

Women-Led Pulse Agriculture for Enhanced Household Nutrition Security in East African Countries

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Abstract

Pulse crops are significant sources of starch, fiber, protein and micronutrients for the human population. Four East African countries (Ethiopia, Tanzania, Uganda, and Rwanda) have huge potential of pulse production but are constrained by several challenges in the production-consumption chain. This scoping review has assessed the challenges and opportunities related to women-led, nutrition-sensitive pulse agriculture in the four East African countries. This scoping review is based on data from major scientific databases, such as PubMed, Scopus, and Web of Science, which are commonly used for research purposes, as well as grey literature. The criteria used were studies conducted in Ethiopia, Tanzania, Uganda, or Rwanda; grey literature which includes reports, theses, and other unpublished materials that may be relevant to a particular topic (years 2010 to 2023); observational studies, including case-control, cohort, and cross-sectional studies that assessed pulse crop production and consumption; and those published in English. Evidence from these countries shows that the historical gender gap and low level of participation by women in the sector have had adverse effects on the production of pulses. There are also social and cultural barriers that severely constrain women's role in pulse agriculture, such as poor knowledge of the benefits of pulses, constraining cultural practice and gender-based norms in the pulse sector, limited access to market, land and finance, underdeveloped delivery/supply chain and extension services, less developed value addition culture, and the stigma of pulse consumption. This study identifies multiple avenues to ameliorate the identified socioeconomic, cultural and policy constraints, including promoting women-led pulse production through increasing access to financing for small-scale pulse crop farmers, improving market access through better marketing and distribution networks, and investing in infrastructure to support pulse production and consumption.

Keywords: pulses, gender, nutrition-sensitive agriculture

1. Introduction

This scoping review assessed the challenges and opportunities related to women's participation in pulse crop agriculture in four pulse-producing East African countries (Ethiopia, Tanzania, Uganda, and Rwanda). There are several features common to these countries. They are all characterized by population growth coupled with a large proportion of youth (age < 30). For example, Ethiopia's population of 120 million is the second largest in Africa, next to Nigeria, and the 12th largest in the world (UN, 2017). Similarly, Tanzania, a country of 69.4 million, is experiencing one of the fastest population growth rates in Sub-Saharan Africa. Substantial proportions of women and children in these countries practice a poor and monotonous diet of grains and tuber crops. Food security is estimated to decline by 5-20% on average with each significant episode of flooding or drought (EU, 2022). There are also other macro-level factors contributing to food insecurity in East African countries, including poor infrastructure, frequent conflict, and inadequate capital, that are critical for crop production and income growth (EU, 2022). While the incidence of stunting among under-five children decreased globally from about 200 million in 2000 to 144 million in 2019, Sub-Saharan Africa remained the only region with an increasing incidence of stunting in children, where two of every five stunted children reside (Otekuntin, 2021). In East African countries, malnutrition rates are staggering, with 3.6 million children and pregnant and lactating women

projected to develop moderate acute malnutrition and 376,000 children facing severe acute malnutrition (FAO, 2019).

Pulses, a diverse group of dried seeds of leguminous crops, encompass a variety of species such as common beans, cowpeas, chickpeas, lentils, pigeon peas, fava beans, and many others. While the numerous advantages of pulses are well-documented (EU, 2022; UN, 2017), it is worth noting that most scholarly and grey literature emphasizes their environmental and direct agricultural benefits (EU, 2022; UN, 2017). However, pulses can improve food security and livelihoods, particularly in regions where they are a staple crop.

It is well established that pulses play a crucial role in sustainable agriculture due to their ability to fix nitrogen in the soil, enhancing its fertility and reducing the need for synthetic fertilizers. Adding pulses to a cropping system can boost the total productivity of all crops by disrupting disease cycles, pests, and weeds, thereby enhancing nutrient and water use efficiency and reducing the impact of weather extremes (EU, 2022; UN, 2017). In the last few years, the role of pulses in sub-Saharan Africa has become even more significant, especially about their characteristic of being good sources of fiber, dietary protein, and micronutrients. The ever-increasing dual epidemics of malnutrition, both under and overnutrition, required the need to alter dietary patterns, including increased representation of high-protein, low-fat, high-fiber pulses in human diets (Otekuntin, 2021). Beyond being nutrient-dense, consuming pulses several times a week may help with weight management and decrease the risk of diet-related health problems, such as coronary heart disease and diabetes (Gwata, 2010). Furthermore, the high fiber content found in pulses offers significant benefits for gastrointestinal health. These fiber-rich pulse crops can reduce transit time in the colon and lower the risk of constipation, potentially contributing to a decreased incidence of colon cancer (Global Pulses Confederation, 2016). Pulses and legumes are excellent alternative food sources for poor households with limited access to animal-based foods. Accessibility to pulses, either in a home garden or at the market, helps address nutritional deficiencies and improves the dietary diversity of those with limited resources, promoting better health outcomes.

Pulses have a long history as staple crops for smallholder farmers in Sub-Saharan Africa (FAOSTAT, 2019). Notably, pulse production in the region has seen a discernible increase over the last five decades. On average, pulse production in Africa has experienced an annual growth rate of 3.32% (Miller et al., 2017). This upward trend can be attributed to growing awareness and understanding of pulses' health and nutrition benefits. However, there have been surges in the production and yield of pulses in Africa in the last decade from 2010 to 2020, with a fall between 2015 and 2016 and a steady rise from 2017 to 2020. This is partly due to local food preferences and a complex interplay between institutional, cultural, and socio-economic factors (Earth First, 2021).

It is indeed apparent that despite the significant potential of pulse crops to enhance food security and promote agricultural sustainability as supported by multiple studies (EU, 2022; Henry et al., 2015; UN, 2017), there has been relatively limited investment in pulses at the global level. A striking example of this disparity is the fact that pulse crops receive only modest annual research funding of USD 175 million, in stark contrast to the USD 61 billion allocated to public and private research in the broader field of food and agriculture (EU, 2022). Global pulse crop production has remained relatively stagnant in yield per hectare, hectares planted, and total volume produced. The science of pulse agriculture is markedly underdeveloped compared to other staple crops, including cereals (Global Pulses Confederation, 2016). The 2016 Morocco Declaration shone a spotlight on the unmet potential of pulse crops to deliver food and nutrition security, agricultural sustainability, and reduced climate change risks, while contributing to economic empowerment of the rural poor, especially women and youth (Global Pulses Confederation, 2016).

The African pulse agricultural system is a predominantly small-scale farming activity, with women accounting for more than 50% of pulse production and about 60-70% of overall food production. While women and girls in agriculture have been central to household farming, their contribution is neither understood nor appreciated due to restrictive gender norms and conventions (Henry et al., 2015; Tsegaye et al., 2015). Ensuring better food and nutrition security requires introducing measures that ensure better access for women and youth to complementary inputs, especially land, labor and extension services, and closing the gender gaps in the production and consumption of food.

Gender disparities in agriculture continue to affect the productivity and profitability of pulse-growing smallholder farmers in East Africa (Franke et al., 2019). According to studies conducted in these countries, women are responsible for up to 60-70% of pulse production in this region, greater than the continental average. For example, Ethiopian women contribute up to 60% of the labor required in post-harvest activities and up to 60% of the labor required for pulse production in Uganda (CASA, 2023). Women farmers typically have smaller landholdings than men and have limited access to credit, making it difficult for them to invest in modern

technologies and inputs that would increase their productivity (CASA, 2023; Earth First, 2021). They seldom participate in pulse marketing, mainly due to a lack of information on prices and market opportunities and little bargaining power (Tefera, 2014). This is further compounded by gender-linked differences in the adoption of agricultural innovation which result from gender-linked differences in access to complementary inputs, where women are further disadvantaged. From a nutritional health perspective, the degree of women's access to and control over important household and community resources may determine how well they nourish themselves, their children, and the family, since they are mostly responsible for preparing meals for the family (Ersino et al., 2016; Mucha, 2012).

This review outlines multi-level approaches in identifying women-led, pulse-based nutrition interventions, challenges, gaps, and opportunities to promote the pulse sector for improved nutritional status of the most vulnerable individuals. The scoping review addressed three overarching research questions: (1) What are the key characteristics of pulse agriculture led by women? (2) how does it contribute to improved nutrition in specific countries? And (3) How do pulse crops enhance household food security, generate income, and empower women?

