

Gendered livelihood impacts and responses to an invasive, transboundary weed in a rural Ethiopian community

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Abstract

Gender as unequal power relations intersects with global environmental change threatening agriculture-based livelihoods, including land degradation, increasing climate variability, and invasive alien plants. Commonly overlooked, invasive alien plants may have gendered impacts on everyday life that disproportionately affect the less powerful. Drawing on experiences of smallholder farmers in Ethiopia's Oromia region with an invasive, transboundary weed, *Parthenium hysterophorus* L., this paper illustrates how environmental change interacts with pre-existing vulnerabilities to shape individual and household-level impacts and responses. We applied a feminist perspective in livelihoods and environmental change research and praxis to explore the intersection of gendered livelihoods and parthenium management in spaces of everyday life. While invasive plants, including parthenium, may be easily perceptible in the field, understanding impacts on livelihoods requires consideration of women's and men's roles and responsibilities within the broader household compound as well as intra-household decision-making. Parthenium can be harmful to environmental, animal, and human health, but unduly impacts women's labor, spaces, and assets, including cows whose milk may be tainted by grazing in parthenium-infested fields. We demonstrate the importance of considering women's social networks and so-called reproductive space and labor to understand gendered and place-based inequities of climate change. This study reveals intimate connections between environmental stressors and gendered livelihoods. Our findings demonstrate how inequalities can be reinforced by new forms of vulnerability, with response options socially differentiated. We argue that a feminist livelihood lens helps bridge the global scale of environmental change with local scales of gendered livelihood adaptation embedded within broader socio-environmental change.

Key words: livelihoods, adaptation, gendered space, everyday life, house-lot garden, *Parthenium hysterophorus* L.

Introduction

Environmental change occurs in a context of unequal power relations at different scales, with gender playing a key intersecting role (Rocheleau, Thomas-Slayter, and Wangari 1996; Ravera et al. 2016). Invasive plants, which are embedded within environmental change, are a growing global threat to the viability of agriculture-based livelihoods. An estimated 40% of crop yield losses in global food security hotspots are attributed to insect pests, plant diseases, and weeds (Savary et al. 2019). Invasive alien species create special hardships in developing countries, where the majority of people are smallholders with 2 ha of land or less ill-suited to adapt to new shocks and persisting stressors (Pratt, Constantine, and Murphy 2017). Increasing temperatures and atmospheric CO₂ along with changing rainfall patterns magnify the impact and spread of invasive species, including one of the world's most problematic and invasive weeds, *Parthenium hysterophorus* L. (Nigatu et al. 2010; Bajwa et al. 2016; Adkins, Shabbir, and Dhileepan 2019). Of tropical American origin, parthenium has dispersed to at least 48 countries, infesting Ethiopia in the 1970s (Adkins, Shabbir, and Dhileepan 2019). Along with negative impacts on agricultural yields, grazing lands, and biodiversity, parthenium can cause allergic reactions in humans and livestock, such as skin lesions, dermatitis, and respiratory problems (Duguma, Fitamo, and Kebede 2019). Animals that ingest the weed produce lower-quality meat and milk and infested fields require more labor for weeding (Adkins, Shabbir, and Dhileepan 2019). Gender norms and roles influence how women and men are differently impacted by parthenium (Fish et al. 2010). Our approach to studying parthenium brings issues of environmental change, unsustainable agro-ecological practices, and adaptation home within a context of inequities at local and global scales.

Gender relations mediate women's and men's division of labor and access to resources (Agarwal 1997) and thus, parthenium's impacts on individuals, households, and communities. Women's unequal access to assets within the household and the economic importance of their labor, including domestic and reproductive labor, were raised as key development issues as early as the 1970s and have remained central to discussions of intrahousehold resource allocation (Weeratunge et al. 2016; Doss and Quisumbing 2020). Many positive development outcomes, including child nutrition, depend on women's bargaining power and control over assets within the household, with men generally owning more and higher value assets than women (Yimer and Tadesse 2015; Johnson et al. 2016). Decades of research on household decision-making and

assets refutes the unitary model of the household as a single production or consumption unit, confirming it instead as a site of cooperation and contestation (Agarwal 1997; Doss 2013; Badstue et al. 2020). Our research builds on this important literature by examining intrahousehold decision-making, specifically over assets affected by parthenium in Ethiopia.

