

Gender-based constraints and opportunities to agricultural intensification in Ethiopia: A systematic review



RESEARCH
PROGRAM ON
Integrated Systems
for the Humid
Tropics

ILRI PROJECT REPORT



Gender-based constraints and opportunities to agricultural intensification in Ethiopia: A systematic review

Annet Abenakyo Mulema and Elias Dامتew
International Livestock Research Institute (ILRI)

August 2016

The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research for development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative. Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program's monitoring, evaluation and impact assessment. <https://africa-rising.net/>

© 2016 International Livestock Research Institute (ILRI)

ILRI thanks all donors that globally support its work through their contributions to the [CGIAR system](#)



This publication is copyrighted by the International Livestock Research Institute (ILRI). It is licensed for use under the Creative Commons Attribution 4.0 International Licence. To view this licence, visit <https://creativecommons.org/licenses/by/4.0>.

Unless otherwise noted, you are free to share (copy and redistribute the material in any medium or format), adapt (remix, transform, and build upon the material) for any purpose, even commercially, under the following conditions:



ATTRIBUTION. The work must be attributed, but not in any way that suggests endorsement by ILRI or the author(s).

NOTICE:

For any reuse or distribution, the licence terms of this work must be made clear to others.

Any of the above conditions can be waived if permission is obtained from the copyright holder.

Nothing in this licence impairs or restricts the author's moral rights.

Fair dealing and other rights are in no way affected by the above.

The parts used must not misrepresent the meaning of the publication.

ILRI would appreciate being sent a copy of any materials in which text, photos etc. have been used.

Editing, design and layout—ILRI Editorial and Publishing Services, Addis Ababa, Ethiopia.

Cover picture: ILRI

ISBN 92-9146-481-3

Citation: Mulema, A.A. and Damtew, E. 2016. *Gender-based constraints and opportunities to agricultural intensification in Ethiopia: A systematic review*. ILRI project report. Nairobi, Kenya: ILRI

Patron: Professor Peter C Doherty AC, FAA, FRS

Animal scientist, Nobel Prize Laureate for Physiology or Medicine—1996

Box 30709, Nairobi 00100 Kenya

Phone +254 20 422 3000

Fax +254 20 422 3001

Email ilri-kenya@cgiar.org

ilri.org

better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia

Phone +251 11 617 2000

Fax +251 11 667 6923

Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa

Contents

Acronyms	iv
Acknowledgements	i
Abstract	ii
1. Introduction	1
2. Sustainable agricultural intensification	3
3. Agricultural intensification in Ethiopia	4
4. Gender-based constraints and opportunities to agricultural intensification	6
4.1 Natural capital	7
4.2 Human capital	9
4.3 Financial capital	12
4.4 Cultural capital	13
4.5 Social capital	14
4.6 Physical capital	16
4.7 Political capital	17
5. Conclusion and recommendations for further research and actions	19
6. References	21
Annex: Methodologies of key studies	26

Acronyms

ADLI	Agricultural development-led industrialization
CCF	Community capitals framework
DA	Development agents
DHS	Demographic and health surveys
FGD	Focus group discussion
GDP	Gross domestic product
GRUMP	Global rural–urban mapping project
GTP	Growth and transformation plan
GHG	Greenhouse gas
PADETES	Participatory agricultural demonstration training extension system
SNNP	Southern Nations Nationalities and Peoples'

Acknowledgements

We are grateful to Cheryl Doss for her helpful comments on the initial drafts of this report.

We are grateful to the research teams in Africa RISING (Research in Sustainable Intensification for the Next Generation) sites that facilitated the focus group discussions (FGDs) to validate the literature. We are also highly indebted to the male and female farmers who actively participated in our study and to the site coordinators for all their great work.

Funding for this validation was provided by Africa RISING project, a USAID funded project under the Feed the Future Initiative.

Abstract

We employ a community capital's framework to provide a holistic perspective of the stock and interaction between the capitals required by men and women farmers for effective engagement in agricultural intensification. We reviewed literature which was validated by male and female farmers in four regions of Ethiopia. Ethiopia has relatively equitable land distribution due to the land reform. Although reform has enhanced women's access to land, participation in decision-making and asset control are yet to be achieved. Female-headed household farm sizes are smaller compared to those of male-headed households. On average men possess more livestock species and numbers than women. Therefore, women have limited access to manure for soil fertility management and adoption of the practice. Time use studies show that women work longer hours compared to men, affecting their decisions to adopt time and labour intensive technologies. Due to cultural norms, there are discrepancies in access to information and extension services. Inadequate access to credit lowers women's access to farm inputs, such as seeds, tools and fertilizers to invest in irrigation and land improvements. Women have lower membership to farmer-based organizations compared to men, and lesser for women in male-headed households. When women's membership in informal groups is higher, women can achieve economies of scale in access to markets, build confidence, and leadership. The Ethiopian government has plans to develop the agricultural sector and gender equality is one of the pillar strategies. Policy enforcement, transformation of gender constraining norms, gender capacity development, development of women's social capital, increasing women's access to and control over resources and benefits from their investment will minimize the inequalities.

