Gender dynamics in dairy production in Kenya: A literature review

Working Paper No. 182

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Abstract

This literature review serves as a background document to better understand gender roles and dynamics in the dairy sector in Kenya and thus aims to inform research activities on the gender dimensions of mitigation options, such as sustainable dairy intensification. Technology change has strong gender and labor implications, as it typically involves renegotiation, reassignment, or deepening of roles and responsibilities within households. It can also alter traditional patterns of access to resources such as milk, land, and income. Clarifying gender issues is critical to inform programs and policies for effective design and delivery of mitigation technologies among smallholder households, and to ensure that the benefits of mitigation technologies reach women and men fairly, and thus contribute to both poverty reduction and sustainability.

Keywords

Dairy; gender; Kenya; sustainable intensification; greenhouse gas emissions

About the author

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Contents

Acronyms

FAO	Food and Agriculture Organization
IFAD	International Fund for Agriculture Development
ILRI	International Livestock Research Institute

1. Introduction

This literature review aims to increase understanding of the gender roles and dynamics in the dairy sector in Kenya, and should complement field research on the gender dimensions of existing climate change mitigation options in the sector. Clarifying gender issues is critical to inform programs and policies for effective design and delivery of mitigation technologies among smallholder households, and to ensure that the benefits of mitigation technologies reach women and men fairly, and thus contribute to both poverty reduction and sustainability.

In Kenya, as in many developing countries, the government has elaborated livestock sector development strategies that aim to conserve natural resources, raise productivity, expand production, and optimize the allocation of resources (van Dijk, Tennigkeit, and Wilkes 2015). Climate change mitigation practices in the livestock sector can lead to multiple benefits, such as conservation of natural resources, management of livestock waste, improved resource efficiency, and income generation for smallholder farmers, thereby contributing to both sustainability and productivity goals.

Progress in implementation of climate change mitigation actions has been slow in Kenya. Several constraints continue to hinder the dissemination and adoption of proposed technologies, including weak extension systems and poor access to productive resources among smallholder farmers, especially women, who make up the majority of Kenya's dairy producers. There is also limited information on emerging experiences, barriers to adoption for some practices, limited means to address barriers, and an under-investigated gender dimension for some recommended practices.

Gender relationships and dynamics can influence the way mitigation technologies are designed and delivered (Edmunds, Sasser, and Wollenberg 2013). **Specific roles and interests vary for women and men and across different production systems and geographical areas, leading to different responses to mitigation technologies. Thus, given existing structural gender inequalities, the outcomes of mitigation initiatives might not benefit women and men equally.** In addition, valuing—and utilizing—women's knowledge can also lead to the development of new technologies, management practices, organizational forms, and political strategies that are effective in encouraging sustainable, low emission agricultural development (ibid.).

Hence, to improve our understanding of how gender dynamics shape the development of the sector, this literature review focuses on the following issues: the gender division of labor; ownership and decision-making patterns; how technology changes toward dairy intensification impact women and men producers differently; key challenges faced by women along the dairy value chain; good practices and promising approaches to promoting women's access to services, technologies, and assets; and the potential gender implications of mitigation technologies.

The review is based on the analysis of several peer-reviewed articles and gray literature on gender and dairy production in Kenya. The most recent articles, especially those focusing on the analysis of dairy intensification, have been privileged and were not yet available to the public at the time of the literature review.

2. The gender division of labor in dairy farming

In smallholder households across Kenya, as in many other African countries, dairy production is a family operation in which all family members—men, women, and children—contribute to production, processing, and marketing activities. Dairy production can be especially important for women, for whom it may provide a regular income stream, and thus contributes to household food security. Women are generally involved in several activities along the dairy value chain (e.g., collection, processing, and marketing of milk and other dairy products).

Studies assessing the gender division of labor in dairy farming indicate that women farmers play a predominant role in milking, watering, cleaning out the pens, and feeding the animals (Flintan 2008, 2011; World Bank, FAO, and IFAD 2009; Kristjansen et al. 2010). Traditionally, women also do the marketing of milk and other dairy products. Men tend to have a larger role in activities related to animal health, such as artificial insemination and seeking veterinary treatment, and in marketing of live animals and meat.

A study of dairy farming in seven districts of Western Kenya (Waithaka et al. 2002) reports that, in 35% of all households surveyed, a female adult—not the male household head—played a key role in taking care of and feeding the cattle, including grazing and/or cutting and carrying feed, depending on whether the production system was based on grazing or stall-feeding. In 48% of dairy farms, women took primary responsibility for fetching water or

watering the animals. Women were responsible for milking in 56% of the farms, and for milk marketing in 60% of households. Other activities (e.g., spraying, dipping, and contacting veterinary services) were carried out primarily by the head of household, whether a male or a female. Children and hired labor, both long term and casual, were found to play only a secondary role in dairy farming.

In Kenya's arid and semi-arid lands, women pastoralists typically manage sheep and goats. Because these animals tend to remain closer to the homestead, their care is perceived to be an extension of women's domestic activities. Gender roles and dynamics in dairy production in the dry lands present specific features based on the socio-cultural setting and type of production system, which is still largely based on extensive grazing. Management of bigger animals, such as cattle and camels, is usually a male domain (Flintan 2011). However, recent changes in land use and pastoral livelihood systems are having a profound impact on the roles and labor responsibilities of men and women. Traditionally, men have a prominent role in livestock management, while women engage mostly in household-based activities and childcare. Recently, there has been a shift toward more arable crop-based production, so women are taking up extra agricultural activities, while men remain responsible for the herds of larger animals (Flintan 2008, 2011). At the same time, increased male out-migration in search of wage labor and other livelihood diversification opportunities is resulting in women who remain at the homestead responsible for the home herd of cattle and camels (Bruce 1996; Flintan 2011). Among the Keyo, for example, it was found that when men are absent from home, women, young males, and persons aged 65 years and older spend considerable time in livestock production. In such situations, women also tend to acquire a greater role in decision-making, especially concerning milk marketing (Bruce 1996).

Flintan (2011) shows that the roles of pastoral women in livestock management, including of large livestock like cattle, should not be underestimated. Their knowledge of livestock and of grazing areas, migration routes, and water points is often extremely rich. As keepers of indigenous technical knowledge, both women and men contribute to the enhancement of gene flow and domestic animal diversity as well as prevention and treatment of livestock illness (World Bank, FAO, and IFAD 2009). Indigenous technical knowledge often varies by age and gender: men, women, and children tend to have specific knowledge and skills relating to livestock, depending on their roles, authorities, and responsibilities in animal husbandry.

