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The Nexus of Gender and Nutrition: A Literature Review

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Authors

Alyson Young, PhD
Sarah Lindley McKune, MPH, PhD
Sandra Russo, PhD
Thérèse D'Auria Ryley
Astou Diao Camara

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Contents

Introduction

Climate change has significant impacts on communities worldwide due to the increasing occurrence of uncharacteristic weather patterns and the intensification of both the frequency and severity of environmental shocks, such as drought. These manifestations of climate change have the potential to directly and severely impact communities that rely on livestock production as a primary livelihood strategy because of their reliance on water and grazing land. Pastoral populations always have been highly adaptive, a necessary trait given the weather variability that is characteristic of the arid and semi-arid ecosystems in which they live. However, climate change is forcing new levels of adaptation among livestock holders, and many are significantly affected by the consequences of their adaptations, particularly human nutrition. The negative impact on health is manifest not only in terms of undernutrition, but also in terms of disease and injury. Women, who have limited power and agency in livestock-holding communities are at particularly high risk of suffering the ill effects of climate change, both in terms of their nutrition and otherwise.

This literature review will address the interaction of climate change and nutrition within livestock communities. While this is a global issue, we focus on scholarship from West Africa, and engage a gendered perspective. We show how adaptations, such as sedentarization, may serve as a detriment to the nutrition of people in livestock-holding communities, in addition to the ways in which climate change directly affects health. We use an inclusive definition of livestock holder–one that captures agricultural and pastoral communities–to gain a more complete understanding of those affected. We look beyond calorie deficiency in our evaluation of nutritional outcomes to provide a complex illustration of the ways in which communities are hampered in terms of nutrition.

We are using gender as a framework for our discussion. Gender-based discrimination can be intensified by, and can intensify, the effects of community adversity – the dire effects of climate change are no exception. Therefore, it is crucial to examine issues stemming from climate change with gender as a primary focus. Birks succinctly articulates, "By incorporating a gendered lens, the pernicious nature of gender-based differentials in power is brought to light, revealing variable manifestations of gender-based discrimination" (Birks et al., 2011, 590).

Furthermore, gender mainstreaming is the intentional strategic action that policy makers use to reduce gender-based discrimination in nations throughout the world (Preet et al., 2010, 2). As a result, gender mainstreaming has been a key discourse in global efforts to ensure human rights to women. Incorporating a gendered lens into the development of policies and legislation is an ongoing process and, consequently, must be continually reincorporated when new issues arise, such as the impacts of climate change on nutrition (Preet et al., 2010, 2).

Climate change is already having an impact on gender rolesby forcing community men and women to take on activities and roles in which they were not previously engaged (Djoudi and Brockhaus, 2011). Unfortunately, a gendered approach to issues stemming from climate change has not been systematically applied in the related scholarship. As of 2010, no scholarly articles were published that discussed climate change, nutrition, *and* gender; despite significant research indicating a) climate change impacts the poor (Alderman, 2010), b) women are the poorest of the poor (Glazenbrook, 2011), and c) climate change will disproportionately impact nutritional status of poor populations (Preet et al., 2010; Alderman, 2010; Lloyd et al., 2011; Blackwell, 2010). Impoverished livestock holders are intimately dependent upon the environment for survival, and suffer quickly and profoundly from environmental events related to climate change. Understanding gender issues as they relate to climate change and nutrition is of utmost importance for these communities.

In this document, we first engage in a discussion of livestock holders: who they are, how their livelihood is affected by climate change, and what the nutritional implications of livelihood adaptations among livestock holders are. Next, we explore the role of nutrition and gender in the short-term coping strategies and long-term livelihood adaptations of livestock holders. Last, we look at the broader implications of climate change on nutrition and situate the experience of livestock holders within that framework.