Key words: Women, gender, equality, agricultural intensification, community capitals, Ethiopia

I. Introduction

Agricultural intensification has become of great interest to Africa and the developing world as a whole due to the rise in population growth, increase in land degradation, declining fallow periods, low investment in improved technologies by governments and international donors, a shift away from diversification to mono-cropping and climate change (Jhamtani 2011; Snapp et al. 2010; Lee 2005; Pretty 1999). These trends have contributed to low agricultural productivity and food insecurity. Sustainable agricultural practices including crop improvements, agro-forestry, soil conservation, livestock and fodder crops, conservation agriculture, integrated pest management and novel policies and partnership are believed to increase productivity in a more sustainable manner by addressing the degradation of ecosystem services and increasing the ability of smallholder farmers to adapt to climate change and variability (Pretty, Toulmin, and Williams 2011; Lee 2005; Antle and Diagana 2003).

Ethiopia is a highly agrarian and densely populated country with a fragile natural resource base. Mixed crop–livestock farming systems is the most predominant. Although Ethiopia has a long history of agricultural intensification through adoption of technologies that save labour (e.g. ox-plow) and preserve natural resources (e.g. through use of soil structures and tree crops to conserve soil), technological change may not be responding to the rapidly growing population (Headey, Dereje and Taffesse 2014). The majority of the population live in rural areas which are experiencing rapid population growth, land degradation and declining farm sizes (Pender and Gebremedhin 2007). A high integration of crops and livestock is often considered as a step forward and smallholder farmers need sufficient access to knowledge, assets and inputs to manage this system in a way that is socially, economically and environmentally sustainable (Moraes et al. 2014; Duncan et al. 2013).

Although effort has been made to address gender inequalities in Ethiopian agriculture, the wide gender gap still persists. The gender gap in Ethiopia's agricultural productivity is 23% (World Bank 2014). Unequal gender relations create differences between men's and women's access to and control over resources which has implications for adoption of intensification technologies. Three studies in Ethiopia revealed that female-headed households have persistently lower productivity measures compared to their male-headed counterparts (Aguilar et al. 2014; Bezabih and Holden 2006; Holden, Shiferaw and Pender 2001; Tiruneh et al. 2001). However, simply comparing male- and female-headed households renders women living in male-headed households—the majority of the world's women—invisible. Therefore, understanding gender issues in agricultural intensification in Ethiopia, will help us appreciate the underlying factors that actually cause the gender gap in agricultural production, know how to integrate gender into agricultural intensification programs, develop gender sensitive sustainable farming systems and develop strategies to overcome the barriers to intensification thereby contributing to the nation's economic growth and poverty reduction.

The objective of this paper therefore, is to characterize the gendered constraints that holdback women's productivity potential through a systematic literature review and highlighting areas of knowledge gap. The review is based on broader literature (including grey literature and robust peer reviewed publications) on agricultural production in Ethiopia, adoption of technologies, and gender and agricultural intensification. Focus was on literature that employed rigorous empirical methods, both 'old' and recent literature. The literature was validated in 2015 by eight men and eight women groups in the Amhara, Oromia, Southern Nations Nationalities and Peoples' (SNNP) and Tigray regions to understand the current situation, trends and areas that required further research. Focus group discussions were

conducted with men and women farmers within Africa RISING (Research in Sustainable Intensification for the Next Generation) project sites or districts (i.e. Basona woreda in Amhara region, Lemo in SNNP region, Endamehonei in Tigray and Baale Sinana in Oromia region). Within each district, four separate FGDs were conducted in one kebele which was purposely selected based on representativeness and knowledgeability of farmers. This limits generalization to the entire region but provides a good frame of reference. Participants included farmers who are participating and those not participating in the project.

The key questions that guided the enquiry include:

1. What are the differences and similarities between men's and women's access to productive resources (inputs, agricultural information, credit, land, technologies etc.)?
2. What are the differences between men and women on choices of crops, livestock species, and decisions on inputs, production practices and household income?
3. What are the differences and similarities in men and women's participation in local institutions such as cooperatives?
4. How are men and women farmers involved in different agricultural activities?
5. How do norms, culture, policies or legal frameworks influence intensification by men and women farmers?

We categorize the gender-based constraints and opportunities into seven capitals i.e. social, human, financial, natural, political, physical and cultural that are required to intensify farming systems and improve livelihoods. This paper contributes to the literature on sustainable intensification in Ethiopia by adding a gender lens to the analysis. Ethiopia, where management of farms is mostly joint but also with individually managed farms presents an interesting case study to examine gender related differences in uptake of agricultural innovations.