This paper presents the gender component of an inter-disciplinary agricultural research-for-development project. It aims to contribute to feminist approaches to livelihoods and global environmental change while speaking to scholars and development practitioners alike. We draw from theories and methods that have emerged from feminist livelihoods (Oberhauser, Mandel, and Hapke 2004), including a focus on human-environment relations (Radel 2012; Langill 2021), and feminist political ecology (Rocheleau, Thomas-Slayter, and Wangari 1996; Sultana 2011; Elmhirst 2015) to examine gendered impacts and responses to parthenium in eastern Ethiopia. While feminist livelihood scholars have approached globalization with a critical focus on markets and neo-liberal policies (e.g. Johnston-Anumonwo and Oberhauser 2011), we extend an environmental lens to this literature that reveals new forms of vulnerability contexts (Ellis 2000).

We argue that a feminist livelihood lens highlights the interconnections between gender, environmental change, and inequality, of essential relevance to livelihood literature and practice. Focusing on gendered spaces of everyday life, including the house-lot garden, we contribute the case of an invasive weed to engage with discussions of livelihoods and environmental change. With an eye on women's control of livestock assets, we explore 1) how the spread of parthenium impacts women's and men's gendered livelihood roles and responsibilities, and 2) how gendered intrahousehold decision-making dynamics shape livelihood adaptation strategies. While our research site is in Ethiopia, our approach and findings are relevant to other places where scholars and practitioners seek to understand socially differentiated livelihoods in the context of global environmental change and interwoven vulnerabilities (Zuo et al. 2021).

Feminist approaches to livelihoods, the environment, and spaces of everyday life

Livelihood frameworks include “resources (what people have), strategies (what people do), and outcomes (the goals they pursue)” (Oberhauser, Mandel, and Hapke 2004: 205). Livelihood assets include natural, physical, human, financial, and social capital (Ellis 2000). Sustainable livelihood approaches were institutionalized by the UK's Department for International

Development in the 1990s “with large doses of misapplication and misunderstanding along the way” (Scoones 2009, 179). These sought to address poverty alleviation by focusing on the ways people make a living, including their adaptation to shocks and stressors (Chambers and Conway 1992; Scoones 2009). Criticisms of livelihood approaches include their excessively economic and top-down focus, and their neglect of power relations, the environment, and social networks (Scoones 2009; De Haan 2012; Hanrahan 2015). Voices from the Global South have criticized the lack of attention to gender in livelihoods literature and stressed a need to consider gender-related barriers to adaptation to climate change (Krishna 2012; Abebe 2014; Mersha and van Laerhoven 2016). Feminist livelihood and feminist political ecology (FPE) approaches put gender as power relations at the center, considering decision-making, knowledge, and control of assets in that space, and stress the role of social networks (Rocheleau, Thomas-Slayter, and Wangari 1996; Oberhauser, Mandel, and Hapke 2004; Nelson 2016; Smucker and Wangui 2016).

The spaces and practices of everyday life, including productive and reproductive spheres, are central to feminist livelihood and FPE approaches (Rocheleau, Thomas-Slayter, and Wangari 1996; Oberhauser, Mandel, and Hapke 2004; Nightingale 2011; Sultana 2011; Radel 2012; Langill 2021). Gender norms and relations are affirmed and challenged in these spaces (Nightingale 2006; Christie 2006). Women and men cope with climate and other environmental changes in the context of their everyday lives (Bee, Rice, and Trauger 2015; Ravera et al. 2016; Rao et al. 2019; Langill 2021). King (2011) called for spatializing livelihoods within the context of social relations, stressing that “a livelihood system must be interpreted beyond the material conditions necessary for survival to include the meanings imbued in everyday experience and decision-making capacities” (299).

These perspectives frame our investigation into how parthenium infestation in the fields connect to the spaces within the household compound. Prioritizing the latter aligns with literature on the house-lot garden, which can include plants, animals, and food products that serve for gifting or exchange and often fall within women’s sphere of influence (Christie 2004). The house-lot garden provides important contributions to livelihoods and food security (Dissanayake and Maredia 2021) and supports gendered social networks (Kimber 1966; Winklerprins 2002; Christie 2006, 2004). A binary conception of productive and reproductive work and the limited

visibility of women's unpaid labor has contributed to the house-lot garden and other spaces in the so-called domestic sphere often being ignored by both scholars and practitioners. These spaces are rendered important in feminist livelihoods and FPE, with their focus on gendered access and control over livelihood assets, which for women are often situated there. Research framed by FPE has pointed to the household and house-lot garden as important scales of analysis for understanding women's agency and complex intrahousehold negotiations, while also considering the linkages between the household and broader socio-cultural and ecological processes (Christie 2004; Nightingale 2011; Elmhirst 2015). In this paper, we look at decision-making and livelihood strategies enacted by women in these spaces and the blurring of scales between house-lot garden and field in response to parthenium infestation.