Livestock holders - shifting livelihoods

Whereas climate change is commonly quantified in terms of isolated, aberrant environmental disasters such as drought and flooding, it is important to note that these instances are part of a more subtle and ongoing pattern of change. Baro and Deubel (2006) highlight that rural communities experiencing challenges to livelihood and nutrition see environmental disasters as a continuous problem, whereas researchers and policymakers tend to focus on the causality of isolated events. They write, "…insiders' and outsiders' perception often differ significantly; insiders view famine as a problem of poverty and an intensification of ongoing processes rather than as an unusual or extraordinary circumstance" (Baro and Deubel, 2006, 525). An integral part of this process is the cumulative effects of the interaction between climate events, livestock holdings, and human nutrition. It is therefore essential that researchers and policy makers conceptualize the impact of climate change on nutrition as an interactive and ongoing process. While it may be possible to identify one isolated period of drought, the specific detriment that any given drought period has on nutrition is context dependent, showing both immediate and longer-term consequences.

Pastoralism is linked to cultural values

Pastoralism is a livelihood that for centuries has been entrenched in the cultural values and practices of peoples throughout Sahelian West Africa. Pastoralists also have been historically marginalized; so-called development policies, designed to pressure pastoralists into sedentarization, have served to push these communities further towards the margins of national attention (Pedersen and Benjaminsen, 2007). In Adriansen's study of the Fulani of Ferlo, Senegal, individuals indicated that livestock holding and pastoralism, not lineage, was the ultimate determinant of Fulani identity (Adriansen, 2008). Yet, increases in aridity force rural communities to adjust their livelihood strategies as a means for coping, including those livelihoods that have been integral to their ancestry for centuries. However, local ecologies are changing due to climate change. Grazing land has become sparse, and many natural water sources such as seasonal lakes have dried up, rendering it impossible to maintain large heads of cattle throughout West Africa (Djoudi and Brockhaus, 2011). Pastoral communities including the Fulani of Ferlo have been forced to alter their livelihood practices because of worsening environmental conditions and development policies. The movement away from practices so seamed with cultural meaning and well adapted to the natural environment, reveals the force of the impact climate change has on rural West African communities.

Pastoralists are highly adaptive

Previous research on livestock production often referred to West African pastoralists as "pure" pastoralists, or communities that were highly mobile, characterized by frequent periods of transhumance, and the partaking in little to no sedentary cultivation practices. However, the reality of pastoral livelihoods is much more complex. Pastoralism is a livelihood that is not homogeneous in time or space, and never has been (Roth and Fratkin, 2005). Pastoralism is a finely tuned relationship that exists between humans, livestock, and fragile ecological systems, ecosystems often too poor to support agriculture and/or large populations. Independent of climate change, pastoralists are highly adaptive, responding to the highly variable nature of their environment. This adaptability, however, does not render the livelihood of pastoralists infallible. On the contrary, because of consecutive and sometimes chronic environmental shocks delivered by climate change, many pastoral coping mechanisms and adaptation strategies are no longer effective. Current research suggests climate change has considerably increased the level of flexibility required of pastoral communities, while social structures, political policy, and economic change have simultaneously limited the historical adaptive capacity of these communities (Blackwell, 2010). As a result, many pastoral communities are straining their adaptive capacity, or the threshold at which they are able to effectively diversify activities and mitigate the negative effects of environmental perturbation (Folke, Berkes and Colding 2000, 433). Women in pastoral communities are particularly vulnerable because they have limited power and occupy a

marginal position in society. Glazenbrook explains, "When the feminization of poverty is put together with the connection between environmental degradation and poverty, it is clear that women are especially vulnerable to environmental damage" (2011, 766).

Climate change adversely affects livelihood sustainability

When discussing livestock holdings in West Africa, it is therefore necessary to identify the populations under consideration, particularly given the changes in livelihood activities that have occurred in recent decades (Turner, Ayantunde, Patterson, and Patterson, 2011). Scoones' sustainable livelihoods framework describes the process of livelihood diversification in response to changing environmental conditions, showing that environmental, economic, and health concerns influence communities to take on a variety of activities (Scoones, 1998 and Frankenberger, 2003). Climate change, with its associated increase in frequency and severity of extreme events, can have deleterious effects on livelihood sustainability. A "portfolio" strategy, such as the one described by Scoones, provides more flexibility; if unforeseen circumstances cause one activity to be less productive, communities can rely upon other livelihood activities. Where climate change has burdensomely asserted itself, pastoralists and others who hold livestock are forced to seek new livelihoods. Based on their study conducted in Sahelian West Africa, Turner and colleagues explain that among traditional pastoralists, most families have adopted varied livelihood activities that differ from the traditional mobile pastoralism that is central to their identity. Instead, current livelihood practices consist of sedentary farming and livestock rearing as well as various income-generating activities outside the agricultural community, including migration to larger cities in order to send remittances back to families in the rural areas (Turner et al. 2011, 184).