2. Sustainable agricultural intensification

Intensification has been defined in different ways. This paper, however, does not intend to explore the meaning of intensification. Traditionally, agricultural intensification is defined in three ways i.e. increasing yields per hectare, increasing cropping intensity (i.e. two or more crops) per unit of land or other inputs and changing land use from low to high value crops or commodities (Pretty et al. 2011). Sustainable agricultural intensification is defined as producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to the natural resource base and the flow of environmental services (Godfray et al. 2010; Pretty 2008 and Royal Society 2009).

According to Pretty (2011:8) and the Royal Society (2009:7), a sustainable production system exhibits most or all of the following attributes:

1. Utilizes crop varieties and livestock breeds with high productivity ratio per externally and internally derived input;
2. Avoids the unnecessary use of external inputs;
3. Harnesses agro-ecological processes such as nutrient cycling, biological nitrogen fixation, predation and parasitism;
4. Minimizes the use of technologies or practices that have adverse impacts on the environment and human health;
5. Makes productive use of human capital in the form of knowledge and capacity to adapt and innovate and social capital to resolve common landscape-scale problems; and
6. Quantifies and minimizes the impacts of system management on externalities such as greenhouse gas (GHG) emissions, clean water availability, carbon sequestration, conservation of biodiversity, and dispersal of pests, pathogens and weeds.

Sustainable agricultural systems are less vulnerable to shocks and stress and make best use of crop varieties, livestock breeds and their management practices (Pretty et al. 2011 and Royal Society 2009). Application of sustainable management practices requires enhanced knowledge and skills by farmers. Farmers need proper understanding of the conditions under which agricultural inputs (such as seeds, fertilizers and pesticides) can either complement or contradict biological processes and ecosystems services, and understand how to access markets and rural credit. Creation of social capital (trust, networks and norms) is critical as it facilitates spread of innovations (Pretty et al. 2011).

3. Agricultural intensification in Ethiopia

In the mid-1990s Ethiopia formulated a development strategy centred on agriculture. In order to increase productivity the Ethiopian government formulated a smallholder intensification extension program known as Participatory Agricultural Demonstration Training Extension System (PADETES). The strategy was a technology-based, supply driven intensification which consisted of enhanced supply and promotion of improved seeds, fertilizers, on-farm demonstrations of improved farm practices and technologies, improved credit supply for the purchase of inputs and close follow-up of farmers' extension plots (Byerlee et al. 2007; Kassa 2005; Keeley and Scoones 1999). Efforts for intensification have been motivated by low agricultural productivity, small land size attributed to population growth, high natural resource degradation and chronic rural poverty (Josephson, Ricker-Gilbert and Florax 2014; Headey et al. 2014; Gebreselassie 2006).

Ethiopia is characterized by diverse agro-ecological zone, which support diverse crops, although five cereals (teff, wheat, maize, sorghum and barley) account for three-fourths of total cultivated area and about a third of agricultural gross domestic product (Taffesse, Dorosh and Gemessa 2012). Fertilizer application is mostly done on cereal crops such as wheat and maize (Rashid et al. 2013). Despite the profitability of fertilizer use, usage remains low. Escalating fertilizer price and production and market risks have resulted into reduction in use of inorganic fertilizers (Kassie et al. 2009; Dercon and Christianensen 2007). In addition, unstable and insufficient supply of fertilizer does not match the demand (Spielman, Mekonnen and Alemu 2012). Good quality seed varieties, e.g. of wheat and maize, have been developed through modern breeding practices to increase production and food security. Similarly, uptake of these improved seed varieties is low due to limited and inconsistent supply which does not meet the demand (Spielman et al. 2012). Low financial incentives also limit investment in inputs (Gebreselassie 2006). Better access to output markets in the Blue Nile Basin was found to have a significant positive impact in adopting rainwater management technologies (Gebregziabher et al. 2013). Development of market infrastructure and institutions would be one good initiative to increase access and availability of agricultural inputs and better output markets.

Innovative integrated pest management practices are used to control pests and diseases. Research on drought tolerant beans has been done to respond to climate change (Asfaw and Blair 2014). Disease tolerant potato has also been tested and introduced (Tefera 2013). Low season river flows support only a limited area that can be irrigated by surface water throughout the year (Wale et al. 2013). Development of this infrastructure would increase access to water and increase labour efficiency.

The livestock sub-sector contributes approximately 12% to the total gross domestic product (GDP) and over 45% to the agricultural GDP (MOA 2010). However, some regions are not able to supply sufficient livestock feed. The increasing pressure on land and the growing demand for livestock products makes it more and more important to ensure effective integration and use of feed resources in intensified farming system (Abera et al. 2014; FAO 2001). Adoption of improved forages, however, remains very low. Soil and water conservation practices (such as terracing, grassed water ways and stabilized structures) are promoted by government and other institutions to reduce soil and nutrient loss and make better use of available water resources (Girmay et al. 2009; Descheemaeker et al. 2006). However, promotion has not resulted into widespread adoption of the practices by smallholder farmers despite the problem of land degradation, soil erosion and nutrient loss (Fentie et al. 2013).