Our research responds to calls for feminist approaches to be more central to studies of environmental change (Iniesta-Arandia et al. 2016; Ravera et al. 2016), where gender norms and gendered power relations remain understudied and their integration into the design and implementation of programs and policies limited. Rao et al. (2019, 14) note that “nearly all policies aimed at developing and strengthening the adaptive capacity of local communities fail to recognize the gendered nature of everyday realities and experiences.” Previous research straddling agriculture, environmental change, and livelihoods stresses that “in the context of climate change, it is particularly important to understand how gender mediates opportunities and challenges to increase agricultural productivity and livelihoods” (Kristjanson et al. 2017, 482). Most of this research has focused on documenting women's greater vulnerability. One study on gender dimensions of agriculture and climate change shows women to be less adaptive in part because available adaptation strategies “tend to create higher labour loads for women” (Jost et al. 2016, 133). Abebe (2014) stresses that climate change has exacerbated pre-existing problems in East Africa with impacts disproportionately felt by women, whose lesser access to resources and decision-making results in a weaker adaptive capacity—particularly rural women whose livelihoods are dependent on natural resources. FPE recognizes that “women carry a disproportionate share of responsibilities for resource procurement and environmental management” and that the “gender imbalance in environmental rights and responsibilities derives from relations of power based on gender, among other factors” (Rocheleau, Thomas-Slayter, and Wangari 1996, 13).

Ravera et al. (2016) state that “despite their vulnerability, women are also increasingly proactive in negotiating and adopting individual and collective innovative strategies for dealing with and adapting to environmental change” (S235). Much of the literature addressing women’s adaptation to climate change and other environmental stressors point out the importance of gendered social networks. In Tanzania, Muthoni and Wangui (2013) found that women play an important role enhancing their village’s adaptative capacity to climate change, despite having fewer livelihood assets and less control over decision-making than men, and that women’s social networks based on trust and reciprocity between women are key. Smucker and Wangui (2016) stress that the largest challenge to women’s effective adaptation to climate change is a lack of access to the social networks and institutions that allocate necessary resources; they warn that “while there is much to be learned from the ingenuity and innovative practices that have enabled women to cope with greater climate variability, our understanding of them should never be divorced from the gendered forms of exclusion that shape knowledge–practice complexes” (S284).

In South Africa, one study on gender-related vulnerabilities to climate change and other stressors finds that “women may be more innovative in their individual and collective responses to stressors than men and may have more social capital to draw on” (Shackleton, Cobban, and Cundill 2014, 73), again pointing to the importance of local social networks...” (85). Also in South Africa, Nyahunda and Tirivangasi (2022) found rural women “embarking on a cocktail of activities to adapt and mitigate to climate change impacts” (1061), and argue that “social networks are providing a unique adaptation resource to rural women” (1070). They conclude, however, that rural women “are confronted by an avalanche of challenges which serve as barriers to effective adaptation” (1071).

Building on this literature, we identify women’s agency in adapting to parthenium infestation in a context of a changing climate, unsustainable grazing practices, increased labor demands, and limited control over assets. Heeding feminist warnings against viewing women as a homogenous group of passive victims perpetually vulnerable to climatic and environmental shocks (Arora-Jonsson 2011; Rao et al. 2019; Alston 2020), we present women as agents of change shaping household and community responses to shocks and stressors. Our study highlights the context of

unequal gendered power relations compounded by an invasive, transboundary weed and the root causes of underlying vulnerabilities.

Gendered livelihoods in eastern Ethiopia

We carried out this study with smallholder farmers around the town of Welenchiti, Boset Woreda, eastern Shewa Zone, Oromia region, Ethiopia (Figure 1) as part of a research-for-development project funded by the U.S. Agency for International Development (USAID) through the Feed the Future Innovation Lab for Integrated Pest Management (IPM IL). The IPM IL has been engaged in Welenchiti since 2007, collaborating with farmers and local development agents from the government agriculture extension system to assess the potential of using natural insect enemies as a cost-effective and environmentally safe approach to controlling parthenium. The project worked with local universities and a research institution to establish a quarantine facility, hold workshops for researchers and extension agents, breed the leaf-feeding beetle *Zygogramma bilocolorata*, and in 2014 released the beetles to help control the weed (Mersie et al. 2019). We selected Welenchiti based on the relationship between the project and the community. The level of parthenium infestation and livelihood activities there are similar to other communities in eastern Ethiopia, making it an ideal location to investigate the intersection between gendered livelihoods and invasive weeds with broader significance of the findings.