Shift to small ruminants is one adaptive strategy

While pastoralists have recently adopted more sedentary practices that reduce dependence on livestock, they also have been forced to adapt to climate conditions by changing the types of livestock they keep. Adriansen discusses this mode of herd composition and adaption when examining the impact of climate change among Fulani in Ferlo (north central Senegal). She articulates that families have opted to take on more small ruminants, such as goats and sheep, in place of cows. This is because cows are larger, require more feed and water, and greater mobility for grazing (Adriansen, 2008). While the lack of water renders it difficult to rear cows, the high cost of feed during drought when grazing is insufficient also deters livestock holders from rearing cattle. Adriansen argues that rearing small ruminants with lower caloric intake requirements enables Fulani to expand livelihood activities and reduce their vulnerability to climate change (Adriansen, 2008). This preference for small ruminants due to their resilience in environmental hardship was

embraced and brought into practice by the Fulani of Ferlo in the 1980s, as a result of the intense drought that had begun in the 1970s (Benefice et al., 1982). A study by Turner that focuses on the greater region of Sahelian West Africa, echoes this point, showing that a significant reduction in size of cattle herds has been favored by communities across the larger region due to lack of water (Turner, 1999). Ancey and colleagues, however, suggest that the increased rearing of small ruminants serves a different purpose for the Fulani of Ferlo (Ancey et al, 2009). They argue that small ruminants serve to help Fulani pastoralists economically, actually reinforcing their cattle herds. They argue that the sale of small ruminants provides income to buy feed for their cattle, enabling many Fulani communities to maintain or return to pastoralist livelihoods (Ancey et al., 2009, 112).

Reduction in herd size has implications for human health and nutrition

This reduction in herd size and focus on small ruminants has clear implications for human health and nutrition, as smaller and fewer animals mean less milk, and as a result, fewer calories from protein. Pastoralist diets generally change seasonally and inter-annually with changing climatic and socioeconomic circumstances. Animal products make up the majority of diet for pastoral populations that depend heavily on livestock and are an important source of protein. Grain comprises a small portion of these diets, but it becomes increasingly important as livelihood strategies shift towards agriculture and market-based activities. Milk is a dietary staple among pastoral communities, comprising 60-90% of diet depending on the population and season (Galvin et al., 1994). Meat and sometimes blood also serve as sources of protein, but serve as secondary sources. The importance of grains and cereal products varies depending on season, with grains becoming more important when milk is less available.

Pastoral populations overall tend to have diets that are calorie deficient but high in protein. Dry season intake among East African pastoral populations has been estimated at between 800-1400 kcal/day depending on season (Galvin et al., 1994; Galvin, 1992). As diets become more grainbased , there is a corresponding change in the prevalence of protein. So, while calorie density may increase, the prevalence of protein and micronutrient deficiencies also increases (Shell-Duncan and McDade, 2005). These changes are particularly important for women and children, who suffer the greatest consequences from undernutrition during critical periods of growth and reproduction (such as pregnancy and lactation).

Other adaptation strategies include diversification

Reduced dependence on livestock is not the only strategy used for coping with climate change in rural West Africa, however. According to Jones and Thornton (2009), many agricultural communities that have not traditionally relied upon livestock production have begun to do so as a means of coping with adverse climate changes. Ebi and colleagues reinforce this finding in their USAID study of smallholder agriculturalist adaptations to climate change in southern Mali. Crop producers stress the importance of livestock production as a livelihood strategy, and their suggestions focus on how to improve harvestsas well as how to improve community capacity to rear livestock (Ebi et al., 2011, 433). The increased incorporation of livestock production into historically agricultural communities might seem to contradict the activities of traditional pastoral communities; rather, it shows clearly that the increase in *diversity* of activities is the coping mechanism to combat the ill effects of climate change on rural communities. Livelihood diversity – the incorporation of a variety of activities to livelihoods of livestock holders – is a functional means for livestock holders to adapt to climate change (McPeak and Little, 2005, 88; Ancey et al., 2009).