Odongo (2015) reports that gendered division of roles and responsibilities in cattle management has resulted in women and men having different but complementary knowledge on Contagious Bovine Pleuro Pneumonia. Odongo found that women appear to know more about the clinical signs of the early onset of the disease manifested by individual animals, whereas men appear to be more knowledgeable about signs associated with its later stages.

As a consequence of gendered roles, responsibilities, and interests regarding cattle, women's and men's priorities concerning investments in new technologies, as well as their understanding of how food and livelihood security can be attained, are often different. Heffernan and Misturelli (2000) show that women often consider livestock as primarily contributing to food security, whereas men often consider livestock a source of long-term investments.

Women often have a preference for dairy goats and local chickens over dairy cows for several reasons (Njuki and Sanginga 2013). Goats and chickens do not require land ownership. They are also easier to manage, as goats can be zero-grazed under the cut and carry fodder system, and chickens can survive with minimum supplementation. Both species are also favored because of their market values. Goat milk and chickens can be marketed easily by women in the village because market channels for these products are mostly informal and easy to access by women. Men's preference for dairy cattle is related to the high monetary value of both cattle and cow milk. Conversely, women complained that cattle are too costly, less resistant to disease, and very labor demanding.

According to the "traditional" cattle culture in Kenya, as well as in the broader East African cultural belt, milk is seen as a female product because it is a key subsistence product. Cattle (meat and marketing of live animals), on the other hand, tend to be associated with men. Milk marketing in the northern part of Kenya is exclusively the responsibility of women. A study of women's marketing of milk and small ruminants in Mandera Triangle (WABEKBON Development Consultants 2009) shows that pastoralist women generally travel to towns to sell the milk. The trips typically involve waking up before dawn, carrying some share of the milk collected the prior evening from the household herd in a small plastic or traditional woven container, and walking to a town where they sell the milk themselves. They then use the income generated by these milk sales to make purchases before returning on foot to the household before nightfall.

Despite the important role women play in milk production and marketing, and despite the increasing opportunities for commercialization of dairy products in the country, some cultural aspects in the livestock sector remain unchallenged, including that cattle are predominantly seen as a "male domain."

3. Ownership and decision-making

Livestock are an important asset for women, as women can own livestock more easily than other productive assets, most notably land. Livestock are not bound by complex property rights, which disfavor women's ownership (Kristjanson et al. 2010; Flintan 2011; Njuki and Sanginga 2013). In pastoral societies, women frequently own fewer animals than men; however, livestock are generally more equitably distributed between men and women than are other assets like land (Flintan 2011). In Kenya, as well as in Uganda and Nigeria, most urban cattle farmers are women (Grace 2007). In Kenya and Rwanda, the percentage of women ownership of local cattle is higher than for ownership of exotic cattle. Men are more likely to own exotic cattle, which are usually more productive than the local breeds but also require more inputs (ILRI 2009).

Typically, women are more likely to own small animals such as poultry, sheep, and goats than larger ones such as cattle, buffaloes, and camels. The study on livestock ownership and marketing in Kenya by Njuki and Sanginga (2013) shows that men own 10 times more cattle and four times more goats than do women. The only livestock that were mostly owned by women were chickens, usually the local variety. This reinforces the finding that traditional "cattle culture" depicts men as the main owners and managers of cattle. Although decisions in both female- and male-headed households are "jointly" made, men have the dominant influence on decisions, particularly on the sale of livestock and use of income. This is particularly evident in male-headed households, where there is a higher frequency of livestock sales than found in female-headed households (ILRI 2009).

Ownership of livestock does not necessarily mean that women have ultimate control over the animals (and thus a say about selling or slaughtering them). Many women acquire animals through different channels, such as the market, inheritance, or gifts; but they may not have decision-making power over such livestock. It is not uncommon in Kenya for husbands to sell

women-owned dairy cattle, sheep, goats, and pigs without having to consult their wives (Njuki and Sanginga 2013). Among the Luo, for example, a woman can buy a cow, but if the couple separates the animal remains with the man (Chavangi 1983).

In pastoral societies, customary norms regulate access and ownership of clan assets, including livestock. Women and men are entitled to access livestock either as owners or users. Some of the factors that influence women's ability to access livestock are marital status, age, and the overall production system in place. Key decisions are generally made jointly with their husbands; large sales of livestock are usually controlled by the clan elders. Women tend to have greater control over livestock given to them through dowry or gifts. Patterns of ownership and decision-making are complex and vary depending on the local culture. For example, it has been reported that among Maasai, women livestock owners generally have very little say in decision-making concerning the animals they own (Flintan 2011). Conversely, among the Nandi, women might have a say even though they do not own livestock (Flintan 2011).

As previously discussed, milk and dairy products are particularly important for women since they tend to exercise greater control over those products than over the animals themselves. Traditionally, pastoral women determine what proportion of milk is to go to the children and calves, and therefore they balance between household food security and herd growth (Nunow 2010). Pastoral women also have the right to market the milk. In many traditional pastoral societies, women's priority is child nutrition, whereas men's priority is herd growth. Much of this division in gender roles is affected by the commercialization of livestock production (Njuki and Sanginga 2013).

Dairy intensification is a practice that has been identified to have climate change mitigation potential. In 50% of the zero-grazing dairy units studied in five districts (Kiambu, Meru, Migori, Nandi, and Vihiga) of Kenya, husbands were found to be the main decision-makers in relation to land use for fodder and crop production (Maarse 1995). Decisions concerning dairy management—including watering, feeding, milking, cleaning animal sheds, spraying, hiring employees, selling, and using dairy income—are made by women. Men make more decisions in the selling and buying of cows and land. In 66% of the households studied, women made decisions regarding use and appropriation of milk. Husbands and wives were found to receive 33% and 45% of income from milk, respectively.

Where and how much milk is sold influence women's ability to control and make decisions regarding income earned. Very often, women have greater control over the evening milk than morning milk, and greater decision-making authority over milk sold in local and informal markets (Kristjanson et al. 2010). Njuki et al. (2016), in an analysis of the impact of dairy intensification on gender dynamics, find that although women tend to have greater control over decisions about evening milk sales, men seem to be increasing the control of total dairy income.

In many cases, milk is a contested commodity: it has many functions and is thus in demand for calf-rearing (mainly by men), feeding the household (mainly by women), and generating income (mainly by women). Decision-making dynamics around milk marketing can devolve into tensions and conflicts.