2. Materials and Methods

2.1 Search Strategy

This scoping review was conducted following the original methodological framework developed by Arksey and O'Malley (2005) and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Liberati et al., 2009). The review began with identifying relevant sources of information by searching the major scientific databases and the grey literature available as reports. The popular databases searched include Pubmed/Medline, Embase, Cochrane Review, ISI Web of Science, and Scopus. Searching started with the primary concept, finding synonyms, and adding other components.

Table 1. Search keywords

Steps	Search terms
#1	Chickpeas OR common beans/pinto, black and kidney beans OR dry peas, lentils, OR cowpeas such as black-eyed peas OR legumes
#2	Pulse production OR pulse consumption OR pulse marketing OR pulse farming
#3	Food security OR nutrition Security OR household food security OR household nutrition security
#4	Women OR pregnant women OR mothers OR households OR family
#5	Ethiopia OR Uganda OR Tanzania OR Rwanda
#6	#1 OR #2 OR #3 OR #4 OR #5

2.2 Search Criteria

The literature survey was undertaken over the period of January to April 2023 with the following inclusion criteria:

- ✓ Study area: Studies conducted in the concerned East African countries (Ethiopia, Uganda, Tanzania and Rwanda) were considered.
- ✓ Publication year: Materials published since the year 2010 were identified;
- ✓ Design: All observational studies (case control, cohort, and cross-sectional) that assessed pulse crop consumption and production were included;
- ✓ Language: English.
- ✓ EndNote™ reference software was used to download 858 articles from various databases and libraries.

2.3 Data Extraction and Abstraction

Data were extracted using the Joanna Briggs Institute (JBI) data extraction from observational methods/tools (JBI, 2024).

The relevance of the reviewed studies was checked based on inclusion and exclusion criteria. The screening of the most relevant materials was done at three stages. At the first stage, one investigator selected 802+56 records through database searching. In the second stage, a total of 468 records were obtained after removing duplicate retrievals and after excluding 224 records because their titles were not related to the review topic. At the third

stage, another reviewer independently re-reviewed the topics and abstracts, and some articles were excluded from those selected in the first stage based on relevance of contents.

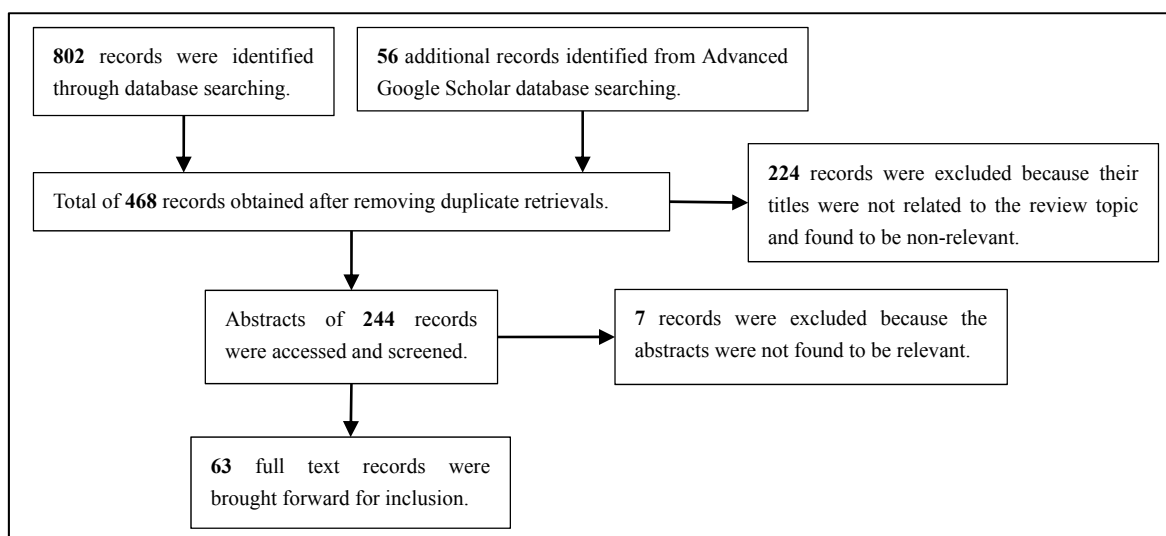


Figure 1. Flow chart showing the procedure of selecting studies for the scoping review.

2.4 Analysis and Synthesis

The synthesis of the scoping review followed the social-ecological model (SEM) (also known as the ecological model). SEM is one of the most used theoretical frameworks that account for the multiple determinants of behavior ranging from individual to community/societal-level factors (Stokols, 1966). Concerning pulse consumption, the SEM suggests that individual behaviors must be situated and contextualized within people's broader environments (Christina, 2019). The individual-level factors include personal beliefs, behaviors, and motivations. There are also interpersonal factors such as family, friends, and peers. The physical environment affecting pulse consumption and preferences could include socioeconomic status, school food environments, geographic location, homes, and the surrounding environment. The macro-level refers to the various national policies (e.g., youth policy, agricultural policy, health policy, food marketing, and social norms). The analysis and synthesis of the reviewed articles in terms of the SEM framework provides a means of gaining a deeper understanding of how each level influences another and guides the development of comprehensive, multi-level interventions.

The review also incorporated the Gender-Based Analysis Plus (GBA+) framework (Government of Canada, 2022), which assesses how different identities, including gender, race, and age, intersect to generate distinct experiences of inequality and discrimination (Government of Canada, 2022). In the context of pulse crops, such as lentils, beans, and chickpeas, a GBA+ approach becomes essential for comprehending how gender and other factors influence the production, consumption, and distribution of these crops. A literature review on GBA+ in pulse crops revealed that women and men assume distinct roles and responsibilities within the production and consumption of these crops.

3. Results and Discussion

3.1 Efforts in Promoting Nutrition-Sensitive Agriculture

Several nutrition-sensitive agriculture interventions have been implemented in the countries studied with varying degrees of success. A study by the International Food and Policy Research Institute (IFPRI) indicated a potential to reduce child undernutrition and stunting in Tanzania by creating a 'pro-nutrition' agricultural environment, which primarily targeted improving income and productivity (Olivier et al., 2011). The study argued that nutrition programs implemented by government and nongovernmental organizations are fragmented and lack coordination among different actors (Olivier et al., 2011). In Tanzania, specifically in the Lindi and Ruangwa districts within the Lindi region, the Harnessing Agriculture for Nutrition Outcomes (HANO) project was conceived to investigate the connections between household agricultural practices, dietary choices, and nutrition outcomes. This project has been ongoing since 2012. The overarching goal of the HANO project is to address the

issue of chronic malnutrition among children under two years of age. It achieves this by implementing a comprehensive approach combining nutrition interventions with diverse agricultural activities (Roschnik et al., 2017).

There are also studies in sub-Saharan African countries reaching similar conclusions. For example, biofortification programs on orange sweet potatoes in Mozambique were found to be successful in increasing the effects of vitamin A intake among children (de Brauw et al., 2015). In addition, evidence of nutrition- and gender-sensitive agriculture intervention in Zambia that focused on homestead food production of nutrient-rich food positively affected some aspects of agricultural diversity and women's empowerment, i.e., social capital, increased financial and agricultural decision-making power (Kumaret et al., 2018). Nonetheless, the intervention had limited impacts on the dietary diversity of children and households. A review of 23 studies reported that agricultural interventions positively affected the production of the agricultural goods promoted but not on households' total income. The interventions successfully promoted the consumption of food rich in protein and micronutrients, but the effect on the overall diet of poor people remains unclear (Masset et al., 2012).

On the contrary, some studies conducted in sub-Saharan Africa have reported unclear or weak connections between agricultural productivity and human nutrition (Mulualet et al., 2016; Teshome et al., 2020). A review publication, which aimed to uncover evidence of agriculture's impact on nutrition, indicated that positive impacts of agriculture remain "disappointingly scarce". The study also highlighted that the limited connection between agriculture and nutrition and the absence of empirical evidence demonstrating impact, despite the evident potential, can be attributed to weak study designs. In sub-Saharan Africa, the inadequate promotion of nutrition-sensitive agriculture can be attributed mainly to deficient agricultural policies. In support of this argument, a recent study examining policy documents of 30 countries (Ethiopia included) highlighted several shortcomings. These included inadequate focus on nutrition and the production of micronutrient-rich foods, absence of strategies to increase farmer market access, and deficiencies in multi-sectoral collaboration and capacity building (Asirvatham et al., 2022). All available evidence and efforts to establish the link between agriculture production and nutrition in sub-Saharan Africa acknowledge that increasing average productivity does not automatically result in improved nutrition among the most vulnerable groups (Asirvatham et al., 2022; Mulualet et al., 2016; Teshome et al., 2020). This improvement is contingent on nutrition initiatives such as education and child feeding programs, which are highly effective in developing countries (Asirvatham et al., 2022; Mulualet et al., 2016; Teshome et al., 2020).