See Figure 1. Study site in eastern Ethiopia.



Ethiopia is a landlocked country in the Horn of Africa. With over 85 ethnic groups and most world religions represented, as well as animist belief systems, the country’s diversity extends to its agro-ecological zones and farming systems (Fafchamps and Quisumbing 2002). Despite recent economic progress, Ethiopia has a history of recurring drought, famine, prolonged armed conflict with Eritrea, and a current civil war. The country’s level of development, gender disparities, and dependence on agriculture make it particularly vulnerable to climatic and environmental change (Mersha and van Laerhoven 2016).

About 80% of the population and 40% of Ethiopia’s GDP is in agriculture, with 90% of production derived from the work of 12 million smallholder households (World Bank 2019).

Five crops comprise about 75% of total cultivated land and are the main source of Ethiopians' caloric intake: teff, wheat, maize, sorghum, and barley (Di Falco 2014; Aguilar et al. 2015). Crop production is primarily rainfed with only 3% of Ethiopia under irrigation, but increasing climate and rainfall variability has resulted in more frequent and intense droughts that adversely impact productivity and food security (Di Falco 2014; Mersha and van Laerhoven 2016). Parthenium has invaded crop and grazing lands across the country, endangering biodiversity and food security, causing declining agricultural yields and health problems for humans and livestock—among other impacts (Nigatu et al. 2010; Duguma, Fitamo, and Kebede 2019). The annual costs of weeding parthenium in Ethiopia alone have been estimated at US\$16.8 million (Pratt, Constantine, and Murphy 2017).

In many parts of Ethiopia, available pasturelands are not adequate to support the relatively large livestock population, resulting in overgrazing. As McFadyen (1992) reported from Australia, overgrazed lands are highly susceptible to invasion by parthenium. A study in Ethiopia showed that as the density of parthenium in a grazing area increases, the densities of different grass species were significantly reduced (Nigatu et al. 2010). In addition to the decrease in the above ground population, the level of grass seed below the ground also declined because of parthenium infestation. In another study in Ethiopia, Ayele et al. (2013) showed that the aboveground cover of grasses was reduced by 47% at the maximum weed density of parthenium as compared to plots without parthenium. These studies in Ethiopia show that the distribution and level of valuable pasture grasses are negatively affected by parthenium infestation. Thus, in this agro-ecological context, parthenium infestation is facilitated by overgrazing of pasturelands as well as climate variability.

As in many countries in the Global South, gender norms and disparities in Ethiopia present major barriers to agricultural production and food security (Mersha and van Laerhoven 2016). Women have substantially less access to and control over livelihood assets required for agriculture than men, and significantly lower education levels (Fafchamps and Quisumbing 2002). Women are nearly 24% less productive than men (Aguilar et al. 2015) and female-headed households are twice as likely as male-headed households to experience food insecurity (Negesse et al. 2020). The World Bank states that “wide and pervasive gender gaps hinder not only female livelihoods, but also the potential for poverty alleviation and growth on a national level” (2019, 8).

Women's access to land, agency in farm decisions, and participation in community farmer associations varies across Ethiopia, but prevailing inequitable gender norms and power imbalances undervalue women's contributions to rural livelihoods (Mersha and van Laerhoven 2016; Mulema and Nigussie 2019; Tsige 2019). Despite women's involvement in most agricultural activities, men are perceived to be the farmers and heads of households, with women considered assistants to their husbands, providing labor but having minimal control over farm management (Gella and Tadele 2014; Tsige 2019). Historically, women are considered food processors and men food cultivators (Tsige 2019).

In their study of control and ownership of productive assets within rural Ethiopian households, Fafchamps and Quisumbing (2002) found that these are controlled by the household head regardless of who brought them into the marriage. While most animals are owned jointly, the head has the right to sell livestock and keep the proceeds. They found "the only exception is the right to keep money generated from the sale of dairy products such as milk, butter, cheese and eggs, a right that more often than not goes to women" (62).