A study investigating intra-household production decisions on milk sales among the Gabra, a nomadic society in northern Kenya, shows that men in some families were using their authority to decide where the household should camp, with the strategy to weaken women's ability to sell milk independently (McPeak and Doss 2006). According to traditional Gabra culture, once the animals have been milked and the milk has been inspected by the husband, the container is passed to the wife, who becomes the primary milk manager and can make key decisions on how much milk to use for each meal, how much to conserve as fermented milk, and how much to give to other households. Gabra women also may decide how much milk to take to the market: they can go to the town and sell the milk independently and make autonomous decisions on how to spend the income from sales before returning home. Since greater distance to town translates into fewer marketing opportunities, some men opt for migration routes that interfere with women's sales opportunities.

The emergence of new markets in dairy products is opening up important income-generating opportunities for women, thereby contributing to strengthening their autonomy and decision-making power. In some cases, however, men are resisting this development.

4. The gender implication of technology change

The livestock sector in Kenya is dominated by smallholders. It is estimated that milk producers account for 1.8 million farm households, of which 70% are smallholder farmers and

mostly women and youth (Makoni et al. 2014). **The sector is characterized by low productivity, weak extension systems, limited availability of chilling and processing plants, and informal dairy markets, thus resulting in high emissions per kilogram of milk and low climate resilience** (van Dijk, Tennigkeit, and Wilkes 2015). In Kenya, 80% of dairy cattle are found in rural smallholder semi-intensive and intensive dairy production systems, using exotic and crossbred dairy cattle. The semi-intensive dairy system uses mainly zebu and a few crossbred cattle. It is more subsistence oriented and found especially across Nyanza, Western, Coast, Eastern, and Rift Valley provinces. The majority of semi-intensive dairy farmers free-graze or paddock-feed their cattle, and the land area per household is slightly larger than in intensive systems. Intensive systems are characterized by the use of exotic and crossbred cattle and are found mostly in Central and Rift Valley provinces. The majority of smallholder farmers in intensive systems stall-feed their cattle. Farms are generally small, grow both cash and food crops as well as milk, and keep about four cattle on 1 ha of land, typically with coffee, maize, horticultural, and fodder crops (Bwonya Orodho 2006).

The rapid growth in milk consumption across the developing world has generated new opportunities for smallholder, market-oriented dairy production (Delgado et al. 1999). As a consequence, interest in technologies to sustainably intensify smallholder-led dairy production has also increased. Overall, intensification involves the introduction of high-yielding cows and complementary feed production and feeding strategies, including growing and cutting fodder, improved fodder, management of disease control measures, and improved recordkeeping, for the production of dairy products, fresh milk for sale in particular (Nicholson, Thornton, and Muinga 2004). Intensification of dairy production also involves a shift to zero-grazing, a labor-intensive operation that consists of stall-feeding, using cultivated fodder and crop residues, and bringing water to the animals.

Zero-grazing dairy livestock production has grown considerably in popularity for several reasons, such as the reduced availability of grazing land and emerging opportunities in dairy markets. There is evidence that exotic, stall-fed production generates employment opportunities in the small-scale farming sector and improves household incomes (Bwonya Orodho 2006). Farmers who adopt improved technology generally get higher yields and profit margins (ibid.). In Kenya, the sustainable intensification of dairy farming is associated with both

increased incomes and improved nutritional outcomes for the rural poor (van Dijk, Tennigkeit, and Wilkes 2015).

Dairy intensification has strong gender and labor implications, as it typically involves a renegotiation, reassignment, or deepening of roles and responsibilities within the household, which can also alter traditional patterns of access to resources. Studies focusing on the gender dimension of intensified dairy farming in mixed farming systems indicate that women's labor demand is more likely to increase with zero-grazing (Chavangi and Hansen 1985; Mullins et al. 1996; Mwangi n.d.). Women's already prominent role in milking, processing, feeding, watering, and cleaning animals tends to increase (Tangka in Kristjanson et al. 2010). Women's traditional crop responsibilities also tend to increase because of the shift in cropping patterns to accommodate fodder cultivation. Conversely, intensification requires less labor for herding and grazing, which are traditionally carried out by men.

Chavangi and Hansen (1985) report that women contributed up to 85% of the total labor to zero-grazing units on smallholder farms in Kenya. In a gender-differentiated impact analysis of intensified dairy farming in five districts (Kiambo, Meru, Migori, Nandi, and Vigha), Maarse (1995) found that women were contributing 32% of all labor. Activities such as cutting grass, applying manure, feeding animals, cleaning, milking, fetching water, heat detection, and milk sales were carried out mostly by women. Maarse found that men contributed about 23% of total dairying labor and played a major role in activities such as planting Napier and fodder trees, buying dairy inputs, and spraying animals. Hired workers handled 33% of the overall dairy-farming activities, whereas children contributed about 5% of total labor, mostly through assisting in water collection, milk marketing, and application of manure. Mullins et al. (1996) reported similar findings from the Coast Province of Kenya, where women supplied 48% of the total labor inputs in dairy farms. **These studies raise concerns about equity in the distribution of costs and benefits of more intensive dairying and the potential negative impacts on female-dominated activities such as child care.**

The results of these studies are not conclusive, however. A more recent study in coastal Kenya (Nicholson, Thornton, and Muinga 2004) suggests that ownership of dairy cows and intensified dairy production lead to positive outcomes for smallholder households, especially in terms of higher incomes associated with increased milk production and sales. The study also found positive impact on household welfare through increased milk consumption, which

apparently was not challenged by the increases in milk sales. Further, little evidence was found to suggest that dairy cows result in additional time burdens on household members. According to the study, hired laborers conduct much of the additional labor required, with clear positive effects on employment generation. Taken as a whole, these results suggest that more intensive dairying has a number of benefits and few negative outcomes from the households' perspective (Nicholson, Thornton, and Muinga 2004)

The importance of hired labor in dairy production is highlighted in a further study focusing on peri-urban areas of Machakos and Wote (Njarui et al. 2012). All household members have high participation in dairy production, whereby women mostly contribute to daily tasks and men engage mainly in weekly or seasonal tasks. For example, forage is planted during the wet season, spraying is done weekly, and milking is carried out daily. However, household labor is not sufficient to run the dairy units: a significant amount of labor must be sourced from elsewhere. Overall, hired labor contributes about two-thirds of total labor required in running the dairy enterprises studied, indicating that external labor is important for the success of dairy farming in the peri-urban areas of semi-arid regions. Similar arrangements are reported by Njarui et al. (2009), who found that hired employees contributed about 50% of the entire labor requirement of dairy units in the rural areas of semi-arid Kenya.