3.2 Gender Roles in Pulse Agriculture in the Four East African Countries

Pulse production and consumption patterns in the region have been a subject of concern in recent years, particularly regarding women's role and experiences. The contribution of women to labor in African agriculture generally falls in the range of 60 to 80 percent. According to a study that utilized data from nationally representative household surveys across six sub-Saharan African countries, the average female labor share in crop production was 40 percent (Palacios-Lopez et al., 2015). However, there were notable variations in these estimates across countries, with the rate slightly above 50 percent in Malawi, Tanzania, and Uganda, and significantly lower figures in Nigeria (37 percent), Ethiopia (29 percent), and Niger (24 percent) (Palacios-Lopez et al., 2015). The same study reported no significant differences in the estimates even after controlling the gender and knowledge profile of the respondents (Palacios-Lopez et al., 2015).

Women are often responsible for labor-intensive tasks like planting, weeding, and harvesting, while men typically wield decision-making authority over crop-related issues. This gendered division of labor can affect women's access to resources, such as land and credit.

Previous studies have reported that women in rural East African communities play a crucial role in food processing and allocate a significant portion of their income to meet household nutritional needs. However, it is essential to emphasize that there is limited data available on various aspects of women's involvement in agriculture, such as their access to and control of crop harvest adoption rates of agriculture technologies and utilization of farming inputs. In many cases, their valuable contribution goes unrecognized. For instance, a study by MoARD (2010) indicated that Ethiopian women make up over 65% of the workforce engaged in crop production, storage, and processing. However, their roles often remain invisible (Henry et al., 2015). Women-headed households, particularly in low-income countries, face disadvantages in access and control of essential resources, resulting in smaller land holdings and fewer livestock compared to men-headed households (Henry et al., 2015).

A crucial aspect of addressing gender disparities in agriculture in East African countries concerns women's ownership and decision-making autonomy on land and its production. For example, the recent proclamation on

land ownership in Ethiopia granted rights to women through a joint land certification program. However, it is worth noting that this intervention alone did not lead to significant improvements in enhancing women's empowerment within the sector (Tefera, 2014). A study conducted in Southern, Ethiopia, by Tefera examined the impact of land tenure reforms on women's empowerment in land management decisions at the household level based on survey data collected from 394 wives and female heads of families. It revealed that men dominate land-related decision-making. While there has been a shift in favor of women with the implementation of land tenure reforms, the change remains limited.

Gender based disparities continue to affect the productivity and profitability of pulse-growing smallholder farmers in East Africa. For instance, in a study conducted in Rwanda, household resource endowment and gender of the farmer was strongly associated with increased bean yield, where poorer households and women farmers achieved lower yields than wealthier households and male farmers. Poorer households and female farmers grew beans on soils with poorer soil fertility (Franke et al., 2019). A study by Mudege and Wawire (2018) found that female farmers in eastern Kenya face multiple challenges, including limited access to credit, extension services, and information. Similarly, Kinyanjui and Muradian (2016) argue that patriarchal land tenure systems in Kenya discriminate against women and limit their participation in agriculture. However, some initiatives aimed at empowering women, such as training programs and women-led producer groups, have shown promise in enhancing the productivity and income of female pulse farmers.

In Ethiopia, women are actively involved in pulse production, particularly in smallholder farming. According to a study by the International Food Policy Research Institute (IFPRI), women are responsible for up to 70% of pulse production in some regions of the country. Women are involved in all aspects of pulse production, from land preparation and planting to harvesting and post-harvest handling. Women also play a crucial role in the local consumption of pulses, as they are responsible for preparing meals and managing household food security. Ethiopian women contribute up to 60% of the labour required in post-harvest activities (Olika et al., 2019). According to a study by the International Center for Tropical Agriculture (CIAT), women are responsible for up to 60% of the labour required for pulse production in Uganda. In Ugandan bean agriculture, women make significant contributions to both production and marketing. However, their economic share does not exceed 20%. Most post-harvest activities are manual, with substantial contributions by women. Based on gender-disaggregated survey data from 500 men and 625 women in central Uganda, it was reported that all male-headed and 87% of female-headed households had membership in farmers' groups. Women majorly owned the bean crop, but men were also involved in all activities, and it was concluded that a significant proportion of bean production activity was done only by men or only by women (Nakazi et al., 2017).

In a more authoritarian family system, there is notable gender disparity, with men predominantly holding control over both the production and marketing of pulse crops. At the same time, women are primarily responsible for processing and cooking. According to a study conducted in pulse-growing districts of Southern Ethiopia (2017), more than 90 per cent of men, in contrast to 6 percent of women, are consistently involved in land preparation activities. Similarly, 87 percent of men and 13 percent of women usually participate in sowing. Harvesting is also reported to be performed mainly by men at 87.5%. Furthermore, men are the primary decision-makers in the marketing of pulses, with women playing a more dominant role only in the processing and cooking of pulse-based foods at 78.9 and 88.7 percent, respectively (Table 2).

Table 2. Gender differences in participation in pulse production based on respondents' recall of the most recent harvesting year Southern Ethiopia, n = 665.

Type of Activity	Never	Rarely	Sometimes		Always
			%		
Land preparation (men)	8.0	0.3	0.5	91.3	
Land preparation (women)	42.1	23.9	28.0	6.0	
Sowing (men)	10.4	0.2	2.4	87.1	
Sowing(women)	40.8	20.9	25.3	13.1	
Growing crops (men)	9.3	0.8	4.4	85.6	
Growing crops (women)	29.3	19.8	34.3	16.5	
Harvesting (men)	9.5	0.8	2.3	87.5	
Harvesting (women)	48.1	24.5	18.9	8.4	
Collection of production in the farm (men)	13.5	0.3	4.5	81.7	
Collection of production in the farm (women)	17.3	22.1	38.6	22.0	
Transporting production (men)	15.8	2.9	14.1	67.2	
Transporting production (women)	16.2	19.8	32.3	31.6	
Grinding/processing (men)	85.6	2.0	5.0	7.5	
Grinding/processing (women)	12.5	2.1	6.6	78.8	
Selling production (men)	14.3	1.7	5.1	78.9	
Selling production (women)	25.1	16.1	27.4	31.4	
Cooking pulse-based food (men)	90.4	2.7	4.2	2.7	
Cooking pulse-based food (women)	5.4	0.9	5.0	88.7	

Source: Henry et al. (2016).

A study conducted on male- and female-headed households in Southern Ethiopia (Tsegaye et al., 2015) concluded that there are significant differences in gender roles when it comes to making decisions concerning pulse production and marketing. The selling, transporting, and spending of the income generated from the sale of pulses is usually considered to be the husband's responsibility at 35.8%, 38.8%, and 38.3%, respectively, compared to the wife's 10.2%, 10.1%, and 10.2% respectively. About 27% of the respondents reported that both the husband and wife are actively involved in selling, transporting, and spending of the income generated from pulses (Table 3). The same study also indicated significant differences in access to agricultural packages (such as fertilizer, pesticides, etc.). Female-headed households had lesser access to agricultural packages as 31.6% of male-headed households were full package users compared to only 11.7% of the female-headed households (Tsegaye et al., 2015).

Table 3. Decision-making in pulses production, consumption and marketing, Southern Ethiopia, 2013, n = 665

Activities	Main decision maker (%)				
	Do not produce or purchase	Wife	Husband	Both	Others
Sale of pulses	26.9	10.2	35.8	27.1	-
Keeping the money from the sale	51.4	10.1	31.9	6.7	-
Spending the money from the sale of pulses	34.4	10.2	38.3	15.3	1.7
Taking the pulses to the market	33.8	10.1	38.8	15.3	2.0

Source: Gete et al. (2015); Tsegaye et al. (2015).