An enabling environment that is in support of micro-credit services to smallholder farmers, and infrastructure development (such as roads, telecommunication, electricity, market institutions etc.) is important for agricultural intensification. The government of Ethiopia has made effort to invest in infrastructure development resulting into improved market efficiency and market access (Rashid and Negassa 2012).

TILRI implements similar initiatives—under the Africa RISING project and CGIAR Research Program on Integrated Systems for the Humid Tropics (Humidtropics CRP)—to aid intensification of crop-livestock farming systems in Ethiopia in order to improve income, food and nutritional security especially among women and children, which is conserving the natural resource base. Gender and nutrition are key project components to ensure that both men and women benefit from the interventions. The farm household is the focal domain for Africa RISING's interventions because it's the scale at which household production decisions, gender and nutrition issues, and household welfare as well as soil health and productivity issues operate. Africa RISING project acknowledges that intensification through the adoption of technologies and practices by farmers is a stepwise process. So new components are integrated as households move up the intensification ladder. The research is not technology focused but also integrates issues around knowledge management, financial capital, markets and other institutional factors that drive sustainable intensification (IITA, IFPRI and ILRI 2012).

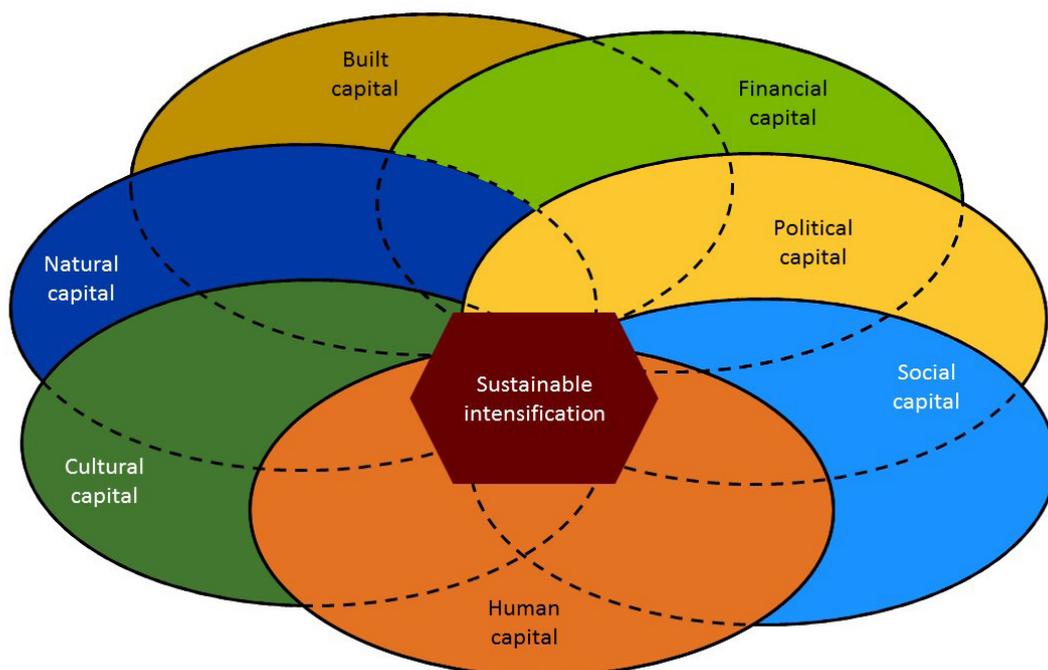
The aim of this section however, is not to compare different approaches to intensification but to highlight some of the approaches used by other projects in Ethiopia.

4. Gender-based constraints and opportunities to agricultural intensification

This section categorizes the gendered constraints and opportunities into seven capitals of the community capitals framework (CCF) i.e. natural, human, financial, cultural, social, physical and political capitals to give a holistic perspective of the resources required by men and women farmers to adopt sustainable agricultural practices for intensification and equitably manage the benefits. Community capitals are assets or resources that can be utilized to produce additional resources (Flora and Flora 2013). A holistic perspective helps to determine the actions to improve women's access to and control over resources to effectively engage in agriculture.

The CCF is a tool to help researchers and community members approach community change from a systems perspective through the identification of assets in each capital (stocks of capital), how people invest in capitals (flow of capital), and the ways in which the capitals interact, and then assess resulting impacts across capitals (Emery and Flora 2006). Categorization was done after reviewing literature collected using general search engines and keyword tracking. The review includes data in publications from 1999-2014 to trace any changes in gender dynamics over time. Although we cite literature from other countries, most of the analysis is from research specific to Ethiopia.

Figure 1: The community capitals framework based on literature.



4.1 Natural capital

Natural capital comprises the stock of assets available in a particular location, including farmland, agro-bio-diversity of plants and animals, water, soil, air and climate.