These studies argue that intensification does not add an extra-burden on women, as dairy producers opt for hiring extra labor. Njuki et al. (2016), however, also suggest that different levels of intensification can lead to differentiated impact on women's work burden. Women from medium-intensity households reported spending more time on dairy activities than women from high-intensity households. This also might indicate that poorer households, living in more remote locations and with more limited financial and business management capacities, might not necessarily be able to sustainably move to dairy intensification without inadvertently compromising women's already difficult work balance. For livestock intensification to be sustainable and gender sensitive, it must be accompanied by special measures to reduce women's workloads in other areas and help them to secure their rights to produce (WABEKBON Development Consultants 2009).

5. Constraints faced by women in dairy production and marketing

5.1 Access to extension services

Women and men often have different objectives for keeping animals, different rights to their animals' products, and differing abilities to access new information and improved technologies, depending on their roles and whether they are targeted by the extension services. A study on gender differentials in adoption of soil nutrient replenishment technologies under mixed crop–livestock systems in Kenya's Meru District found that women-headed households were less likely to use cattle manure than those headed by men because of women-headed households' limited ownership of animals and pasture land. Hence, they were barely targeted by extension officers (Kirumba et al. 2011).

Limited access to knowledge and information on dairy production, processing, and marketing is a critical constraint faced by both women and men farmers. Informal channels of dissemination, such as farmer-to-farmer interaction, are the most common source of information for all farmers, irrespective of their gender (Njuki and Sanginga 2013). Conversely, formal government extension had very limited outreach. Njuki and Sanginga, however, also found that generally more men than women in male-headed households were targeted for training activities, whether from government or other institutions. Also, the range of topics covered by trainings was broader for men than for women. And although men were more likely to receive training on multiple technical subjects such as livestock health, breeding, and marketing, women were mostly trained on generic livestock management issues. **It appears that the actual roles and responsibilities of women and men in cattle production tend to be systematically overlooked in the delivery of extension services, and dissemination of innovative livestock practices and technologies rarely targets women.**

Training opportunities for upgrading skills in dairy processing and marketing are scant, though these are areas that can open up important income-generating opportunities for women farmers. In a study analyzing the constraints faced by women in milk micro-enterprises in Kenya, it was found that only 18.6% of women entrepreneurs had received formal training in dairy processing before starting the venture (Odero-Wanga, Mulu-Mutuku, and Ali-

Olubandwa 2009). The majority of women acquired value-addition skills primarily through informal channels (e.g., from relatives, friends, or previous employment). Women most often acquired the technical knowledge through passive observation rather than active participation. After setting up the milk-processing enterprises, relatives and friends remained the most common source of information (40%), immediately followed by customers and competitors (8%). The most critical constraints to upgrading skills mentioned by the women interviewed were, in order of importance, lack of knowledge on sources of information, lack of time to look at this information, and the high cost of acquiring this information.

The location of training may also be a constraint for women, especially in strong patriarchal settings. It has been broadly recognized that in order to improve outreach to women, extension services should be delivered at times and in places where women can easily convene. Cultural and time constraints are powerful disincentives to women's participation. For instance, Maasai women face restrictions in accessing extension services mainly because of workload and mobility constraints (Flintan 2011). In many pastoral societies, local gender norms discourage women from attending public meetings, as these are seen as male spaces. As a consequence, women mostly rely on their husbands to acquire technical information. Flintan (2008) found that pastoral women were unable to access information on dairy production and marketing since extension messages were usually made in public, male-dominated forums. Similarly, Njuki and Sanginga (2013) found that most of the trainings attended by women were held within the village.

The gender of the extension agent also matters. A study on the impact of intensive dairy production on smallholder farms in coastal Kenya found that women performed the major part of the work on all farms; however, women on female-contact farms were spending their dairy income on food for the household and children's schooling more often than their counterparts on male-contact farms (Mullins et al. 1996). On the basis of these and other findings, the gender of the extension contact, dairy operator, and farm owner are determinants of the intra-household impacts of intensive dairying on smallholder farms.

Intensification increases the need for technical knowledge and services (e.g., veterinary care, fodder cultivation, artificial insemination, etc.), which are often not directly available to women. It is also clear that since intensification requires additional labor from women, which is often not compensated, they have less incentive to adopt new technologies (Kristjanson et al. 2014).

Many projects in East Africa that have experimented with training villagers to be animal health workers have not directly targeted and trained women to become service providers in their own community (Kristjanson et al. 2010). Odongo (2015) argues that recognizing and valuing gender-specific roles and knowledge in the management of cattle disease can help to prevent the spread of the disease more effectively. Hence, attention to gender should inform the way veterinary and other extension services are designed and delivered.

Finally, a further constraint is that dairy marketing cooperatives tend to be heavily dominated by men (Flintan 2011). This hinders women from accessing training and technologies related to sustainable intensification, which are usually channeled through these organizations. Conversely, **many researchers have noticed that when women dairy producers form their own groups, their capacity to access and effectively use new technical knowledge and information tends to be higher.** This finding has profound implications for the dissemination of sustainable intensification technologies in the dairy sector.

5.2 Marketing

As previously discussed, the considerable increase in milk consumption in Kenya has opened up new employment and income-generating opportunities for milk producers along the livestock value chain. It is estimated that smallholder dairy farmers produce up to 56% of all milk produced in the country and market about 70% of the milk they produce (Njuki and Sanginga 2013). Most milk surplus (about 55%) is sold to individual consumers, 38% to milk-marketing cooperatives and middlemen, and the other 5% is marketed directly to processors.

Although women traditionally have the right to sell milk and milk products to earn small amounts of income, limited production and distant geographical locations in pastoral areas limit their possibility to access distant, but more profitable, markets, especially due to high transaction costs arising mostly from transportation. Producers and consumers are spatially separated, whereby producers live in very remote rural areas and consumers are found in urban centers (WABEKBON Development Consultants 2009).