Poor access to strategic resources also likely limits women's participation in high-income earning activities, which are associated with age, educational attainment, family size, land size, market distance, livestock holding, and access to credit (Alemu et al., 2022). Only husbands are expected to participate in high income-generating activities due to the local customs. In contrast, men have better access to land and credit, enabling them to invest in improved seeds, fertilizers, and technologies.

A study conducted on 660 households in Southern Ethiopia reported that female-headed households had much lower access to land, inputs and technologies compared to male-headed households (Henry et al., 2015). The same study noted that only half of the female-headed households used partial agricultural extension packages or never used any. Of those who benefited from the recently introduced land certification program, some female-headed households transferred their land temporarily to others because they did not own oxen and labor to execute demanding agricultural activities (Henry et al., 2015). Another study from Ethiopia, based on a survey of 360 households, reported that the main challenges to the adoption of improved varieties consisted of differential access to timely and adequate seeds of improved varieties, quality fertilizers and pesticides, affordable credit, and equitable access to information, and increased occurrence of pests and diseases (Dessalegn et al., 2022). In Uganda, men own 98% of the land, limiting women's access to productive resources (Mukankusi et al., 2019). A Ugandan woman's right to land under the land holding system is largely limited to access rights but not ownership rights, and women face significant challenges accessing justice when their rights are violated (Kemigisha, 2021). Such gender inequalities often result in lower productivity and income for women farmers, leading to food insecurity and poverty (Henry et al., 2015).

Women and disadvantaged groups are often excluded from markets. They cannot participate systematically in interactions between different market actors. They may periodically sell some produce, but because of factors such as lack of information and supply, they may have minimal quantities to sell and lack information on prices and market opportunities. They typically have little bargaining power. A study by the Canadian International Food Security Research Fund's (CIFSRF) project staff was conducted in three districts of SNNPR in Ethiopia, namely Hallaba, Hawassa Zuria, and Damot Gale districts and in one district of the Oromia region (Jido Combolcha). It revealed that among those who produce pulse crops, about 85% were male heads of household, while only 15% were female heads of household. The multivariate analysis of the same study indicated that being a female head of household reduced the likelihood of pulse (chickpea) market orientation by 0.331 units compared to male heads of household to sell their pulse production.

One of the gender-based constraints is that women are not organized in cooperatives or women/youth-led farmers' groups. These fundamental issues must be addressed to facilitate their engagement in commercial markets. A few producers are organized into producers' organizations and cooperatives, which provide services to members that may typically include seed access, storage, access to credit, and grain marketing. A few women-led, farmer-based organizations exist, especially in local seed businesses and rural aggregators. The main challenge for women is finding time for crop activities, household management responsibilities, and the other productive roles they play in their communities (CASA, 2023).

3.3 Pulse-Based Nutrition Education as a Strategy for Women Empowerment

Promotion and intervention efforts have demonstrated that knowledge and practices on pulse consumption can be changed through nutrition education and other behavioural change models (Palacios-Lopez et al., 2015). Lack of knowledge among mothers, family members, and health workers about appropriate foods for young children is one of the significant problems in addressing poor diet and malnutrition (Bhutta et al., 2013). Culture and tradition (such as food taboos) play a significant role in the diet and health of children and mothers in most African communities. Three baseline studies conducted in Southern Ethiopia (Hawassa University and University of Saskatchewan, 2017) reported that the knowledge, attitudes, and especially practices of mothers toward pulse use for their families, particularly their use in complementary feeding, was significantly associated with the diet diversity score (DDS). Poor practice (< 0.5 out of 5) had a DDS < 3 while better practice (> 3.5 out of 5) showed a DDS > 3. Figure 2 below implies that nutrition-related knowledge, attitudes, and practices (KAP) of mothers were key determinants of the nutritional status of both mother and young child. Recent studies in some rural communities of Ethiopia have also showed the important contribution of pulses in the diet while at the same time indicating the need for appropriate nutrition education to optimize the benefit of pulses as an alternative source of protein and micronutrients as well as to change the attitude/perception that 'pulses are the meat of the poor' (Njuki et al., 2011; Tela et al., 2020).

In another study conducted in Southern Ethiopia, a total of 772 mother-child pairs randomly selected from twelve villages were included in the study. The 386 mother-child pairs in the Intervention Group (IG) received additional messages about pulse-cereal complementary food, and 386 pairs (the Control Group-CG) received only routine health education for nine months. The results showed that with intervention mothers, KAP improved ($p < 0.001$) at midpoint and end point compared to that of the control group, as did frequency of pulse consumption and DDS among children. At 9 months, the prevalence of stunting, wasting, and underweight was significantly reduced in the intervention group compared to the control group ($p = 0.001$) (Figure 2) (Teshome et al., 2020).

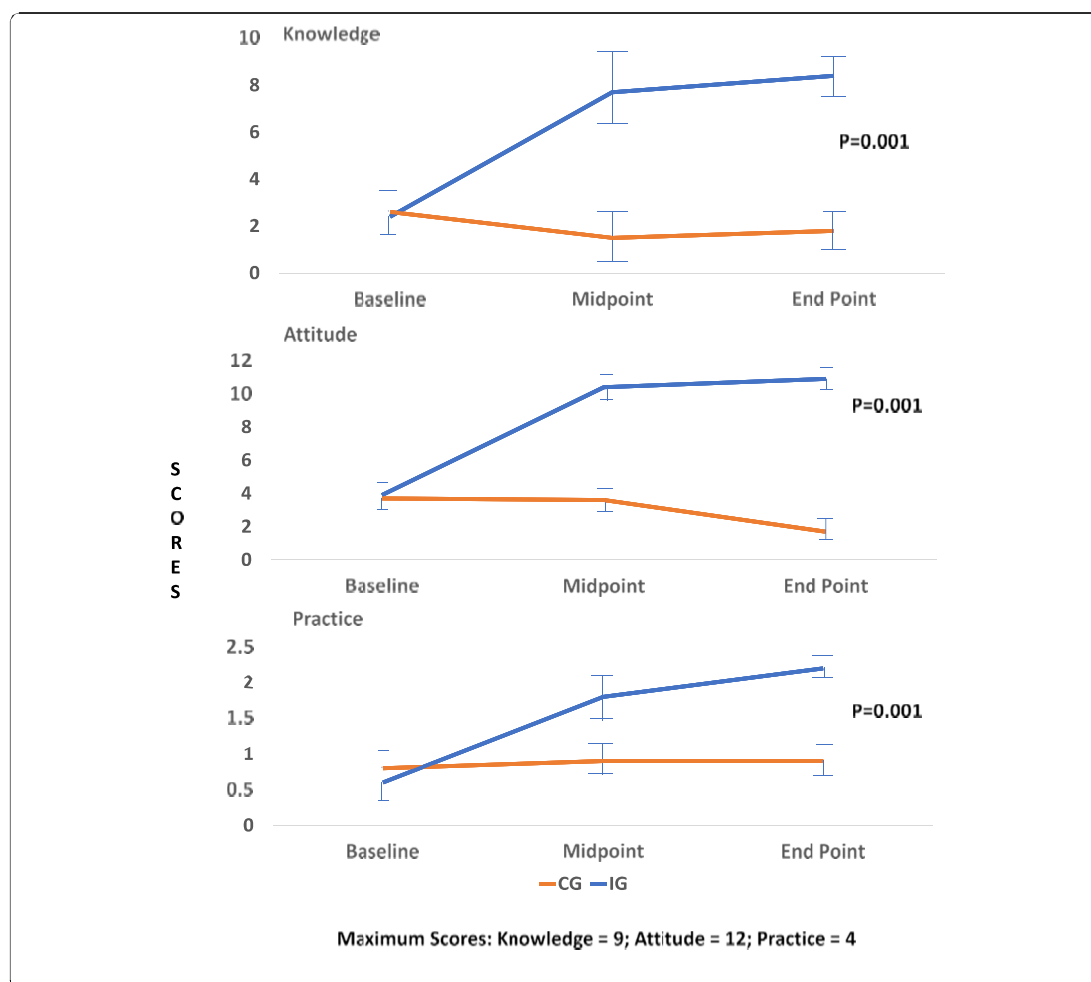


Figure 2. Mean Knowledge, Attitudes, and Practices of Mothers about Pulse-Incorporated Complementary Foods, Sidama Zone, 2016 ($N = 621$): IG = Intervention Group; CG = Control Group (Teshome et al., 2020)

While several factors determine the success and failure of behavioural change communication through pulse-based nutrition education, the nature and type of communication platform is a key variable. In the context of rural areas in Eastern African countries, the information sharing, and diffusion networks cannot be ignored as most people may have more access to such media than formal nutrition education per se.