Land and land tenure system

In Ethiopia, the state owns all land, with user rights being allocated by local peasant associations (the local administrative unit in rural areas). There is a wide variation in access to and control of land in Ethiopia as there have been several attempts to reform land ownership. To date, some regions such as Tigray and Amhara, are undertaking some amendments on issues concerning land. Women from some regions have reported to have better access to and ownership of land, especially as a result of the land reform programs, while in other regions land is still allocated mainly to men and to a limited extent, to female heads of households (World Bank 2001). Women in male-headed households appear to have equal access to land within the household in many locations, with continued access dependent on remaining within the marital union (Torkelsson and Tassau 2008).

The Amhara land registration data analysed by Teklu (2005) revealed that approximately 29% of the registered land was held by women and 32% by men and 39% was jointly held. National data (representative of four major regions) analysed by Ragassa. et al. (2012) shows variation in the number of plots (agricultural land) owned solely by women (23%), men (54%) and jointly (23%). Demographic and Health Surveys (DHS) data analysed by Doss et al. (2013) similarly show that a higher percentage of men than women own any land individually or jointly (54%) or only individually (28%). Fifty percent of women own any land solely or jointly and 12% own any land solely. The gap is much smaller for household collectively managed land. LSM-ISA¹ data shows that the share of total household agricultural land that is documented solely in men's names is 19%, in women's names is 6%, and jointly under both men's and women's names is 17%. Average parcel area among men and women who solely own documented land is very low among women (1.1:1) in Ethiopia. World Bank (2001) reported that farm sizes for female heads of households are usually smaller than those under male-headed households, and moreover women tend to suffer from landlessness more than men.

Although women have increasingly been allocated land, they have not always been allocated land of equal quality to that of men. Among the Amhara in northern Shoa, fertile land is called 'yewand maret' (male earth) whereas poor land is called 'yaset maret' (female earth) (Lvova 1997). Where land is brought under irrigation, women are allocated the most marginal land, which requires extensive labour to clear and prepare for cultivation, or land that is far from home and next to forests where wild animals threaten their crops and lives (World Bank 2001). Women farmers are less likely to rent their farm land from someone else, which explains 20% of the yield gap. Land rental allow farmers to obtain better quality land than they might own (World Bank 2014:20).

Holders of user rights need to convincingly demonstrate 'use' through the concept of land to the tiller. This is problematic for women due to widely prevalent taboos on women ploughing (Araya et al. 2012). Due to these constraints female heads of households tend to engage in unfavourable share-cropping arrangements which restrict their income and investment capacity or leave farming altogether (Torkelsson and Tassau 2008; EEA/EEPRI 2002; World Bank. 2001). Were women do not own land, upon divorce her access to her husband's land is taken away and she is forced to move to another location and peruse her own livelihood. In case of husband's death, the peasant association is quick to take away a large portion of the land for reallocation to someone else, which is not the practice if the wife passes away (World Bank 2001).

Akin to the literature, validation revealed that as a result of land reform, more women own land within their own right, with their names appearing on the land certificates. Across all the regions, women and men farmers reported that women own the same land size as men since land is equally allocated to both men and women on a rotary basis. Land size may vary in terms of area cultivated, with male-headed households cultivating larger pieces of land compared

1. Living standard measurement surveys: Integrated surveys on agriculture

to women-headed households. Women whose names appear on the land certificate do not lose their land upon husband's death. However, women without children are more likely to lose part or all of their land upon the death of their husbands. The literature often generalizes that the quality of land owned by women is low. Validation revealed that the quality of land owned by men and women (land given by government) is the same with some men and women owning either good quality or poor quality land. However, quality of land acquired through other means such as inheritance is not well documented.

Available empirical evidence specific to all regions is not available. Analysed national data that is representative of all regions is aggregated. Analyses have not been correlated with adoption of improved technologies by men and women. The study conducted by Josephson, Ricker-Gilbert and Florax (2014) revealed that small farm sizes have a positive relation with input demand, demonstrated by increased fertilizer use per hectare. Increase in fertilizer use, however, did not correspond to increase in staple crop yields. Yet, this study does not further investigate how fertilizer demand and usage varies across household types or land owners or plots managed by men and women and the gender differences in returns to fertilizer usage.

Although decision-making over land is still dominated by men, the land tenure reform had made modest changes in women's decision-making power over land (Tefera 2013). Although most of the research considers tenure security at the household level, other research suggests that individual tenure within the household may also affect the outcomes of some household decisions (Doss 2005; Allendorf 2007; Deere and Twyman 2012). Therefore, a more systematic analysis of national data is required to explore variation in land ownership, land sizes, area cultivated and quality/value across regions and how this influences application of sustainable intensification practices by men and women farmers. Recent analyses done by Doss et al. (2013) present results of land ownership based on value measured for five African countries under their study except Ethiopia.

Livestock

In Ethiopia, preference for particular livestock species is partly generated by agro-ecologies and partly by gendered roles in the household. Male-headed farming households prefer oxen as they can be used for ploughing—overwhelmingly a 'male' task in Ethiopia (Tegebu et al. 2012; Araya et al. 2012), whereas female-headed households with access to credit prefer breeding cattle. However, the presence of an adult male in a household, regardless of the gender of the household head, increases the probability of a household keeping oxen. Chickens are typically selected by female-headed households with a small number of dependents and no adult males (Tegebu et al. 2012).