Given these constraints, women tend to focus on and dominate informal markets. They are rarely members of marketing cooperatives, and very often the organizations do not deal with marketing activities. Hence, they engage in milk marketing on a small scale and rarely bring their product directly to processors (ibid.). In 2009 the East Africa Dairy Development project

surveyed households in Kenya, Rwanda, and Uganda. It shows that women receive dairy income in 35% of the households selling to individual traders but in only 16% of households that bring milk to collection centers (ILRI 2009). Women generally have to struggle with unpredictable and insecure markets. Milk is highly perishable, so the lack of milk-processing and storage facilities means that the milk that cannot be sold is wasted if not returned to the household, which is only possible in some cases (Gemtessa, Emana, and Tiki 2005).

A further constraint is that the reduction in livestock numbers—due to the current shift to agricultural production in many pastoral societies, the loss or degradation of grazing areas, and/or increased drought—has meant that there might not be a surplus of milk to sell. Limited production may exacerbate gendered conflicts over access to the milk. Men may prefer to use the milk for the herd rather than sell it (McPeak and Doss 2006). Several studies have documented that men may keep the livestock away from the town or household to maximize herd productivity and let calves consume the milk rather than reserving it for human consumption (ibid; WABEKBON Development Consultants 2009). Research in northern Kenya showed that men deliberately resisted increased marketing activities by their wives by moving further away from towns (McPeak and Doss 2006). This can also undermine women's status, which is determined by their ability to provide milk for the family and the community.

The daily trade-off between marketing and food consumption has clear gender and food security implications. As milk levels have reduced, women may compromise the health of calves to ensure that there is enough milk left for their children (Bruggeman 1994). Research analyzing the relationships between commercial livestock production, nutrition, and intra-household dynamics in Uasin Gishu District clearly shows that the move toward commercialization has deepened male control over milk, with negative consequence on family nutrition and health (Huss-Ashmore 1996). Further research reveals that settled Rendille and Ariaal populations in Marsabit District, northern Kenya, had far poorer growth patterns for children relative to same-aged children from the pastoral community (Fratkin, Roth, and Nathan 2004). Furthermore, since protein is an indispensable nutrient for pregnant and lactating women, infants, and growing children (ibid.), the potential protein loss associated with agricultural settling may have a negative impact on maternal nutritional health.

Hence it is clear that, although market development can provide opportunities for both women and men producers, it also bears gendered risks and challenges. Women tend to experience

greater difficulties than men in accessing and benefitting from formal and more profitable markets because of the structural disadvantages they experience in the society as women (Flintan 2011). Flintan argues that an increase in the value of a resource that has been customarily accessed by many people, including both women and men, might result in the alienation of the resource to only a few.

Increased demand for higher value fodder and improved breeds, along with the development of roads and market-related infrastructures, negatively affects those with more insecure rights to livestock and other productive resources—namely poorer pastoralists and women. Many studies recognize that women engaged in commercial dairy production tend to receive little if any remuneration for their work (Chavangi 1983; ILRI 2009; Farnworth et al. 2012). Any strategy for commercialization should be based on a careful gender-sensitive value chain analysis that also considers customary norms and values (Flintan 2008).

5.3 Access to productive assets and credit

Women dairy farmers tend to be heavily disadvantaged in access to and control over productive assets. Specifically, they have more insecure rights over livestock and land; limited access to labor, credit, and technical support; and less control over incomes from sales.

Even when women are directly targeted by extension programs, women might find it more difficult than men to adopt the proposed practice due to gender-specific constraints in access to assets. This is especially true for women who are heads of households. **A study on the factors that hinder uptake of mitigation technologies (including agroforestry, improved fodder production, tree nurseries, manure management, composting, and biogas generation) among dairy farmers of Kaptumo in Nandi County found that more female than male heads of households faced problems in using new practices due to a number of barriers. These include lack of labor to carry out agronomic activities, limited access to information on suitable fodders and planting materials, lack of initial capital for establishment, lack of space on the small land holdings, and insecure rights over land** (Mutoko, Rioux, and Kiru 2015).

Women heads of households practiced composting at less than half the rate of male heads of households, mainly due to labor shortages. The commonly used paddocking system requires extra labor to collect the scattered fresh cow dung. Similarly, feed conservation strategies to

ensure that livestock feed is available during both dry and wet seasons, such as making silage, require hired labor and were more often adopted by men. Finally, many more women heads of households found it difficult to plant fodder trees because of lack of land ownership and limited user rights. The women reported that since men are the custodians of land title deeds, planting fodder trees is seen in the community as "marking own farm boundary," which is perceived to be inappropriate for women (ibid.).

Limited access to credit is often identified as one of the most critical challenges to women milk producers. Female dairy farmers in Kiambu, Kenya, reported that their enterprises would have been more productive had they had access to financial resources to purchase more feed and feed supplements and more land on which to grow forage (Kristjanson et al. 2010). Considering that women play a critical role in dairy operations in Kenya, their inability to access credit and other financial resources is a key constraint to the development of the country's small-scale milk production. High rate of illiteracy among Kenyan dairy women represents a further obstacle to their engagement with formal institutions.

Odero-Wanga, Mulu-Mutuku, and Ali-Olubandwa (2009) argue that lack of finance and problems accessing credit facilities due to high interest rates represent the major obstacles to acquiring appropriate technology for value addition for micro-enterprises led by women in the dairy sector. A critical finding from the study is that 92.9% of the women interviewed could not acquire equipment because of its high cost. Additionally, 56.5% of women interviewed reported problems linked to the high interest rates of credit; 34.9% reported lack of collateral as the main challenge. The authors (ibid.) identify improved access to credit facilities and the provision of technical assistance as the main measures needed to support women to upgrade their enterprises.

A survey carried out in Kenya, Rwanda, and Uganda as part of the East Africa Dairy Development project (ILRI 2009) showed that significantly more men than women had applied for loans from financial institutions or local cooperatives. Lack of secure titles to property impede women dairy operators in Kenya from obtaining credit from formal financial institutions. This represents a major constraint to expanding the country's small-scale milk production (Kristjanson et al. 2010).

Since lack of access to credit limits women's opportunities to develop commercial enterprises, the formation and strengthening of women savings and credit groups are critical steps toward

the creation of women-owned dairy enterprises. Schemes supported by nongovernmental organizations offer important alternatives (Flintan 2011).

6. Good practices and promising approaches

6.1 Examples of gender-sensitive extension services

Fodder and feed scarcity is one of the major bottlenecks for livestock sector development. Under the Livestock Development Program, a study was carried out to determine the relationship between fodder production practices and current dairy production among dairy farmers in Homa Bay and Ndhiwa districts. The study shows that age, gender, and marital status did not influence daily milk yield because the young, elderly, men, women, single, and married people were all provided with equal opportunities to increase daily milk yield (Mulwale, Munyua, and Olubandwa 2014). The program made a conscious effort to target and reach out to women of different age groups and marital status. Indeed, women comprised the majority of project beneficiaries and received intensive training on improved methods of production and fodder varieties. This resulted in women allocating more land for fodder production and growing more varieties. The study also found that those who had smaller pieces of land either leased land to grow adequate fodder or bought extra to supplement what they grew.