3.4 Implication of Gender Roles for Nutrition and Health

When women can effectively participate in the pulse value chain, they can generate income, improve household nutrition, and contribute to food security. Addressing gender inequalities in the pulse sector is essential to ensuring that the benefits of pulse production and consumption are shared equitably among all members of society. It has also been observed that whoever holds household food decision-making power in each community plays a big role in deciding who should eat what within a given household. Husbands and children are often given priority in the context of food shortage (Tela et al., 2020). This kind of food distribution, that follows the traditional gender roles and relations more so than physiological needs, would have a substantial impact on the nutrition of women and young children.

Ironically, women who usually get poor nourishment in the family do most of the work in the homestead (reproductive role), engage in productive activities (including working on the farm and engaging in petty trading to earn income), and have various social responsibilities in their communities. The multiple roles carried out by women may predispose them to increased activity (work burden). In places where women experience some level of empowerment (be it in terms of resource acquisition, control over important assets, or being able to make important decisions), a positive impact has been shown on the nutrition of children (Dansa et al., 2019).

Many African studies have justified maternal concern over resources, as men tend to control income from cash crops and pay for lump-sum and prestige items rather than food (Njuki et al., 2011). Women's autonomy has been less studied (Abate & Belachew, 2017). The theoretical rationale that links women's autonomy and child malnutrition is dual such that it is either through the pathway of maternal own-nutritional status, which affects breastfeeding, or through the reduction of access to household resources for childcare (Ares Segura et al., 2016). Most domains of women's autonomy (their decision-making on household assets, their own and their children's) were integral parts of developing countries' demographic health survey (DHS) assessment tools. Some notable reports of DHS data on the effect of women's autonomy on the nutritional outcomes of children were those done for Tanzania (Motbainor et al., 2016). The results of a study in Tanzania revealed children who belonged to mothers with autonomy of decision-making on their healthcare had better nutritional outcomes compared to children whose mothers did not have independence. A recent study in Ethiopia found that maternal empowerment and autonomy made significant contributions to child health and nutritional status (Abate & Belachew, 2017). Another study conducted in Northern Ethiopia reported that lactating mothers who practiced income-generating activity (IGA) were 4.45 times more likely to diversify their diet than those who did not practice IGA (Fentahun & Alemu, 2020). Such associations are not always direct. Studies in Kenya showed maternal autonomy variables have limited or no influence on child nutrition measures (Brunson, 2009). Previous studies around the world reported that improving women's status makes significant changes in the nutritional status of both mothers and their children. For example, the results of multivariate linear regression analyses based on 749 farming households living in three coffee-producing sub-districts of Jimma zone, Ethiopia, showed that weight for height (WHZ) scores of children of mothers who had autonomy in conducting big purchases were higher by 0.42 compared to children whose mothers did not (Abate & Belachew, 2017).

3.5 Opportunities and Promises for Women-Responsive Interventions

There are some encouraging initiatives in the four countries reviewed here (Ethiopia, Uganda, Tanzania, Rwanda). These include promotion of pulse consumption through successful nutrition education programs and development of pulse-based food products and diets. For example, the Uganda Women Entrepreneurship Program has provided training and financing to women engaged in pulse production for school feeding programs (Nakazi et al., 2017). The Pan-Africa Bean Research Alliance-PABRA has had a great deal of success in promoting biofortified beans in school meals in Tanzania, which has some of the world's highest levels of malnutrition (PABRA, 2023). The initiative began with five schools, taking a multi-stakeholder approach where local government, farmers, processors, grain traders, and suppliers all worked to give schools 10 kg of high-iron beans. From this seed, schools would grow 100 kg of beans, replanting 90 kg then passing the remaining 10 kg to another school. The process continues to evolve and engage new schools.

3.6 Pathways of Women-Led Nutrition Sensitive Pulse Agriculture: A Framework

Promoting youth and women empowerment is one of the Sustainable Development Goals established by all participating countries (UN, 2015). The preceding scoping review has highlighted that women in East African countries are often engaged in domestic chores that do not generate cash income. They are primarily responsible for productive work around the homestead and farm-related activities while men typically seek off-farm activities that generate cash income. The gender disparity between men and women in terms of access to formal resources (such as land, credit, information) is unacceptably low. From a nutritional health perspective, the extent of women's access to and control over important household resources may determine how well they nourish themselves, their children, and the entire family. This is particularly significant as women are primarily responsible for preparing meals for the family (Earth First, 2021; FAO, 2019). This underscores the importance of developing a comprehensive understanding and the implementation of agriculture practices that are sensitive to the needs and roles of both youth and women in the countries in question. Globally, there have been several attempts to document evidence of agricultural interventions (including fisheries, livestock production, home-gardening, irrigation projects) impacting nutrition or nutritional status of children or households. There were also some attempts made to develop nutrition sensitive agriculture frameworks in the sub-Saharan African context (Asirvatham et al., 2018). However, efforts that systematically link agriculture, nutrition, and health are still in their infancy. In support of this claim, a systematic review conducted based on 23 papers indicated a lack of clear indications, beyond a reasonable degree, of the nutritional effects of agricultural interventions (Masset et al., 2012). Above all, none of the previous studies have attempted to specifically address pulse crops in their own right as strategic crops in improving the nutritional status of the most vulnerable groups.

Pulse-based gender- and nutrition-sensitive agriculture is a food-based approach to agricultural development that emphasizes nutritionally rich foods and dietary diversity in overcoming nutrition-related challenges. The existing frameworks emphasize the pathway describing agriculture as a source of food, agriculture as a source of income for food expenditure, effects of agricultural production on food prices, and agriculture as a source of income for non-food expenditures (Asirvatham et al., 2022; de Brauw et al., 2015; Kumar et al., 2018).

This section presents a framework (Figure 3) for women empowerment through pulse crop agriculture with a focus on promoting nutrition security at household and individual levels. The review showed that pulse crops are highly nutritious and play a significant role in addressing malnutrition and achieving food security. However, women and youth, despite their potential contributions, often face various challenges in engaging in pulse crop agriculture.