Livestock holders, then, are any members of a community that incorporate some form of livestock rearing as a necessary component to their livelihood. Livestock holders include those few who maintain livelihoods deeply entrenched in pastoralism as well as those who have initiated livestock production in order to supplement dwindling crop production. Climate change is a continual driver of livelihood change across West Africa. Thus, livestock holders from mobile and settled communities with varied herd compositions and intensification strategies must all be included in a conversation about the impact of climate change on nutrition. Limiting the range of livelihood diversity would greatly reduce our understanding of adaptive capacity and risk further marginalization of those most significantly affected by climate change.

Coping mechanisms and adaptations – implications on gender and nutrition

As livelihood strategies shift, daily tasks and workloads also shift. Tasks originally delineated according to gender shift, muddying gender roles in communities throughout the world. Rural women typically experience an increase in workload as climate change impacts livelihood strategies (Agarwal, 2000). As previously indicated, men often travel to urban areas or abroad to find work, which places women at home as *de facto* household heads (Fratkin and Roth, 2005). When this outmigration occurs, women must tend to their work as well as men's work, performing both feminine and traditionally masculine tasks. Standing (1989) referred to this doubling of work efforts as the 'feminization of labor' (Standing, 1989).

Economic opportunities for women are reduced/threatened

In situations where men remain within the community, men appropriate women's economic resources (Ancey, 2009). Fathers do not give their daughters animals, because they will marry out of the family and take the animals with them. Likewise, upon marrying a woman who has animals, a husband assumes ownership of her animals in place of dowry, and keeps the woman's animals if they divorce (Ancey et al., 2009, 109). Women who own animals often opt to leave their animals with their parents in order to prevent husbands from assuming ownership. Furthermore, Corniaux and colleagues note Fulani men, who have access to larger markets, have begun to sell milk, which is traditionally a woman's responsibility and resource (Corniaux et al., 2006, 518). Women experience heightened discrimination as their limited economic opportunities are threatened.

In their study of communities living around Lake Faguibine in northern Mali, the Djoudi and Brockhaus describe the complex ways that recent environmental events have affected communities along gendered lines as the drying up of the lake has meant a loss of existing water sources (2011). This, in turn, increased women's workload and exacerbated their vulnerability to exhaustion and undernutrition, in addition to the burden of caring for their households alone.

> *"The division of labor along gender lines has also shifted. Several activities such as livestock herding and charcoal production were in the past explicitly associated with men. They have now been added to women's responsibilities. As a consequence, women's workload has increased with the evolution of adaptive livelihood strategies. Sedentarisation… increased women's burden because they have to manage traditionally male activities such as tending livestock…In the absence of male labor due to migration, those new activities have been automatically undertaken by women. With more work and fewer men to do it participants in the women's workshops explained that they were increasingly vulnerable."* (Djoudi and Brockhaus, 2011, 128)

The authors go on to articulate the different ways women and men experience climate change. Men experience a distancing from environmental activities, stepping into market economies, while women experience an intensification of their dependence on the environment. Because of these differing experiences, women and men have different insights and goals about the long-term strategies that will reduce climate change impact on their families and communities. Men, distanced from a continually degrading environment, cite that returning to pastoralism is the ideal, whereas women, who engage with this difficult environment on a daily basis, cite increasing income-generating activities and sending younger generations to school. Women's foci underscore the need for current and future generations to learn skills and expertise that will distance their intimate dependence on the environment, thereby significantly reducing their vulnerability.

Blackwell examines the strategies of pastoralists, finding that the most desirable long-term strategy was to "maintain pastoralism for as long as possible" (Blackwell, 2010, 1324). This is not unlike the

perspective expressed by Djoudi and Brockhaus' male informants, who voice the desire for the costly and inefficient plan to refill the lake through man-made interventions so they can return to a pastoralist livelihood (Djoudi and Brockhaus, 2011, 131). Unlike Djoudi and Brockhaus, Blackwell does not acknowledge the drastically different ways in which men and women experience and cope with climate change. Therefore he misses the critical gendered perspective on climate change, failing to realize the useful insights women have because of the intimacy with which they engage their environment. The positions of the community on long-term strategy is rarely homogenous, but is intensely nuanced along gendered lines, as illustrated by the research in northern Mali. Failure to acknowledge and engage the unique experiences and perspectives of women on the part of researchers and policymakers reinforces gender inequity (Glazenbrook 2011).

