farmers. Policy makers need to be sensitized about the importance of gender considerations in vaccine delivery for the efficacy of their *Peste des Petits Ruminants* (PPR) eradication campaign. This threefold approach was successful in facilitating the access of women farmers to chicken and goat vaccines (Njiru et al., 2024).

Step 4. Ensuring equitable benefits

Intrahousehold benefits from improved genetics should be gender-equitable. It is often assumed that women benefit simply

because they participate in breeding programs or use improved genetics. However, this was not necessarily the case. Another key concern is the potential shift in the control of benefits from women to men, which can occur when household enterprises that benefit women become more commercially oriented (Tavennner et al., 2019). Quisumbing et al. (2023) developed a monitoring framework that was then used by Galiè et al. (2025) to assess the potential impact of animal and crop seed systems using a gender lens (Figure 4).

Tracking whether benefits from improved genetics are equitably shared within households and communities relies on the integration of gender considerations across all the steps discussed in this article. Once a genetic improvement strategy is implemented, continued monitoring, evaluation, learning, and adaptation (MELIA) should be implemented to strengthen the program, including ensuring that women and men can participate at their aspirational level and that women and men equitably benefit. Tools such as the Women’s Empowerment in Livestock Index (WELI) (Galiè et al., 2019) and the Gender Norms in Livestock tool (<https://www.ilri.org/news/addressing-gendered-constraints-womens-empowerment-and-restrictive-gender-norms-case-engaging>) can help assess project impact.

Questions in this step were designed to ensure that women (and men), including and beyond the livestock keepers/agripreneurs originally targeted, benefit from improved genetics.

Gender-accommodative questions:

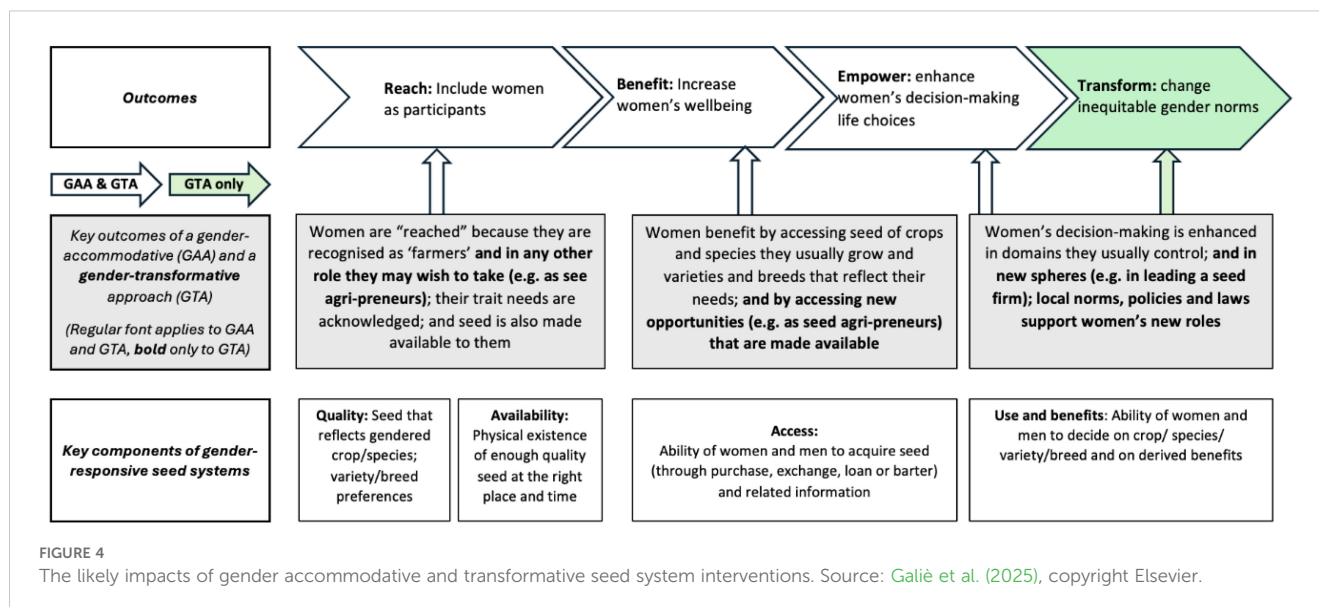
- What needs to happen to ensure that the adoption, utilization, and ability to benefit from improved genetics are equitable between women and men—both within households and across household typologies (e.g., by ethnicity and caste)?