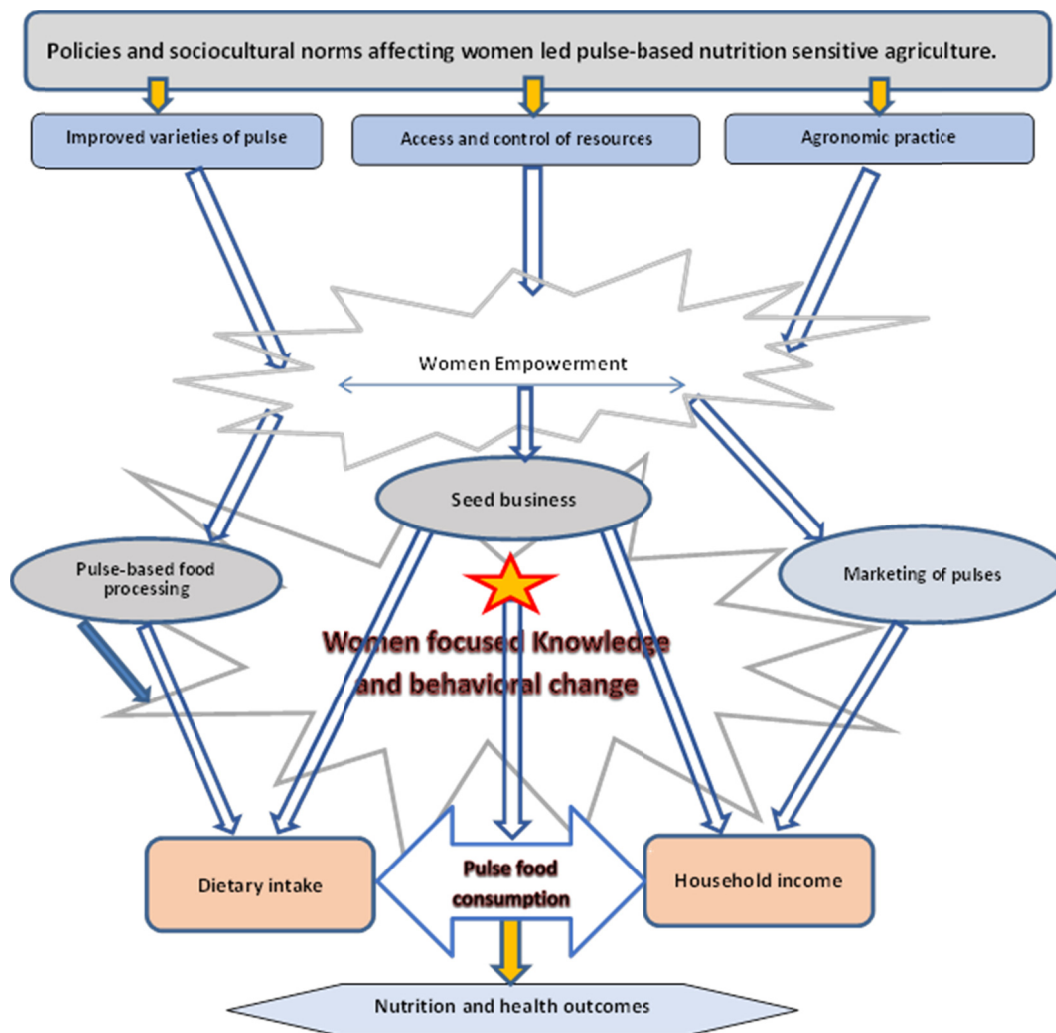


Figure 3. Framework for women-led pulse agricultural interventions to promote nutrition security in the study countries

The framework provides three layers of interventions. Layer 1 (agronomic and resource aspects) is critical to boosting productivity of pulse crops. As noted, many youths and women lack access to the services due to poor land ownership, capital, market information, and ability to pay.

Layer 2 emphasizes the importance of pulse-based food processing, seed business, and marketing. Ample studies demonstrate the great benefits of pulse-based meals for improving the nutritional status of women and children. The recommendations provided in these studies need to be implemented. The seed business is another important component which has been given little attention. Marketing is one of the areas with huge gender disparity, as women have less access to market information.

Layer 3 reflects two important areas of intervention - dietary intake and household income. Both are a direct function of the three components under layer 2. Many studies reported in the preceding section indicate that men are the key players in pulse crop production and are also the principal beneficiaries in terms of control over the income generated from the sale of produce (Tsegaye et al., 2015; Yenealem et al., 2014). According to Asfaw et al. (2010), the opportunity for smallholders to raise their incomes from agricultural production largely depends on their ability to successfully participate in the marketplace exchange which is usually complicated by numerous internal and external challenges. Dietary intake has the potential to improve if pulse-based food processes are scaled up and made accessible to women and children.

The center of the framework - empowerment of rural women - reflects the complex relationship with all three layers. The framework provides more emphasis on women's access and control of resources (knowledge, information, seed, etc.) in part because of the link between pulses and improved household nutrition, as women are more likely than men to invest in children's health and nutrition. Also, women who are reached by agricultural interventions that relay information on nutrition (including pulse benefits) appear to be particularly effective in improving nutrition outcomes for their households (Yenealem et al., 2014). According to Henry and colleagues, women empowerment encompasses promoting knowledge, participation, access and control of resources, and decision-making autonomy at both household and community levels (Henry et al., 2015). Knowledge acquisition entails building women's and men's productive and management capacities through skills training in technology adoption for food processing, pulse marketing, and improved use of income at the household level. One way of doing this could be liaising with governments and officials to advocate for the training of more women extension workers in order to increase and improve extension services to women in female-headed households. Participation would also enhance women's voices in household decision-making because of increased support from cooperative members. In addition, increased participation would improve women's access to harvested pulses through advocacy for the fair sharing of farm harvests before marketing. This would boost women's access to food for household consumption as well as provide opportunities for generating much needed income for the purchase of other household needs. In terms of increasing access and control over resources, the implementation of the framework is expected to narrow the gender differential in pulse production, consumption, and marketing through increasing access to and control over land, information, technologies, and income from sale of produce (Earth First, 2021; FAO, 2019; Yenealem et al., 2014).

This framework for women empowerment through pulse crop agriculture has the potential to address the gender and generational gaps in agricultural practices, enhance nutrition security, and create inclusive and sustainable food systems. By promoting the active participation of women and youth in pulse crop agriculture, this framework can contribute to achieving the United Nations' Sustainable Development Goals, particularly those related to ending hunger, promoting gender equality, and ensuring healthy lives and well-being for all.

4. Conclusions and Implications

The review has shown that women play an important role in both production and consumption of pulse crops, and hence, significantly contribute to household nutrition security in the study region. It was reported that the contribution of women to labor in African agriculture generally falls in the range of 60 to 80 percent. Women are often responsible for labor-intensive tasks like planting, weeding, and harvesting. However, there is notable gender disparity, with men predominantly holding control over both the production and marketing of pulse crops. The selling, transporting, and spending of the income generated from the sale of pulses is usually considered to be the husband's responsibility. Among others, women-headed households face disadvantages in access and control of essential resources which affect the productivity and profitability of pulse-growing smallholder farmers in East Africa. The review further highlights significant presence of poor knowledge among mothers, family members, and health workers about the role of pulse crops in addressing poor diet and malnutrition. Culture and tradition (such as food taboos) play a significant role in the diet and health of children and mothers in most African communities.

Given the challenges and gaps enumerated above, addressing key socioeconomic, cultural, and policy constraints is crucial for the growth and development of the women sensitive pulse sector in East Africa. This can include promoting the nutritional benefits of pulses, increasing access to financing for small-scale farmers, improving market access through better marketing and distribution networks, and investing in infrastructure to support pulse production and consumption.

✓ *Promote nutrition education on diet diversification:* There should be increased efforts on the diversification of diets through awareness creation and education. A diversified diet that includes a variety of foods can help to mitigate the negative impacts of climate change on pulse consumption. This can include the incorporation of

alternative sources of protein and nutrients, such as vegetables, fruits, and animal products. To address the current lack of awareness and promote the consumption of pulses, education and awareness campaigns are crucial. These campaigns can focus on highlighting the nutritional value, health benefits, and culinary versatility of pulses. By educating consumers about the importance of incorporating pulses into their diets, it is possible to increase demand and consumption which in turn will benefit pulse producers. This includes nutrition education programs in schools, community awareness campaigns, media campaigns, and collaborations with healthcare providers. Additionally, promoting local recipes and traditional dishes that incorporate pulses can help showcase their culinary appeal and encourage their consumption.

✓ *Empowerment of rural women:* This is essential and involves facilitating access to education, skills training, and control over vital resources. This empowerment effort would aim to bridge the huge gap in control over resources (land, information, technologies, income from sale of produce) and narrow the gender differential in pulse production, consumption, and marketing. Ensuring equitable access to land, water, and other agricultural resources is crucial for women and youth to engage in pulse production. Access to credit, inputs, and modern technologies such as irrigation systems and machinery should also be promoted. Extension services can play a crucial role in disseminating knowledge, facilitating farmer-to-farmer learning, and promoting good agricultural practices. Liaising with governments and officials to advocate for the training of more female extension workers and providing capacity-building opportunities for women and youth is crucial. Training programs in areas such as leadership, financial management, and entrepreneurship can enable women and youth to establish successful pulse production enterprises. Training in market analysis, value chain development, and business planning would enhance their ability to identify market opportunities and establish sustainable businesses. Given the diverse geographic and socioeconomic conditions of the four countries (Ethiopia, Tanzania, Uganda, and Rwanda), a context-specific, gender-inclusive approach must be used to promote pulse production, marketing, and consumption.

✓ *Access to credit/financing and markets:* Access to credit and financing can help farmers and other actors along the food supply chain to invest in climate-resilient infrastructure and technologies, such as refrigeration and irrigation systems which would help to ensure the availability and quality of pulses. Promotion of control over such resources entails increasing women and youth participation in credit/capital that will increase their economic bases. Participation would also enhance women's voices in household decision-making and bargaining power. This would boost women's access to food for household consumption as well as provide opportunities for generating much needed income for the purchase of other household needs. Creating market linkages and facilitating access (differentiated markets for pulse crops such as local consumption, commodity export, processing) to both domestic and international markets is crucial for women and youth engaged in pulse production. Supporting the establishment of farmer cooperatives, facilitating market information systems, and promoting value addition through processing and packaging can help increase their income and profitability.