Other studies (Kristjanson et al. 2010; Flintan 2011; WABEKBON Development Consultants 2009) reveal that strong, women-led producer organizations can play an important role in delivering extension services to poor women livestock keepers. The Kenya Women's Veterinary Association has partnered with the government to develop the country's semi-arid and arid areas through improvements in animal husbandry (Kristjanson et al. 2010). By building the capacity of organized women in livestock and disease management, the association has contributed to improve women's capacity to control and reduce the incidence and costs of tick-borne diseases in cattle and Newcastle disease in poultry. An impact study shows that the formation of women's groups has helped to improve control of livestock diseases, particularly transboundary diseases (Kimani and Ngethe 2007).

According to Flintan (2008), clusters and networks of women can access resources more cheaply and easily than can individuals. When extension messages are delivered through

women's groups, these tend to be more effective (Kimani and Ngethe 2007). Hence, supporting organized women's groups for the delivery of livestock support services targeting poor female farmers seems to be the most effective way to target poor female livestock keepers.

6.2 Setting women-owned marketing cooperatives enterprises

The vibrancy of organized women groups in pastoral areas is further demonstrated by the experience of a TechnoServe-supported project (http://www.technoserve.org/our-work/stories/maasai-women-launch-successful-dairy-business) that has promoted the formation of a women-only dairy cooperative among the Maasai. The women in this area face several challenges in milk production and marketing, principally due to limited access to more productive cows and fodder and lack of transport. They also face a scarce supply of water. TechnoServe trained a group of women on business management and effective dairy farming techniques, as part of the Agribusiness Development Program. The program supports more than 19,000 small-scale dairy farmers and helps them establish dairy business hubs, including the Maasai Women Dairy, the first dairy plant in Kenya owned almost entirely by Maasai women.

Maasai women had formed a business group in 2003 that collected milk from members to sell in neighboring towns. The proceeds were meager until August 2011, when TechnoServe began working with the women. The firm helped establish the Maasai Women Dairy as a formal cooperative and educated its farmers on the benefits of collective milk marketing. Through the program, TechnoServe also introduced innovative mitigation practices by training the Maasai women in natural resource management, including soil and water conservation, renewable energy, and tree planting. The women learned that milk production can be increased by improving cattle management, and some women began conserving grass around their homestead and feeding cows through rotational grazing. The Maasai Women Dairy has grown to more than 3,200 active members and nearly quadrupled its sales recently. As of 2015, the women were collecting a peak of more than 7,100 gal. of milk per day.

A pilot project under the Food and Agriculture Organization of the United Nations (FAO) Mitigation of Climate Change in Agriculture program also provides a good example of a successful women-owned enterprise. Initiated in Kenya in September 2011, the project focused on small-scale female and male dairy farmers, with the aim of integrating climate-smart agriculture into the farming system and improving farm and milk productivity, income, and livelihoods. A group of women in the Kamotony area were trained on various climate-

smart agricultural practices. As a result of the training, they decided to establish a group-managed tree nursery, which is providing them with income from the sales of indigenous tree seedlings, tea leaves, ornamental trees, and garden flowers. The income gained was used as a financial stepping-stone for investing in dairy production. The adoption of improved fodder production and dairy cattle management led to a sustainable increase in milk productivity, in turn enabling them to access credit for investing in their dairy enterprise. The women can now pay their children's school fees and make monthly contributions to the National Health Insurance Fund for their family members. In addition, the application of composted manure to their home gardens and passion fruits has contributed to improved household nutrition. The success of their enterprise has enabled them to overcome some of the cultural constraints to tree planting, which has also helped to free up the time they used to spend collecting firewood.

6.3 Renegotiating roles and responsibilities of women and men in the dairy value chain

The Kenya Dairy Sector Competitiveness Program, implemented by Land O'Lakes on behalf of the United States Agency for International Development in Kenya, is an excellent example of an intervention that addressed gender inequality issues as a core component in its value chain development strategies. The program aimed to improve the productivity and competitiveness of the dairy sector across the country, increasing the incomes of smallholder dairy farmers through the sale of good quality milk. To do so, Land O'Lakes developed a detailed plan to address gender issues in its program. First, the project team was trained on gender issues. A rapid gender assessment of the dairy sector was then conducted and gender-sensitive monitoring and evaluation indicators were developed.

Most important, the project team involved both women and men as couples in training activities meant to prepare farmers for a move toward commercial production. In this way, the specific roles and responsibilities of both women and men in dairy production were taken into account and addressed. This also enabled all household members to better assess the amount of time and money it would take to produce for the market. Women felt particularly unhappy at the low returns to their hard work. This represented a strong disincentive for women, who were required to increase their labor contribution without being adequately compensated. Hence, promoting intra-family collaboration and joint decision-making regarding the planning of the investment, as well as a more balanced trade-off between labor contribution and

economic benefits, was key to increase the economic incentives for women so they could commit additional labor from their already demanding work schedules.

Cold chain investments in some communities benefitted men much more than women because it allowed evening milk, which was traditionally controlled by women, to be sold into the chain by men. Evening milk is typically used by women for home consumption, as well as for sale within the community and for payment in kind for work provided by neighbors (Farnworth et al. 2012). The team sensitized women on how to influence spouses with regard to decision-making in technical key intervention areas, including breed improvement, fodder establishment and management, linkages to markets and services, and participation in farmer field schools and exchange visits.

Another important activity implemented by the project was the formation of gender-balanced dairy cooperatives (women had to form at least 30% of cooperative membership). To specifically support poor, and female-headed, households, the project suggested that (1) a clause be added to cooperative membership agreements that funds for shares could be raised over time, (2) the cooperative pay the same amount per liter, regardless of delivery size, and (3) it sell all inputs at the same price regardless of size of order. To prevent male capture of income, the program encouraged the creation of a cooperative store to enable payment in kind for milk. Goods for exchange included school books, basic food items, seedlings, and inputs. To ensure men's agreement, they received some cash for each sale. Men were also encouraged to allow women to apply for women-friendly loans at lower interest rates.