Our analysis found crop production including grains such as teff and livestock management including cattle comprise the basis of livelihoods at our research site. Increasingly, farmers there cultivate haricot beans, onions, and legumes due to their higher market values. Several women we interviewed produce and sell Tella, a traditional beer brewed from grains, one owns a mill, and one a restaurant. Most had one to three dairy cows, goats, sheep, and chickens. Land ownership ranged from 0.3–5 ha (average 1.76). One farmer rents her plot. Households contained an average of 6.63 people each. Education averaged 3.54 years, with seven women having no schooling at all.

Data collection and analysis

We collected data via a two-part rapid gender assessment in 2017. Triangulating methods provided a more complete picture of gendered livelihoods. In total, there were 60 research participants (52 women, 8 men). Five key informant interviews (KII) with local development agents and leaders of farmer associations (three women, two men) provided historical context on the spread of parthenium throughout the region and farmers' adaptation strategies. Semi-structured individual interviews (SSII) with 30 women farmers focused on impacts of parthenium infestation on women's and men's labor, women's participation in livelihood

decisions, and beliefs and perceptions about the impact of parthenium on livestock management and milk. They included questions modified from the project-level Women's Empowerment in Agriculture Index (Malapit et al. 2019) such as "Who normally makes decisions about xyz?" and "To what extent do you feel you can participate in decisions about xyz?" Interviews lasted approximately one hour each and took place in women's homes. Focus Group Discussions (FGD) with 25 farmers (two women-only, one men-only) addressed the gendered division of labor in productive (e.g., weeding and milking) and reproductive (e.g., food preparation) activities. FGDs also illustrated ways gender norms shape livelihood strategies and how parthenium may reconfigure women's and men's roles and responsibilities.

We identified farmers for FGDs and SSIs through purposeful sampling with assistance from project staff and KIs using two criteria: awareness of IPM IL activities and self-reported high levels of parthenium infestation on their lands. Interviewees included women aged 19–60 years from households with female and male adults present (F&M) and households with an adult female but no adult males present (FNM).

Participatory activities such as socio-economic activity charts in the FGDs and a milk allocation game (in FGDs and SSIs) facilitated rich, two-way interactions. We developed the milk game to stimulate discussion on household dairy production and consumption. Participants were provided 20 tokens (representing portions of milk) to allocate within a fictional household of one adult male, one adult female, one older adult, one pregnant woman, one lactating woman, one child under five, and one child over five, represented by printed color images (Figure 2). We introduced the game in part two of our assessment, building on findings in part one. Thus, it was used in two FGDs and 17 interviews; not all 22 interviewees in part two had cows or time to play the game.

Our inter-disciplinary research team comprised a weed scientist, an entomologist, and two feminist geographers. We recorded participant responses on flipcharts and notepads, and engaged in ongoing reflection on our findings. Interviews and FGDs were conducted in Amharic or Oromo with translation by a team member. We compared men's and women's FGD responses and used descriptive statistics with quantitative SSII data to analyze gender patterns in production, consumption, and income allocation decisions. We also coded and analyzed data in ATLAS.ti using deductive and inductive approaches.

This research study was approved by the Virginia Tech Institutional Review Board (FWA00000572) as IRB protocol # 16-530 with Expedited review, per Categories 6 and 7. All research subjects gave informed consent.

See Figure 2. Milk allocation game.



Results

Below, we describe the labor demands required to manage parthenium, their gendered character, and the weed's impacts on livestock and the house-lot garden. We then present how gender norms shape intrahousehold power relations that in turn mediate the strategies mobilized to adapt to parthenium.

Weed management, labor, and gendered livelihoods

“Parthenium is like AIDS for our land.” (Men’s FGD, 12/6/17)

Parthenium density varies in Welenchiti. Some farmers said they could manage if they uprooted and burned it in the dry season before it flowered. For others, the problem was more severe, affecting their food crops, cash crops, and dairy production. Households spend 1–3 months weeding parthenium in the wet season, using outside labor as needed. Children over seven are out of school then and help. In the dry season, households usually manage the weeding themselves unless they have no adult male or children.

Hand weeding, the principal method for managing parthenium, both in Ethiopia and throughout Sub-Saharan Africa, has been reported as primarily women's responsibility (Fish et al. 2010). In Welenchiti, both women and men participate in weeding parthenium: "Managing parthenium is a family affair, all must be involved" (woman farmer, 7/21/2017). While all adult household members are typically mobilized, the division of labor is gendered. Most women are not strong enough to uproot the more established weeds by hand; these are primarily uprooted by men and then collected by women for burning. Women also clear parthenium from the house-lot garden before the weed is well established.