Compromises are made between short-term coping and long-term strategies

Livestock holders make compromises between short-term coping activities and longer-term adaptation strategies (Niamir-Fuller, 2000). This conflict is fundamental to understanding the nutritional situation of livestock holders, particularly those who are still involved in highly mobile pastoralism and recently sedentarized communities. Referring back to Djoudi and Brockhaus as well as Blackwell, regardless of the long-term strategy desired, both men and women are cited as very much wanting to focus on long-term adaptation strategies (2011, 132; 2006, 1324). This usually is not possible for a variety of reasons, including the financial expense of committing to activities that will not yield immediate gains. Despite long periods when men are absent, women still have limited authority to steer their families and communities in the direction they see most fit due to gender-discriminatory policies and reinforced gendered expectations (often on the part of mothers-in-law who seek to serve the interest of their sons who are away and not necessarily the interest of their daughters-in-law) (Djoudi and Brockhaus, 2011; Mwangnome et al., 2011).

With this desire to attend to long-term adaptations in mind, we turn to Richardson's study on food security (Richardson, 2010). According to the author, livestock holders perform short-term coping activities during times of environmental crisis in order to meet – or attempt to meet – daily caloric needs (Richardson, 2010, 13). However, unfavorable terms of market exchange for livestock holders during environmental disaster leads to lower caloric intake (Nori et al. forthcoming). Women are particularly vulnerable as they experience increased workloads and, consequently, increased caloric output (Martorell and Zongrone, 2012). Stressing that environmental disasters are not simply isolated and short-term events as they often times appear to be in the literature, the extended and compounding threats of undernutrition are of continuous concern for livestock holders (Baro and Deubel, 2006).

Nutrition is arguably the strongest determining factor of when and what livelihood adaptations are adopted by livestock holders. Desire to reduce vulnerability to environmental conditions is motivated by

threats to nutrition. At the same time however, efforts to make long-term adjustments to combat environmental conditions are trumped by immediate nutritional needs. Nutrition as an impetus for action is not one-directional but serves to both motivate and restrict. Likewise, the deleterious presence of undernutrition in livestock-holding communities is manifest in a variety of ways, as will be seen in the following section.

Global profile of climate change and nutrition

Climate change has direct impacts on nutrition on a global scale, but has disproportionate effects on rural poor. O'Hara, citing a 2003 WHO study, explains that climate change was directly responsible for 150,000 deaths and 5.5 million disability adjusted life years (DALYs) in the year 2000 alone (O'Hara, 2011, 36). Undernutrition, a lack of protein and or micronutrients, contributes to both mortality and years of health life lost (captured in DALYS). The first to develop a model to estimate undernutrition projections for 2050 adjusted to account for the impact of climate change. Lloyd et al. use low-height-for-age with a standard deviation of two below the WHO/CDC norm (considered moderate stunting) to measure undernutrition in South Asia and Sub-Saharan Africa (1817). According to Lloyd et al., the dwindling livestock populations and poor crop yields associated with climate change leave individuals with a deficit in the number of calories needed to maintain health (Lloyd et al., 2011). Their model predicts the effects of climate change will lead to a 55% increase in severe stunting in sub-Saharan Africa, (Lloyd et al., 2011, 1820). Shockingly high, they acknowledge the repercussions of such stunting will be far reaching, as "moderate stunting increases the risk of all-cause death 1.6 times and severe stunting increases the risk 4.1 times" (Lloyd et al., 2011, 1821).

Potential is high for undernutrition in climate-impacted pastoral populations

The potential for undernutrition from environmental perturbation is particularly high in communities where livestock rearing is a significant source of income, due to market fluctuations and unfavorable market exchange, referring specifically to non-monetary exchange or bartering. Research has documented that the caloric terms of trade between livestock product and grains is typically a favorable exchange for pastoral populations (Nori et al., forthcoming). When environmental conditions are favorable, or at least normal, livestock products are exchanged at a lower calorie-per-kilogram (cal/kg) value than cereals. However, when harvests are poor, these terms of trade reverse, and (cal/kg) values of grain rise significantly. Livestock holders exchange their livestock quickly to avoid animal losses to starvation and disease, therefore exchanging more cal/kg of livestock product for significantly less cal/kg of cereals. Therefore, during times of crisis, livestock holders experience a significant caloric deficit (Nori et al., forthcoming).