An important success factor was that the program adopted a flexible gender strategy, based on the diversity of local gender norms. The project team avoided openly challenging cultural norms. Rather, they ensured that men and women were trained together, and gave successful couples a role as change agents (ibid.).

7. Conclusion

Given the critical role women play in the dairy sector across Kenya and throughout different production systems, addressing gender issues in the development and delivery of innovative mitigation technologies can definitely lead to more effective uptake and impact of promoted practices among smallholder farmers, thereby contributing to both sustainability and

productivity goals. Women dairy producers represent an untapped potential. If they are not adequately considered and targeted, it could hinder the sustainability and impact of emerging mitigation practices, and have negative spill-over effects on natural resource conservation, productivity, and overall household food security.

Despite this premise, it is clear from this review that women's specific roles and responsibilities in dairy production systems are still largely overlooked in the design and implementation of dairy development strategies and programs. There is an urgent need to unveil how gender dynamics and customary norms influence the development of the sector. This requires more in-depth understanding of how livelihood and technology changes, often as a response to both environmental degradation and emerging marketing opportunities in the dairy sector, can lead to differentiated outcomes for women and men dairy producers.

For example, in extensive grazing systems that are prominent in dry land areas, managing grazing land and improving its productivity would be vital to its sustainable use. Loss or degradation of grazing land as a result of drought and changing livelihood systems has led to a reduction in milk production, with negative spill-over effects on the livelihoods of both women and men producers. Resource scarcity has particularly affected women because they tend to have more insecure rights to livestock and other productive resources. In some cases, women have lost access to the milk surplus they usually bring to the market, due to pressure from men to keep the milk for the herd.

The gender blindness of many interventions promoting smallholder dairy intensification is also related to the fact that, although dairy is important to the livelihoods of poor women and men in Kenya, the factors that limit or promote opportunities for women livestock keepers have received very little empirical analysis. In particular, it would be important to further explore the linkages between sustainable dairy intensification and intra-household gender dynamics, including division of labor and decision-making patterns.

Far from being a gender-neutral process, sustainable dairy intensification often involves the deepening of roles and activities that are usually associated with women, thereby increasing women's work burden and further constraining their access to resources and income. Given its nutritional and market values, milk can be a highly contested commodity, more so in the context of emerging opportunities for commercialization of dairy products in the country. Changes in intra-household gender dynamics as a result of intensification might unwittingly

compromise or limit the adoption of new production practices because women might not be willing to engage in costlier and labor-intensive technologies without receiving adequate benefits in terms of access to markets, income, and decision-making. Hence, such analysis would be critical to understand how to convert existing gendered barriers into incentives for successful adoption of sustainable intensification practices by farm households.

The shift to sustainable intensification requires access to complex technical knowledge and a range of services (e.g., extension, credit, veterinary, etc.). However, this review reveals that these services are often unavailable to women, since they are rarely targeted by extension and dairy development programs. Conversely, when women are effectively targeted by extension services and programs, and their awareness and knowledge of intensification practices and benefits increase, they are more willing to switch to sustainable management practices and to find effective solutions to constraints they typically face, such as renting land for producing more and additional fodder varieties.

In some contexts, especially in pastoral areas, empowering women-only groups by targeting them as direct recipients of extension services, processing technologies, and market linkages might be the most effective strategy to successfully promote the adoption of mitigation technologies. Alternative approaches to service delivery, which are based on peer-to-peer training, could potentially enhance women's access to those services that are traditionally targeted at men, such as veterinary services.

Both the TechnoServe and FAO projects demonstrated how the promotion of women-owned enterprises creates an enabling environment for the adoption of mitigation practices, such as soil and water conservation, renewable energy, and tree planting. The women's groups targeted by both programs have learned that improved cattle management contributes to increased productivity and efficiency of resources. However, it is only when women are empowered as business actors, and thus can access and control productive resources, income, and benefits, that they can upgrade to new technologies.

Women's decisions about whether to invest in new practices depend greatly on the availability of targeted support and services that address their specific needs and constraints (World Bank, FAO, and IFAD 2015). As demonstrated by the FAO experience, adoption of mitigation technologies was higher among men although the project targeted both female and male dairy farmers. Weak and insecure access to land, shortage of labor, and limited financial resources

for initiating the investments or acquiring new breeds are some women-specific constraints that remained unchallenged.

Working on gender relations and addressing intra-household dynamics can also lead to improved uptake and impact of climate-smart agriculture technologies by farm households. Promoting intra-household planning and decision-making around dairy intensification and commercial development has the potential to stimulate a positive family environment. This involves engaging all family members to develop a common vision, renegotiate the division of labor to meet the demand for increased labor, and share the incentives and economic benefits of enhanced productivity and sustainable natural resource management.

Last but not least, given that women usually have less control over dairy cows than do men, it is important to explore opportunities for promoting alternative value chains, such as dairy goats, which are usually controlled by women.

8. References

Bruce DR. 1996. Livestock production, age, and gender among the Keiyo of Kenya. *Human Ecology* 24(2): 215–230.

Bruggeman H. 1994. *Pastoral women and livestock management: Examples from northern Uganda and central Chad*. London, UK: International Institute for Environment and Development.

Bwonya Orodho A. 2006. Intensive forage production for smallholder dairying in East Africa. In: Reynolds S, Frame J, eds. *Grasslands: Developments, opportunities, perspectives.* Rome: FAO. Chapter 18.

Chavangi NA. 1983. *Women's role in the livestock sector with special reference to Kenya*. Rome: FAO.

Chavangi NA, Hansen A. 1985. *Women in livestock production with special reference to dairying*. Rome: FAO.

Delgado C, Rosegrant M, Steinfeld H, Ehui S, Courbois C. 1999. *Livestock to 2020: The next food evolution*. Washington, DC: IFPRI.

Edmunds D, Sasser J, Wollenberg E. 2013. A gender strategy for pro-poor climate change mitigation. CCAFS Working Paper No. 36. Copenhagen, Denmark: CCAFS.

Farnworth CR, Nzioki A, Muigai S, Kimani EN, Olungah C, Monyoncho K. 2012. Gender Analysis and Action Plan. Kenya: United States Agency for International Development.

Flintan F. 2008. *Women's empowerment in pastoral societies*. IUCN-WISP, GEF-UNDP.

Flintan F. 2011. *Changing the nature of gender roles in the drylands of the Horn and East Africa: Implications for programming*. REGLAP.