The majority of households prefer to hire labor for weeding, despite its costs, increasingly replacing the use of community labor exchanges, *wenfel* or *jigi*. *Wenfel* involves a reciprocal exchange of labor based on trust that your neighbors will help you in the future if you have helped them. *Jigi* is not reciprocal but can be invoked by resource-poor farmers in need of assistance, e.g., households without an adult man, or older farming couples. One woman explained: "When waiting for people [community exchange] your land will get invaded [by parthenium] so we prefer to hire labor..." (12/7/22). The need to reciprocate was challenging for women from FNM households in particular. One widow said: "If I have two people help me one day, I would have to help each of them for one day. I don't have the time or ability" (12/5/2017).

Women highlighted the indirect ways parthenium disproportionately affects their labor burdens, both physically and mentally. Their multiple livelihood responsibilities, including food preparation, cleaning, and child care, were strained by the time, effort, and costs required to manage parthenium. During the wet season (peak infestation), women wake up early and work late. In addition to their normal duties, women in households using hired labor or community labor exchanges prepared and provided meals for workers. "With parthenium, there is more

pressure on me...I am the one who has to prepare the coffee and injera in the morning ...help with the weeding and feed the hired laborers” (7/21/2017).

Livestock management, adaptation, and gendered space

“What we do is not let the cows graze but feed them in the house.” (Woman, 12/7/17)

Interviewees highlighted the importance of dairy cows for household food security and the impact parthenium has had on milk and other dairy products. Women allocated 78% of all tokens in the milk game to household consumption. Some said children are reluctant to consume parthenium-tainted milk because of a bitter taste. To reduce wastage, women disguised the bad taste with coffee or tea, or by mixing spices into butter. Despite its importance to household consumption, especially for children, access to milk and dairy products required either owning a lactating cow or having funds for purchase. Even as local and regional markets for milk and dairy products have expanded, selling excess production to neighbors remains common. Respondents in the men’s FGD emphasized milk’s market potential, while women highlighted the importance of sharing milk and other dairy products to maintain social relationships.

Women reported negative impacts of parthenium consumption on livestock health, but their main concern was the contamination of milk and dairy products that affect both household consumption and marketing. Women and men emphasized that they cannot sell parthenium-contaminated milk, nor would they purchase dairy products from someone who let their cattle graze in parthenium-infested fields. To adapt to parthenium infestation, many households in Welenchiti have moved dairy cows from the fields to the house-lot garden, feeding them crop residue and/or purchased feed. “One of my cow's health was severely affected ... she stopped lactating and what milk she was producing was mixed with blood and had a bad taste ... We brought the cow into the household compound and started to feed her with supplemental feed and she recovered.” (Woman, 7/20/2017)

Respondents said that lack of trust between neighbors regarding livestock management practices could be disruptive and, with parthenium in the fields, they had to pay close attention to how their neighbors were managing their cows. Women emphasized that people will not buy milk or other dairy products from farmers with parthenium infestation who do not keep their cows in the compound. One said: “One time I bought some butter from a neighbor and it had a bitter taste

and I wanted to return it. Later I saw how they were just letting their cows feed outside. I will no longer accept or purchase any milk or butter from that neighbor” (7/20/2017).

Women and men had differing views on who managed livestock. Men said that feeding cattle was primarily men’s responsibility, since they typically take cattle to the fields to graze. To men, women only “help.” In contrast, women reported that their labor had increased as they were responsible for collecting forage or purchasing feed with the transition of keeping cows in the house-lot garden.

Most respondents agreed that moving cows into the house-lot garden has been essential to maintaining economic, nutritional, and social benefits from dairy products. The transition has been beneficial to women and families, but has also generated new burdens, with women pointing to additional mental stress and concern about the future. Bringing cows into the house-lot garden has reduced the cows’ consumption of parthenium, but with the cost of improved feed, profitability of milk sales has decreased. One woman said: “...many people spend half of the money made or more from selling milk on feed for the cows to keep them from eating parthenium...” (12/7/2017). In the milk game, one woman set some milk aside for sale, rather than allocate it all to the fictional household members, so she could buy feed for her cows. “If I don’t give them feed, I don’t get the milk.” (12/7/17)

Gender norms and intrahousehold decision-making

Our findings align with literature showing dairy assets to be among the few controlled by women in rural Ethiopia, and food preparation to be women’s responsibility. This, and gender patterns in decision-making outlined below, illustrate inequities at the household level that set the parameters of women’s adaptation strategies in responding to parthenium infestation. One woman said she controlled decisions over the milk: “I don’t even tell him whether I sell [the milk] or consume [it] at home” (12/7/17). Her husband decided everything else.