In Oromia, men possess on average more livestock species than do women, and the average number of livestock held is greater. Women heads of households have fewer species and lower numbers than men heads of households. Female divorcees have more livestock than do widow-headed and married women heading households. However, as a category women-headed households own less livestock than do women within male-headed households (Torkelsson and Tassau 2008). These findings are echoed in Tigray, northern Ethiopia, where women-headed households own fewer animals than their male counterparts (Tegebu et al. 2012). Upon divorce, as a rule, livestock (either jointly or individually owned) is distributed equally between husband and wife. However, it's more likely that individually owned livestock is attributed to its owner upon divorce. Upon death of a spouse, livestock goes to the surviving spouse and children (Fafchamps and Quisumbing 2002). These findings were supported by both men and women farmers during the validation. Note that there are variations in asset disposition across regions and pastoral and agricultural areas details of which are discussed in (Fafchamps and Quisumbing 2002).

Livestock are critical to the development of sustainable and environmentally sound production systems through provision of draught power, manure and fuel. Poor access to livestock is likely to hinder female and male farm managers from adopting minimum tillage and manure application for soil fertility management. More so, adoption of such practices is labour demanding and requires knowledge and complementary resources such as livestock and credit. A study conducted in Kenya by Ndiritu et al. (2014) revealed that livestock ownership increased the likelihood

of manure application. Female plot managers owned less livestock which limited the amount of manure available for soil fertility management and adoption of the practice. Similar studies have not been conducted in Ethiopia.

Currently, livestock production is severely challenged, among others, by shortage of feed and poor quality of available feeds to meet production demands. Livestock feeds production and processing has received much attention in the newly established Ethiopian Ministry of Livestock and Fisheries five year (2016-20) plan, the Ethiopian Growth and Transformation Plan (GTP II) and the Livestock Master Plan. In addition, the Africa RISING program in the highlands of Ethiopia has introduced feed and forage innovations that suit various farming systems and different farm typologies within communities. The innovations include planted forages, feed resources management and utilization for large and small ruminants (Africa RISING 2015). However farmers' engagement and benefits from the interventions have not been disaggregated by gender.

4.2 Human capital

Human capital describes the skills, knowledge and abilities of people which they can deploy to mobilize other resources. Human capital includes formal and informal education, health status, and leadership skills. Human capital enables individuals to strengthen their understanding, identify promising technologies and practices, and obtain information to enhance their mobilization of other resources (Flora and Flora 2013). At the household level, human capital includes the amount and quality of labour available and the ability to command labour (DFID 1999).

Technical information and knowledge

Highly skilled extension services enhance the likelihood of adoption of a combination of sustainable intensification practices (Teklewold et al. 2013). The fact that adoption of a combination of practices is knowledge intensive, having knowledgeable extension agents, who visit both male and female farmers fosters technology adoption amongst male and female farmers (Ragasa 2012). However, the ratio of female to male extensionists is about 1:15. At the grassroots level, farmers are in contact with extensionists (known as development agents) of which the female to male ratio is 1:50 (World Bank 2001). In western Oromia, the proportion of male farmers who enjoy agricultural extension services is 72% compared to only 37% of female counterparts (Ogato et al. 2009). Women rarely receive extension advice on effective use of agricultural inputs or technologies as those extension efforts are almost exclusively directed toward male farmers. Development agents only seek out landholders and give advice to them, most of whom are men (Frank 1999).

There are also cultural perceptions that extension programs only address men so women generally do not even conceive that they can receive valuable advice from development agents. Since nearly all development agents are men and in many areas it is perceived as inappropriate for men outside the household to talk to women alone, it is difficult for extension agents to approach women (Frank 1999).

In the study conducted by World Bank (2001) female land owners reported that they had rarely been visited by an extension worker, and only about 2% of the female respondents had been part of a demonstration exercise. Female respondents did not proactively seek extension advice and were only knowledgeable of the credit facilities available from some local institutions. These women were also not exposed to use of and training in fertilizers, pesticides, or small equipment. Extension workers did not monitor women's fields to give advice. The methods used to disseminate technical information, such as the contact farmer approach and the use of training centres, tends to channel information to farmers who have more resources and who are generally men (Tiruneh et al. 2001).

Analysis of a regionally representative data set of the four major regions shows that 42% of household heads surveyed received advice from development or extension agents on fertilizer and seed, while 41% received advice on land preparation. Male heads are more likely to be visited by and to receive advice from development or extension agents than female heads. About 20% of female heads and 30% of male heads have been visited by an extension agent in the

past 12 months; while 46% of male heads and 34% of female heads were visited by Development Agents (DA) in the last five years. In addition, plots of male heads are more likely to be applied with chemical fertilizer, while plots of female heads are more likely to be applied with manure. The rate of fertilizer, herbicide, pesticide and improved seed use was significantly greater in plots managed by male heads than those by female heads. Plots of male heads were also more likely to be irrigated. Difference in technology adoption between women and men was attributed to gender-differentiated land size and access to extension (after controlling for other household, plot, and village level characteristics) (Ragassa et al. 2012). Women in Ethiopia benefit less than men, in terms of increased productivity, from extension services since advice is more attuned to the needs of male farmers. Unequal access to inputs causes differences in returns to inputs (World Bank 2014).