Lloyd et al., (2011) focus on food and non-food factors that contribute to undernutrition. They define non-food factors broadly in terms of socio-economic conditions such as low education rates of women. In focusing on crop yields to resulting caloric availability deficit, however, they fail to take into consideration effects of climate change on disease prevalence that also poses potential threats to nutrition. Climate change can have deleterious effects on communities in terms of disease for two reasons. Poor nutrition causes higher susceptibility to infection, and climate change can also increase significantly the presence of infectious agents in a given region. Diseases such as malaria, cholera, and dengue have increased in various regions of the world due to uncharacteristic vacillations in climate conditions (Haines, 2008). In their discussion of famine, Baro and Deubel underscore that most famine mortality is due to disease outbreak rather than undernutrition alone (Baro and Deubel, 2006, 524). Climatic impact on disease prevalence has a dual impact on former pastoralists who sedentarize. Due to high mobility, pastoralists are said to leave disease behind; they do not remain in a location long enough for their communities to acquire disease from environmental vectors at a significant rate (Roth, Nathan, and Fratkin, 2005). So, when these populations engage in transhumance, they literally move away from disease vectors. However, this also means sedentarizing pastoralists (and their animals) are often susceptible to a higher prevalence of infection due to exposure to pathogens with which the population has limited immunological experience. Therefore, changes in disease prevalence caused by climatic shifts are exacerbated in these communities that are unhabituated to environment-borne diseases associated with sedentary livelihoods (Roth et al., 2005)

Climate change has a direct, four-fold impact on nutrition for livestock holders

If we engage a discussion of Baro and Deubel (2006); Lloyd, et al. (2011); and Haines (2008), we can distinguish that the direct impact climate change has on nutrition of livestock holders is fourfold. First, low crop yields caused by the effects of climate change lead to calorie deficiency causing undernutrition. Second, uncharacteristic changes in temperature and weather causes disease outbreak, which, via infection, exacerbates undernutrition. Third, the ability to perform physically demanding coping tasks required for sustainability of the livelihood is compromised by disease and undernutrition. Lastly, occurring simultaneous to disease outbreak, undernutrition causes increased susceptibility to disease.

According to Denton (2002), women suffer higher rates of undernutrition than men, and are at higher risk for contracting infectious diseases, because of increased biological susceptibility to diseases in addition to the nutritional demands of pregnancy and lactation. For instance, pregnant women have higher susceptibility to malaria because during pregnancy women's bodies emit higher levels of carbon dioxide (Menendez 2006). Malaria-carrying mosquitos are attracted to high carbon dioxide levels and therefore pass the disease to women during pregnancy with higher frequency. In addition, women are at higher risk because

they are responsible for activities such as gathering water that put them in frequent and close proximity to vectors of diseases including malaria. As Denton notes "poor women are generally on the receiving end of the effects of increasing environmental degradation and depletion of natural resources, because of their involvement in, and reliance on, livelihoods activities which depend directly on the natural environment" (Denton 2002, 12). The compounding effect of biology, climate, and livelihood practices render pastoral women at high risk for undernutrition.

Nutrition is not free from gender-discrimination

Nutrition is not free from gender-discrimination in other ways, as exemplified by Mwangome and colleagues (2010) in their study of gender-role impact on child and maternal nutrition in rural communities in The Gambia. They explain that women have little say and little agency in caring not for the nutritional needs of themselves or their children. Despite strenuous workloads and long workdays, which are ever increasing, women serve food to children, men, and elderly first, eating last despite their own high caloric expenditures. In their study, women "reported that men receive the largest, best and first share of the meals and that women only eat after the men and children are satisfied" (Mwangome et al., 2010, 169). Denton extrapolates upon practices such as these that put women at higher risk of suffering health and nutritional problems, explaining that "although women in most countries have longer average life expectancy than men, the quality of women's health is low compared to that of men in their households and communities" (Denton, 2002, 15). Women, despite their significant contributions to household and community function in terms of workload and involvement in child rearing, may be powerless to create or employ new coping strategies to buffer the ill effects of erratic environmental conditions.