Three decision-making themes characterize women’s ability to exercise agency in their households’ response to parthenium: 1) *Cooperative*: men and women cooperate in farm and household decisions, 2) *Consultative*: field and household decisions are linked, but separate, and 3) *Unilateral*: women have little influence and men make most decisions.

“A husband and wife should be one person, but there are two types of husbands in Welenchiti ... those that respect their wife’s opinions and those that are dismissive,” one woman said (7/21/2017). Joint decision-making and mutual agreement were widely reported by respondents, including decisions linked to how income from crop and livestock sales should be spent. Several women who reported engaging in all farm and household management decisions considered themselves “lucky” to have a husband who respected their opinions.

“When we have to hire labor for weeding, I tell my husband how much food I can prepare and that is how much labor we can hire ... if we don’t have enough food then we have to hire less labor and he understands” (12/20/2017). Consultative decision-making was the most common. Men generally had greater responsibility over decisions linked to activities in the field, including parthenium management, and women more responsibility over decisions linked to the production and sale of milk and other dairy products, and household responsibilities. Women in this category emphasized the importance of mutual trust, trusting their husbands to keep the interests of their children in mind. This dynamic extended to parthenium management. Men would discuss plans with their wives, but made final decisions. When outside labor was required, men generally respected their wives’ input and considered the need for women to prepare additional food and drink, recognizing that making injera can take 2–4 days. Separate but linked spheres of decision-making aligned with women’s own preferences and constraints.

“I can sell a small amount of crops without my husband’s prior approval, an amount I can carry on my back” (12/4/17). In the unilateral theme, women have very little influence in decisions regarding farm or home, but reported some agency in decisions regarding small-scale sales of crops or distribution of dairy products. They noted that husbands were primary decision-makers regarding farm and home and that they were simply provided a budget to manage household expenses. Men FGD participants noted that if milk was produced in large quantity, as with households owning two or more hybrid cows, then men controlled its sale (12/6/17).

Discussion

We applied a feminist perspective in livelihoods and environmental change research and praxis to highlight the less visible spaces of rural livelihoods and their interconnections. While invasive plants, including parthenium, may be easily perceptible in the field, understanding impacts on livelihoods requires consideration of women’s and men’s roles and responsibilities within the

broader household compound. Research at the intersection of gender, agriculture, and livelihoods has long demonstrated the need to document women's "hidden" workload (Moser 1993), yet often the only gendered dimension examined is women's and men's roles in the field. Our findings illustrate the blurred boundaries between the farm and the household compound (Sumner, Christie, and Boulakia 2017) and reveal the importance of overlooked spaces within the home and house-lot garden. Here, a range of direct and indirect impacts of parthenium infestation on women's and men's assets, roles, and experiences can be observed. Badstue et al. (2020, 352) state that "the assumption, that the farmer is a man, makes women's work invisible and denies the link between productive and reproductive work." Bringing cows into the house-lot-garden and taking food to hired labor in the field are strategies that help manage the negative impacts of parthenium for the household, but, critically, are built on reconfiguring women's spaces, time, and labor.

Our feminist and spatial examination across scales illuminates interconnected livelihood components and provides a more holistic conceptualization of everyday coping strategies associated with parthenium and socio-ecological change. While we discovered important intersections between the spaces of the household compound and the field, we also note the importance of linkages across scales, the interconnectedness and gendered power relations within households, and the value of reciprocity networks, in part sustained through women's social relationships and gifting of food products. In parallel with the gendered spaces of food preparation in central Mexico, kitchenspace—indoors and extending into the house-lot garden—is a critical site of social and cultural reproduction in Welenchiti where reciprocity networks are nurtured and adaptation is primarily in women's hands (Christie 2004). In Welenchiti, social networks are critical to farmers' livelihoods. Farmers draw on labor exchanges and women's savings networks, and borrow capital from their neighbors. Women's control over income from dairy products is important for their participation in community financial structures and vital for sustaining women's reciprocity networks and solidarity.