✓ *Private-government partnership:* Increasing pulse productivity and consumption in East Africa requires a collaborative effort between governments, farmers, and other stakeholders to address the challenges facing the sector and promote sustainable growth that benefits all members of society. Strengthening partnerships among research institutions, universities, agricultural extension services, NGOs, and private sector entities can facilitate knowledge exchange and technology transfer. Collaborative efforts can enhance the adoption of improved pulse crop varieties, good agricultural practices, and post-harvest management techniques. Sharing experiences and lessons learned within and across East African countries can accelerate the promotion of pulse crops.

✓ *Research and innovation:* It is important to establish research priority strategies that emphasize sustainability, transformative potential, and end-user needs. Although there has been some research conducted on women empowerment in pulse agriculture in selected countries in East Africa, there are still several research gaps that need to be addressed. These gaps include: studies on the role of women and youth in pulse production and consumption in East Africa; the impact of climate change on pulse production and consumption; potential of value addition and processing of pulses; and youth participation in the pulse sector. Of course, the structure and focus of research activities may vary based on country-specific challenges and opportunities in production, nutrition, health, markets, and supply chains. It should also be noted that research-backed effective innovations for increasing pulse production and consumption requires multidisciplinary approaches that combine scientists from the field of agriculture, food science, social sciences, and applied sciences.

References

- Abate, K. H., & Belachew, T. (2017). Women's autonomy and men's involvement in child care and feeding as predictors of infant and young child anthropometric indices in coffee farming households of Jimma Zone, South West of Ethiopia. *PLOS ONE*, *12*(3), e0172885. <https://doi.org/10.1371/journal.pone.0172885>
- Abate, T., & Shimeles, A. (2019). Assessing the governance and institutions of the Ethiopian agricultural extension system. *Journal of Development and Agricultural Economics*, *11*(9), 250-258.
- Alemu, A., Woltamo, T., & Abuto, A. (2022). Determinants of women participation in income generating activities: Evidence from Ethiopia. *Journal of Innovation and Entrepreneurship*, *11*(1), 1-18. <https://doi.org/10.1186/s13731-022-00260-1>
- Ares Segura, S., Arena Ansótegui, J., & Marta Díaz-Gómez, N. (2016). The importance of maternal nutrition during breastfeeding: Do breastfeeding mothers need nutritional supplements? *Anales de Pediatría (English Edition)*, *84*(6), 347.e1-347.e7. <https://doi.org/10.1016/j.anpede.2015.07.035>
- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19-32. <https://doi.org/10.1080/1364557032000119616>
- Asfaw, S., Shiferaw, B., Simtowe, F., Muricho, G., Abate, T., & Ferede, S. (2010). *Socio-economic Assessment of Legume Production, Farmer Technology Choice, Market Linkages, Institutions and Poverty in Rural Ethiopia* (Research Report No. 3). International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh.
- Asirvatham, R., Demi, S. M., & Ezezika, O. (2022). Are sub-Saharan African national food and agriculture policies nutrition-sensitive? A case study of Ethiopia, Ghana, Malawi, Nigeria, and South Africa. *Asirvatham et al. Agriculture & Food Security*, *11*, 60. <https://doi.org/10.1186/s40066-022-00398-x>
- Barungi, M., & Kasirye, I. (2017). Gender and agricultural productivity in Uganda: Evidence from the Uganda National Panel Survey. *African Development Review*, *29*(S1), 55-66.
- Bhutta, Z. A., Das, J. K., Rizvi, A., Gaffey, M. F., Walker, N., Horton, S., ... Black, R. E. (2013). Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *The Lancet*, *382*(9890), 452-477. [https://doi.org/10.1016/S0140-6736\(13\)60996-4](https://doi.org/10.1016/S0140-6736(13)60996-4)
- Brunson, E. K., Shell-Duncan, B., & Steele, M. (2009). Women's autonomy and its relationship to children's nutrition among the Rendille of northern Kenya. *American Journal of Human Biology*, *21*(1), 55-64. <https://doi.org/10.1002/ajhb.20815>
- CASA. (2023). *Beans Sector Strategy*. Retrieved from <https://www.casaprogramme.com/wp-content/uploads/CASA-Uganda-BeansSector-analysis-report.pdf>
- Christina, G. (2019). *Comprehensive School-based Nutrition Interventions in Indigenous Communities in Canada* (Thesis, Department of Agricultural, Food and Nutritional Science, University of Alberta, Canada).
- Dansa, R., Reta, F., Mulualem, D., Henry, C. J., & Whiting, S. J. (2019). A Nutrition Education Intervention to Increase Consumption of Pulses Showed Improved Nutritional Status of Adolescent Girls in Halaba Special District, Southern Ethiopia. *Ecol Food Nutr*, *58*(4), 353-365. <https://doi.org/10.1080/03670244.2019.1602042>
- de Brauw, A., Eozenou, P., & Moursi, M. (2015). Programme participation intensity and children's nutritional status: Evidence from a randomised control trial in Mozambique. *J. Dev. Stud.*, *51*(8), 996-1015. <https://doi.org/10.1080/00220388.2015.1018907>
- Dessalegn, B., Asnake, W., Tigabie, A., & Le, Q. B. (2022). Challenges to Adoption of Improved Legume Varieties: A Gendered Perspective. *Sustainability (Basel, Switzerland)*, *14*(4), 2150. <https://doi.org/10.3390/su14042150>
- Earth First. (2021). *The power of pulses agriculture in Sub-Saharan Africa*. Retrieved from <https://www.foodunfolded.com/article/ss-africa-discovers-the-power-of-pulses>
- Ersino, G., Henry, C. J., & Zello, G. A. (2016). Suboptimal feeding practices and high levels of undernutrition among infants and young children in the rural communities of Halaba and Zeway, Ethiopia. *Food Nutr Bull*, *37*(3). <https://doi.org/10.1177/0379572116658371>

- European Union. (2022). *Africa's Pulse, No. 26, October 2022: Food System Opportunities in a Turbulent Time*. EU. Retrieved from https://knowledge4policy.ec.europa.eu/publication/africas-pulse-no-26-october-2022-food-system-opportunities-turbulent-time_en
- FAO (Food and Agriculture Organization). (2019). *FAOSTAT Statistical Database of the United Nation Food and Agriculture Organization (FAO) statistical division*. Rome, FAO.
- Fentahun, N., & Alemu, E. (2020). Nearly One in Three Lactating Mothers Is Suffering from Inadequate Dietary Diversity in Amhara Region, Northwest Ethiopia. *Journal of Nutrition and Metabolism, 2020*, 1-8. <https://doi.org/10.1155/2020/7429034>
- Franke, A. C., Bajjukya, F., Kantengwa, S., Reckling, M., Vanlauwe, B., & Giller, K. E. (2019). Poor farmers—Poor yields: Socio-economic soil fertility and crop management indicators affecting climbing bean productivity in Northern Rwanda. *Experimental Agriculture, 55*(S1), 14-34. <https://doi.org/10.1017/S0014479716000028>
- Global Pulses Confederation. (2016). *10-Year Research Strategy for Pulse crops*. IDRC. Retrieved from <https://www.fao.org/pulses-2016/en>
- Government of Canada. (2022). *Gender-based Analysis Plus (GBA Plus)*.
- Gwata, E. T. (2010). Potential impact of edible tropical legumes on crop productivity in the small-holder sector in Sub-Saharan Africa. *J Food Agric Environ, 8*(3-4), 939-944.
- Hawassa University and University of Saskatchewan. (2017). *Technical report on Scaling-up Pulse Innovations for Food and Nutrition Security (SPIFoNS) in Southern Ethiopia*. Retrieved from <https://idl-bnc-idrc.dspacedirect.org/handle/10625/58579>
- Henry, C. J., Idemudia, P. E., Tsegaye, G., & Regassa, N. (2015). A Gender Framework for Ensuring Sensitivity to Women's Role in Pulse Production in Southern Ethiopia. *Journal of Agricultural Science, 8*(1), 80. <https://doi.org/10.5539/jas.v8n1p80>
- JBI. (2024). *Manual for Evidence Synthesis*. Retrieved from <https://jbi-global-wiki.refined.site/space/JHEI>
- Kemigisha, P. (2021). Land Tenure Regimes and Women's Land Rights in Uganda: Legality and the Land Legal Framework. *Advances in Social Sciences Research Journal, 8*(1), 116-133. <https://doi.org/10.14738/assrj.81.9462>
- Kinyanjui, M. K., & Muradian, R. (2016). Gender and land tenure in Kenya: An analytical review. *Journal of Gender, Agriculture and Food Security, 1*(1), 54-78.
- Kumar, N., Nguyen, P. H., Harris, J., Harvey, D., Rawat, R., & Ruel, M. T. (2018). What it takes: Evidence from a nutrition- and gender-sensitive agriculture intervention in rural Zambia. *J. Dev. Ef., 10*(3), 341-372. <https://doi.org/10.1080/19439342.2018.1478874>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., ... Moher, D. (2009). The PRISMA Statement for Reporting Systematic Reviews and Meta-Analyses of Studies That Evaluate Health Care Interventions: Explanation and Elaboration. *PLoS Med, 6*(7), e1000100. <https://doi.org/10.1371/journal.pmed.1000100>
- Masset, E., Haddad, L., Cornelius, A., & Isaza-Castro, J. (2012). Effectiveness of agricultural interventions that aim to improve nutritional status of children: Systematic review. *BMJ, 344*(1), d8222-d8222. <https://doi.org/10.1136/bmj.d8222>
- Miller, V., Rangarajan, S., Gupta, R., Mohan, V., Ismail, N., & Wielgosz, A. (2017). Fruit, vegetable, and legume intake, and cardiovascular disease and deaths in 18 countries (PURE): A prospective cohort study. *Lancet Br Ed, 390*(10107), 2037-2049.
- MoARD (Ministry of Agriculture and Rural Development). (2010). *Introduction to Gender and Development*. Alage. MoARD.
- Motbainor, A., Worku, A., & Kumie, A. (2016). Level and determinants of food insecurity in East and West Gojjam zones of Amhara Region, Ethiopia: A community based comparative cross-sectional study. *BMC Public Health, 16*(1), 503. <https://doi.org/10.1186/s12889-016-3186-7>
- Mucha, N. (2012). Enabling and Equipping Women to Improve Nutrition. *Brief Pap, 16*, 1-8.
- Mudege, N. N., & Wawire, N. H. W. (2018). Gender dynamics in smallholder pulse production and marketing in eastern Kenya. *Journal of Gender, Agriculture and Food Security, 3*(1), 62-82.