Gender-transformative questions:

- What needs to be done to ensure that gains to women from the adoption of improved genetics (and the related upgrade of the livestock enterprise with consequent male capture) are retained over the long term?

Equitable distribution of benefits

A key concern is preventing a shift in the control of benefits, whether financial, in terms of improved nutrition or other valued benefits, from women to men. Improved productivity and higher incomes can mean that women lose control over their livestock assets and associated incomes because of their weaker voice in intra-household decision-making over income (Kristjanson et al., 2014; Walugembe et al., 2016). Women who retain control may be primarily restricted to informal market relationships and find it difficult to break them into larger, more profitable markets. For example, in Senegal, the maintenance of crossbred (indigenous Zebu × exotic Bos taurus) animals under improved management practices was found to be notably more beneficial than the traditional system of maintaining indigenous Zebu animals under traditional (low-input) management (Marshall et al., 2020). However, for households with a higher level of market orientation



for dairy (based on the volume of milk produced and sold), which tended to keep the crossbred cattle, only 47% of households had women controlling their income from milk sales, compared to 72% of women in lower market-oriented households (which tended to keep indigenous cattle) (Walugembe et al., 2016). When women have weak control over livestock and their products, this can have negative consequences for household welfare, particularly for young children, when animal-sourced foods are sold rather than consumed within the household. Two different studies conducted in Tanzania show that when men exert exclusive control over agricultural production and sales at the household level, animal-sourced foods are usually sold at the market, leaving very little for children (Mwaseba and Kaarhus, 2015; Ochieng et al., 2017).

There is also a risk that genetic interventions, by posing higher labor and other demands, may increase the workloads of women and girls (Kristjanson et al., 2014) without commensurate enhanced access to, and control of, benefits from increased production. A study conducted in Tanzania found that the introduction of new exotic breeds of goats shifted labor from men to women because exotic goats were kept in the courtyard, a space assigned to women. Although women enjoyed increased access to goat milk, overall decision-making on benefits (such as income) from the new breed stayed with men (Galiè and Kantor, 2016). In Uganda, crossbred dairy cows are introduced to a periodically water-scarce environment. Crossbred cows are raised near the home, which initially appears to favor women since they are primarily responsible for their care, but women have to leave the homestead to bring fodder and water to the cows; men and children also participate, but with less involvement. Additional work ascribable to crossbred cows has significant knock-on effects on women's limited time. However, in Vietnam, women's direct participation in pig management decreases as the size of the enterprise increases. In businesses with at least 50 pigs, 75% of

men spent over 50% of their time involved with pigs, whereas only 20% of women spent more than half of their time involved with pigs. Men prioritize working on pigs because the pig-farming business is the main source of income in these households. In smaller-scale businesses, these figures reverse; 30% of men and 60% of women spend more than 50% of their time involved with pigs (Ninh et al., 2019).

Conclusion

This study aims to identify key gender considerations that livestock breeders need to consider in the different stages of a breeding program, to provide existing evidence available on each stage, and to provide a roadmap for moving forward. We drew upon the experience of breeders, including two co-authors, in this study, and through interviews conducted with dairy cattle breeders in SSA. This was complemented by a wide range of literature reviews.

This study shows that gender-responsive livestock breeding is relatively new, and little direct experience has been gained to date. The literature is sparse on many aspects of interest in breeding programs, particularly in the realm of cost-benefit analysis. The benefits of engaging in livestock breeding programs are not yet well understood. Trait preferences and the rationale behind them are better understood. However, breeding programs do not necessarily respond to this.

Progress towards gender-transformative approaches in livestock genetics is a key steppingstone for supporting sustainable progress towards the empowerment of rural women. Ensuring that the benefit from improved genetics is equitably shared between household members and within communities relies on the integration of gender considerations across the breeding process. Both the accommodative and transformative strategies set out in this study require a wider range of stakeholders in the breeding and value chains.

Livestock breeding programs need to engage gender specialists to ensure that gender considerations are integrated and addressed from the very beginning. It is important to leverage and analyze existing gender- and sex-disaggregated data and commission new gender studies. An adequate budget must be developed to provide staff time and operational costs.

Author contributions

GA: Conceptualization, Funding acquisition, Methodology, Visualization, Writing – original draft, Writing – review & editing. OJ: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. FC: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. JH: Writing – original draft, Writing – review & editing. RL: Writing – original draft. MK: Conceptualization, Funding acquisition, Methodology, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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