During the milk game, several women stressed the importance of sharing dairy products with neighbors to maintain social connections. After distributing the milk tokens to the fictional household members, one woman said she was sad to have nothing left for her neighbor and revised her choice to keep a glass of milk for her. The social networks described in livelihood

studies and FPE are, in Welenchiti, nurtured through women-managed assets such as milk, now threatened by parthenium.

Multiple factors intersect with gender to shape and set parameters to adaptation strategies. In our study, wealth and household composition mediate women's access to labor that they need to manage parthenium. This invasive weed impacts their assets including their cows and dairy products critical to their livelihoods. Our findings offer an example of how inequalities can be reinforced by new forms of vulnerability, with response options socially differentiated. We show that gendered impacts of invasive species and other less obvious forms of environmental change must be considered in attempts to understand and support people's livelihoods around the world. Through the conduit of an invasive weed in Ethiopia, our feminist livelihood and FPE conceptual approach bridges the global scale of environmental change with the intimate and less visible spaces of gendered livelihoods.

Conclusion

Like other forms of environmental change, invasive alien plants may have gendered impacts on everyday life that disproportionately affect the less powerful, yet are commonly overlooked. Smallholder farming households draw on women's networks, assets, spaces, and unpaid labor in the face of this emerging vulnerability context co-produced by climate change, unsustainable agro-ecological practices, and preexisting inequalities. In eastern Ethiopia, parthenium has been a catalyst for transformation of women's spaces and livelihood strategies, shifting labor requirements, simultaneously threatening reciprocity networks that are key to their household's adaptation to shocks and stressors, environmental or otherwise.

This paper aims to illustrate how environmental change interacts with a broader range of pre-existing vulnerabilities and forms of difference, as well as women's agency, drawing on local experiences of gendered impacts and responses to an invasive, transboundary weed. We recognize that differentially distributed impacts of climate change rooted in geographic location interact with gender, wealth, age, ethnicity, and other intersectional variables in shaping livelihood options, and that some have more options available than others.

Reflecting on our findings and building on feminist livelihoods and FPE, we reiterate the importance of including so-called domestic or reproductive space and labor in efforts to

understand and address gendered and place-based inequities of climate change. In the case we present here, parthenium has affected women's care work including feeding cows, laborers, children, and neighbors, in addition to increasing their labor weeding in the fields. Moving beyond gender roles and divisions of labor, we highlight the house-lot garden and its connection with the invasive weed in the field, as well as with women's social reciprocity networks. While we present women as creative agents in the face of environmental change, we also stress that the interlocking vulnerabilities affecting their natural and social capital—in particular their dairy assets and their social networks—risk eroding their well-being as well as that of their household and community.

Development initiatives promoting more equitable livelihoods must be based on a richer understanding of the gendered spaces of everyday life—ensuring that women's specific contributions to household livelihoods are visible—and document complex intrahousehold decision-making dynamics that mediate how individuals and households respond to socio-economic and environmental change. Such an approach can assist researchers and practitioners in exploration of the spatialized intersection between gender, labor, assets, and power.

We are mindful of the increasing focus on “resilience” as a policy objective for sustainable and equitable development (Bousquet et al. 2016), and warnings about the conservative and apolitical nature of “resilience” when applied to social relations (MacKinnon and Derickson 2013). As feminists have pointed out, framing resilience as inherently positive implies the presence of social equality within a system and overlooks the possibility that maintaining the current state perpetuates women's subordination (Iniesta-Arandia et al. 2016). We encourage scholars engaging with the resilience literature to further explore gendered adaptation in everyday spaces, as well as the exacerbation of existing gender and socio-environmental inequities and their co-production with environmental change.

Critical feminist perspectives on livelihoods and political ecology focus on gender, power, and local lived experiences. Alongside critical approaches, interdisciplinary research-for-development is needed to address challenges faced by smallholder farmers in the Global South due to environmental change. This paper has demonstrated the potential of feminist livelihoods

approaches, rooted in gendered spaces of everyday life linked to dynamic socio-ecological contexts, to contribute to interdisciplinary research and practice.

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Disclosure statement

The authors declare that there are no financial or non-financial competing interests to report.

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Daniel Sumner was the Assistant Director for Virginia Tech's Women and Gender in International Development program, where he supported Virginia Tech's Center for International Research, Education, and Development (CIRED) to develop research and evaluation approaches that are participatory, responsible, and reflective. From 2016 to 2022, he supported the Feed the Future IPM Innovation Lab's research activities as a Gender Specialist and worked with project partners

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Figure captions

Figure 1. Study site in eastern Ethiopia

Figure 2. Milk allocation game