Furthermore, Mwangome and colleagues explain that long workdays tending to crops and livestock pull women away from caring for young children, in particular reducing the frequency of breastfeeding and the time allocated for feeding weanlings and older children, and the time allocated for care of sick children (Mwangome et al., 2010). Despite the fact that women may be charged with the task of seeking medical attention for the care of their malnourished children, Mwangome and colleagues have found that women do not have the authority to follow medical treatments. In rural Gambia, men and sometimes older mothers-in-law have the power to decide upon treatments, regardless of the women's knowledge or experience with medical practitioners. They note that men often will opt for less costly forms of care that may not appropriately address undernutrition or another illness. They also note that men have the sole power to decide where women will give birth and on child-spacing, both decisions that could determine the survival, nutrition, and overall health outcomes of women and children.

Current livelihood adaptation strategies are not wholly sufficient to ensure livestock holders' adequate nutrition, where sedentarization leads to nutritional issues for pastoralist women, and crop and livestock losses occur at significant rates (Fujita et al., 2005; Glazenbrook, 2011). Because so many rural communities rely directly on crops and agriculture to feed their families, these climate-related losses have a severe impact on nutrition, including long-term effects on physical and cognitive development and increased risk of malnutrition among subsequent generations (Glazenbrook, 2011; Martorell and Zongron, 2012).

Conclusion

As evidenced by this literature review, the research on the effects of climate change on nutrition among livestock holders is still in its infancy. Coping mechanisms and adaptations that livestock-holding communities employ are being tested by the increasing stress of climate change, and these coping mechanisms and adaptations have clear implications on the nutritional status of the community. We hope that by employing a broad definition of livestock holders and engaging in a discussion of the literature on climate change, nutrition, and livestock holders, that we have established a basis from which to continue future research concerning nutrition within this population. Key environmental, social, and health processes that must be addressed broadly and in an integrative way are yet to be uncovered..

The findings from our review indicate the discussion on climate change and its effects on the health of livestock holders are in dire need of research that engages a deep understanding of the ways in which climate change interacts with gender, especially in impoverished communities where women struggle to meet daily needs. Figure 1 illustrates the findings that climate change is affected by biologic and livelihood processes, which work to undermine the nutritional status and cycle of livestock holding women.

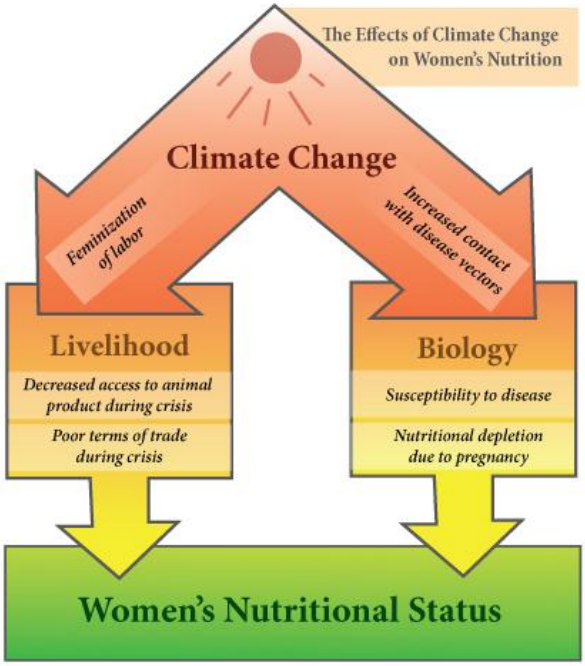

Figure 1. Process by which climate change affects women's nutritional status.

While we have focused on the disproportionately deleterious impact of climate change on women's health in livestock production systems, it is important to keep in mind that gender is more than just "women," and the shifts in gender roles that we outline in this paper often affect both men and women, but in different ways. Gender is not simply the role of women in society, both symbolic and actual, but of women and men. It is the intertwinement of men and women, of the masculine and feminine, and how these two concepts mesh, blur, and conflict with one another in any given situation. Approaching gender in terms of both women and men will allow us to arrive at a complex understanding of society, one that appreciates the differences of opinions and lived experiences of those who constitute these roles in their societies on a daily basis.

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