During validation, both men and women farmers' groups acknowledged the discrepancy in access to extension services, with men having more access. This was attributed, in part, to women's workload, the type of trainings organized and location of trainings. However, women who actively worked with researchers and extension workers on projects argued that they relatively accessed extension services equally as men. Majority of these women were household heads and elderly. Majority of development agents are still men. This reveals a similar pattern over the past 16 years of the literature reviewed.

Farmers' involvement in all stages of research or innovation is important because novel technologies and practices can be learned directly and adapted to suit particular agro-ecological, social and economic conditions. This is particularly important where a sustainable intensification practice does not comply with existing community norms (Pretty 2011). However, the number of women who participate in research is very low. Women are less represented in higher level research, management and decision-making positions compared with their male colleagues. In addition, research on activities traditionally performed by women is not encouraged as part of national or regional programs of agricultural research, nor do extension curriculum generally contain materials relevant to women centred activities. Without changing the extension curriculum and training programs to encompass all activities surrounding agricultural production, development agents will continue to fail to adequately address women's agricultural information needs and perpetuate the stereotype of women as 'weak farmers' (Frank 2001).

Exclusion of women from agricultural research and extension hinders their capacity to enhance their knowledge, learn new ways of doing things which therefore refrain from uptake of new technologies especially those that are knowledge intensive or challenge existing norms. These findings were also affirmed by men and women farmers. However, more investigation needs to be conducted to clearly understand the underlying factors which enable or hinder women's participation in agricultural research and extension. There were some indications that research on crops managed by women such as inset, beans and potato as well as livestock feed was being conducted, and effort was made to introduce labour saving technologies for women especially in SNNP region. This area will require further investigation to clearly understand the technological attributes that trigger women's engagement in agricultural research as well as adoption of technologies and whether the technologies directly address the needs of women and women's level of involvement in selection of technologies.

Division of labour

Labour can affect the long term sustainability of intensification processes. In agriculture there is division of roles and responsibilities between men and women. Women are assigned the 'small' tasks such as weeding, storing, processing, and hand-harvesting of some cash-crops. One of the characteristics of 'small tasks' is that they are ongoing and continuous. Men do the 'heavy' tasks such as clearing and preparing the land usually involving some form of technology, and they harvest. Women are also involved in growing subsistence crops and vegetables for household consumption. Men market the cash crops while women market the surplus from subsistence crops. The income from sales of men's crops is used mainly to purchase agriculture inputs, large livestock or draught power, and for large household equipment. Income derived from sales of women's produce is used to buy small household equipment, food necessities, clothing, and to meet community obligations. Men's and women's income are shared for health and education expenses of the family (Africa Development Bank 2004:14).

It is important to note, however, that in Ethiopia the sexual division of labour and gender roles vary from one cultural setting to another depending on whether the plow or the hoe are used for cultivation. The Ethiopian highlands traditionally have plow-based agriculture, with the plow mostly being used by men, hence men dominate that labour input in the agricultural system. Where the hand hoe is used, women dominate the position within the production system. When the division of hired labour by gender and agricultural production tasks is assessed, most households hired only male labour for threshing (Tiruneh et al. 2001). In relation to livestock, women in farming communities are responsible for herding, barn cleaning, hay processing, milking and milk processing, fetching drinking water for animals, tending sick animals kept at home, and trekking animals to water source and vaccination centres (Frank 1999). Where livestock is enclosed, women's labour is used for cleaning of the animal shelters or space as well as the milking activity. Women are in charge of the dairy processing activity while, generally children are in charge of herding the large animals (World Bank 2001).

Women also have to depend - to a large extent- on male labour and/or rented traction power which is difficult for them. Therefore, their land is not ploughed, sowed, or harvested in time (EEA/EEPRI 2002; World Bank 2001). Women farmers may also not be able to hire labour, control household labour and manage labour on their farms as much as male farmers (World Bank 2014). Nationwide, it is estimated that rural women work between 13 and 17 hours a day, in many cases more than twice that of men. With so much time spent on domestic activities women's opportunities to engage in more productive activities is severely limited. The colossal labour burden carried by rural women also jeopardizes their health and generally inhibits human and family development. Ignoring the link between women's labour burden and household production capacity perpetuates household food insecurity (Frank 1999).