Fratkin E, Roth E, Nathan M. 2004. Pastoral sedentarization and its effects on children's diet, health, and growth among Rendille of northern Kenya. *Human Ecology* 32(5): 531–559.

Gemtessa K, Emana B, Tiki W. 2005. Livelihood diversification in Borana pastoral communities of Ethiopia—prospects and challenges. Ethiopia: WABEKBON Development Consultants.

Grace D. 2007. Women's reliance on livestock in developing-country cities. ILRI Working Paper. Nairobi: ILRI.

Heffernan C, Misturelli F. 2000. *The delivery of veterinary services to the poor: Preliminary findings from Kenya*. Reading: Veterinary Epidemiology and Economics Research Unit, University of Reading, Reading, UK.

Huss-Ashmore R. 1996. Livestock, nutrition, and intrahousehold resource control in Uasin Gishu District, Kenya. *Human Ecology* 24(2): 191–213.

[ILRI] International Livestock Research Institute. 2009. Gender, Dairy Production and Marketing. East Africa Dairy Development Project. Nairobi: International Livestock Research Institute.

Kimani TM, Ngethe EW. 2007. Enhancing livestock management skills amongst Maasai pastoral women of Magadi Division in Kenya: a CVA funded Kenya Women Veterinary Association Project. Proceedings of the 4th Pan Commonwealth Veterinary Conference held in Barbados, West Indies, 4–8 November 2007.

Kirumba EG, Mugendi DN, Karega R, Mugwe J. 2011. Gender differentials in adoption of soil nutrient replenishment technologies in Meru South District, Kenya. In: Bation A, Waswa B, Okevo JM, Maina F, Kihara J, eds. *Innovations as key to the green revolution in Africa: Exploring the scientific facts*. Springer Netherlands: Springer Science+Business Media B.V.

Kristjanson P, Waters-Bayer A, Johnson N, Tipilda A, Njuki J, Baltenweck I, et al. 2010. *Livestock and Women's Livelihoods: A Review of the Recent Evidence*. ILRI Discussion Paper No. 20. Nairobi: ILRI.

Kristjanson P, Waters-Bayer A, Johnson N, Tipilda A, Njuki J, Baltenweck I, Grace D, MacMillan S. 2014. Livestock and women's livelihoods: A review of the recent evidence. In: Quisumbing AR, et al. 2014. *Gender in agriculture: Closing the knowledge gap*. Rome: FAO.

Maarse LM. 1995. A gender differentiated study on the impact of intensive dairy farming in Kiambu, Meru, Migori and Vihiga Districts of Kenya. Nairobi, Kenya: National Dairy Development Project.

Makoni N, Redda T, Van der Lee J, Mwai R, Van der Zijpp A. 2014 White gold: Opportunities for dairy sector development collaboration in East Africa. Centre for Development Innovation, Wageningen, Netherlands.

McPeak J, Doss C. 2006. Are household production decisions cooperative? Evidence on migration and milk sales from northern Kenya. *American Journal of Agricultural Economics* 88(3): 525–541.

Mullins G, Wahome L, Tsangari P, Maarse L. 1996. Impacts of intensive dairy production on smallholder farm women in coastal Kenya. *Human Ecology* 24(2): 231–253.

Mulwale CA, Munyua C, Olubandwa A. 2014. Relationship between fodder production practices and dairy production in Homa Bay and Ndhiwa Districts, Kenya. *American International Journal of Social Science* 3(2): 121–130.

Mutoko M, Rioux J, Kirui J. 2015. Barriers, incentives and benefits in the adoption of climate-smart agriculture Lessons from the MICCA pilot project in Kenya. Rome: FAO.

Mwangi KW. n.d. Challenges facing women in the zero grazing livestock production system in Kenya: A case of Karuri location Kiambu County. Nairobi: Institute of Anthropology, Gender and African Studies, University of Nairobi, Nairobi, Kenya.

Nicholson CF, Thornton P, Muinga RW. 2004. Household-level impacts of dairy cow ownership in coastal Kenya. *Journal of Agricultural Economics* 55(2): 175–195.

Njarui DMG, Gatheru M, Wambua JM, Nguluu SN, Mwangi DM, Keya GA. 2009. Dairy cattle value chain assessment: Characterization of milk production in semi-arid Kenya. Working document, Kenya Arid and Semi-Arid Land Programme (KASAL).

Njarui JM, Kabirizi JK, Itabari M, Gatheru M, et al. 2012. Production characteristics and gender roles in dairy farming in peri-urban areas of Eastern and Central Africa. Nairobi, Kenya: Kenya Agricultural Research Institute.

Njuki J, Wyatt A, Baltenweck I, et al. 2016. An Exploratory study of Dairying Intensification, Women's Decision Making, and Time Use and Implications for Child Nutrition in Kenya. *European Journal of Development Research* 28: 722.

Njuki J, Sanginga PC. 2013. *Women, livestock ownership and markets: Bridging the gender gap in eastern and southern Africa*. London, UK: Routledge.

Nunow A. 2010. *Pastoral innovations and changing political economy: The Orma pastoralists, Tana Delta, Kenya*. United Kingdom: IDS.

Odero-Wanga D, Mulu-Mutuku M, Ali-Olubandwa A. 2009. Value added milk products: Constraints to women in milk micro-enterprises in Kenya. *Journal of Development and Agricultural Economics* 1(7): 144–149.

Odongo D. 2015. Gender in delivery of contagious bovine pleuropneumonia vaccine: Lessons from Kenya. Nairobi, Kenya: ILRI.

Technoserve. n.d. "Maasai Women Launch Successful Dairy Business." http://www.technoserve.org/our-work/stories/maasai-women-launch-successful-dairy-business

van Dijk S, Tennigkeit T, Wilkes A. 2015. Climate-smart livestock sector development: The state of play in NAMA development. CCAFS Working Paper No. 105. Copenhagen, Denmark: CCAFS.

WABEKBON Development Consultants. 2009. Women's milk and small ruminant marketing in Mandera Triangles (Kenya, Ethiopia and Somalia). Ethiopia: CARE.

Waithaka MM, Nyangaga JN, Staal SJ, Wokabi AW, Njubi D, Muriuki KG, Njoroge LN, Wanjohi PN. 2002. Characterization of dairy systems in the western Kenya region. Kenya: Smallholder Dairy (R&D) Project, Nairobi, Kenya.

World Bank, FAO, IFAD. 2009. Gender and livestock. In: *Gender in agriculture sourcebook*. Washington, DC: World Bank, FAO, and IFAD.

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