- Mukankusi, C., Raatz, B., Nkalubo, S., Berhanu, F., Binagwa, P., Kilango, M., ... Beebe, S. (2019). Genomics, genetics and breeding of common bean in Africa: A review of tropical legume project. *Plant Breeding*, 138(4), 401-414. <https://doi.org/10.1111/pbr.12573>
- Mulualema, D., Henryb, C. J., Berhanua, G., & Whiting, S. J. (2016). The Effectiveness of Nutrition Education: Applying the Health Belief Model in Child-Feeding Practices to Use Pulses for Complementary Feeding in Southern Ethiopia. *Ecol Food Nutr*, 55(3), 308-323. <https://doi.org/10.1080/03670244.2016.1161617>
- Nakazi, F., Njuki, J., Ugen, M. A., Aseete, P., Katungi, E., Birachi, E., ... Nanyonjo, G. (2017). Is bean really a women's crop? Men and women's participation in bean production in Uganda. *Agriculture & Food Security*, 6(1). <https://doi.org/10.1186/s40066-017-0102-z>
- Njuki J, K., A., C., & W, C. (2011). Linking Smallholder Farmers to Markets, Gender and Intra-Household Dynamics: Does the Choice of Commodity Matter? *Eur J Dev Res*, 23(3), 426-443. <https://doi.org/10.1057/ejdr.2011.8>
- Olika, E., Abera, S., & Fikre, A. (2019). Physicochemical Properties and Effect of Processing Methods on Mineral Composition and Antinutritional Factors of Improved Chickpea (*Cicer arietinum* L.) Varieties Grown in Ethiopia. *International Journal of Food Science*, 2019, 1-7. <https://doi.org/10.1155/2019/9614570>
- Olivier, E., Athur, M., Adam, K., & Xinshen, D. (2011). *Making Agriculture Pro-Nutrition: Opportunities in Tanzania*. IFPRI, Addis Ababa, Ethiopia. Retrieved from <https://www.cabidigitallibrary.org/doi/full/10.5555/20123112073>
- Otekuntin, O. (2021). Is Africa Ready for the SDG 2 (Zero Hunger) Target by 2030? *Curr Agric Res J*, 9(1), 01-03. <https://doi.org/10.12944/CARJ.9.1.01>
- PABRA. (2023). *PABRA's 'beans without borders'/Collaborating across Africa to tackle climate change, gender inequality & malnutrition*. Retrieved from <https://pulsepod.globalpulses.com/pod-feed/post/pabra-beans-without-borders-collaborating-across-africa-to-tackle-climate-change-gender-inequality-malnutrition>
- Palacios-Lopez, A., Christiaensen, L., & Kilic, T. (2015). *How Much of the Labor in African Agriculture Is Provided by Women?* World Bank, Washington, DC. <https://doi.org/10.1596/1813-9450-7282>
- Roschnik, N., Kivuyo, N. E. G., Muruve, J. A., Ngombalu, A. N. N. N., Copestake, J., & Remnant, F. (2017). Harnessing Agriculture for Nutrition Outcomes: Experience from Tanzania. *Annals of Nutrition & Metabolism*, 71(2), 1303-1304. Retrieved from <http://cyber.usask.ca/login?url=https://www.proquest.com/scholarly-journals/harnessing-agriculture-nutrition-outcomes/docview/2061910503/se-2?accountid=14739>
- Stokols, D. (1966). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion*, 10(4), 282-298. <https://doi.org/10.4278/0890-1171-10.4.282>
- Tefera, T. (2014). Determinants of Smallholder Pulse Producers Market Orientation in Southern Ethiopia. *Asian J Bus Manag*, 6(2), 97-103. <https://doi.org/10.19026/ajbm.6.5333>
- Tela, F. G., Gebremariam, L. W., & Beyene, S. A. (2020). Food taboos and related misperceptions during pregnancy in Mekelle city, Tigray, Northern Ethiopia. *PLOS ONE*, 15(10), e0239451. <https://doi.org/10.1371/journal.pone.0239451>
- Teshome, G. B., Whiting, S. J., Green, T. J., Mulualem, D., & Henry, C. J. (2020). Scaled-up nutrition education on pulse-cereal complementary food practice in Ethiopia: A cluster-randomized trial. *BMC Public Health*, 20(1), 1437. <https://doi.org/10.1186/s12889-020-09262-8>
- Tsegaye, G., Regassa, N., Carol, H., & Idemudia, P. (2015). Smallholder farmers pulse production and marketing of Ethiopia: A gender analysis of access and control of key resources in four districts. *Humboldt International Journal of Gender, Agriculture and Development*, 90-109.
- UN. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. Retrieved from <https://sdgs.un.org/2030agenda>
- UN. (2017). *World Population Prospects: 2017*.
- Webb, P., & Kennedy, E. (2014). Impacts of agriculture on nutrition: Nature of the evidence and research gaps. *Food and Nutrition Bulletin*, 35(1), 126-132. <https://doi.org/10.1177/156482651403500113>
- Yenealem, B., Gete, T., & Nigatu, R. (2014). *Gender Related Challenges of Pulse Production and Management in Damot Gale Woreda Smallholder Farmers in Southern Nations, Nationalities, and Peoples Region* (M/Sc Thesis (Unpublished), Hawassa University, Ethiopia).

List of Abbreviations

CDF	Cooperative Development Foundation
CIAT	International Center for Tropical Agriculture
CIFSRF	Canadian International Food Security Research Fund
DDS	Diet Diversity Score
EAC	East Africa Community
FFQ	Food Frequency Questionnaire
FRI	Farm Radio International
GBA+	Gender Based Analysis Plus
HANO	Harnessing Agriculture for Nutrition Outcomes
HU	Hawassa University
IFPRI	International Food and Policy Research Institute
NAADS	Uganda National Agriculture Advisory Services
PABRA	Pan-African Bean Research Alliance
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
SEM	Social Ecological model
SGD	Sustainable Development Goal
SHGs	Self-Help Groups
SSA	Sub-Saharan Africa
TDHS	Tanzania Demographic Health Survey
UFAAS	Uganda Forum for Agricultural Advisory Services

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Authors Contributions

NR and CH were involved in the conception and design of the study. RT and MGN contributed to the discussion, and critically reviewed/edited the manuscript for intellectual content. All authors read and approved the final manuscript.

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