The study conducted by Teklewold *et al.* (2013) in rural Ethiopia, revealed that adoption of a package of sustainable agricultural practices increased women's workload, which may have affected their decisions to adopt the practices. Adoption of packages of sustainable agricultural practices led to more time spent working on the farm for male and female farmers especially packages that included conservation tillage. Family size and age also influenced adoption, with increase in family size facilitating and adoption, while increase in age shows a decline in adoption of sustainable agricultural practices. Furthermore, the spouse's education level had a positive impact on adoption of sustainable agricultural practices such as conservation tillage, improved seed and fertilizer.

Few studies have been conducted in Ethiopia to understand labour allocation in agricultural intensification. Hence more research is needed to quantify gendered labour allocation as more technologies or practices are adopted and the effect on household welfare. Variation across regions needs to be captured. For instance, during validation, men and women groups in Lemo (SNNP region) expressed low women involvement in agricultural activities since they are kept busy by household chores. Women groups emphasized that husbands did not allow women to get involved in agriculture. This depicts variation in women's contribution to agricultural labour force which needs to be systematically documented. One has to be careful not to generalize that all women contribute a lot to agricultural labour force. In Basona woreda (Amhara region), women and men groups expressed that although culturally women are not allowed to use the plough, women are now increasing using the plow to open land. Women groups in SNNP also echoed this change. Migration is taking a toll on availability of family labour. The majority of migrants are men and the number of households with absentee husbands is on the rise. This has implications on division of labour and requires further investigation.

Health and nutrition

Agricultural intensification presents key opportunities for improving household nutrition and health. However, this connection is often not given due attention, despite parallel initiatives. Emphasis has mostly been placed on increasing productivity and less on enhancing nutrition and health. Much work on gender and assets focuses on reducing the 'gender gap' in assets, the hypothesis being that narrowing the gap can improve women's bargaining power in households. This in turn is thought to translate into improved outcomes with respect to food and nutrition security, health, as well as improved empowerment and agency (O'Sullivan et al. 2014; Meinzen-Dick et al. 2011). However, under nutrition remains a serious public health problem in Ethiopia, accounting for 28% of all child

mortality. Nationally, 40% of children under five are stunted, 15% are underweight and 8% are wasted. Micronutrient deficiencies, notably vitamin A, zinc and iron are prevalent particularly amongst pregnant women and children under five (CSA 2014). The current shift from diversification to high yielding monocrop-dominated cropping systems impedes policy support for crop diversification. In addition, most local agricultural experts do not consider as a priority (Fofanah *et al.* 2015).

Livestock sector development, in Ethiopia's growth transformation plan (GTPII) has also focused on increasing production and productivity and yet the risk of zoonotic disease transmission from animals to human is high. Gender differences in roles and responsibilities and food consumption behavior expose men, women and children to different health risk. A recent study by Nega *et al.* (2012) revealed that prevalence of bovine tuberculosis in Northwest Ethiopia was higher amongst cross breeds under intensive production compared to out-door production system. Out of the 77 households interviewed for the presence of tuberculosis cases within their family and habit of raw milk consumption, there were 11 cases of tuberculosis but not differentiated by gender and production system. The positive relationship between human tuberculosis cases and diseased animals within the heard are akin to the findings in Tigre *et al.* (2011) in Jimma, south western Ethiopia. Use of crop chemicals without protective measures can also pose health risks to humans.

Increasing women's access to resources, services and control of benefits would enhance their income and at the same time improve household nutrition (through dietary diversity) and ability to support children's education and access to medical services (GIZ 2013). More studies integrating the relationship between nutrition, health and agriculture are needed.

4.3 Financial capital

Financial capital refers to the monetary resources available for investment. For monetary resources to become capital, they must be invested to create new resources (Flora and Flora 2013).

Credit

Credit constraints are frequently mentioned in technology adoption literature. Credit availability, by increasing the ability to invest, and improving access to other productive inputs and assets, is very important for improving farm productivity and returns from intensification (Tiruneh *et al.* 2001). Agriculture *credit* requires some form of guarantee of repayment and since women do not own either the land, equipment, or the produce it is more difficult for them to qualify for a loan (World Bank 2001). In Ethiopia, a farmer must have at least 0.5ha under maize to participate in the credit scheme for maize (Doss 2006). In Ethiopia, women are mainly involved in community based revolving credit and savings groups, which are much more convenient to them in terms of the distance, the ease of access, and the fact that they deal with people from the community. However, the sums involved in these credit systems are too small to purchase agriculture inputs and are basically used for household needs satisfaction (World Bank 2001).

A study conducted in the central highlands of Ethiopia showed that female-headed households received smaller amounts of credit than their male counterparts from either a bank or cooperative (Tiruneh *et al.* 2001). No distinction in access was made between men and women farmers (including married) women and control over credit is not discussed.

Results from the FGDs revealed that currently, access to credit by both men and women farmers is not a problem. They both have equal opportunity to access credit and in fact, women have more opportunities to access credit compared to men. Most of the credit beneficiaries were women as microfinance institutions are working more with women. No conditions specifically restrict women from getting credit. The major challenge is the system of providing credit to farmers. For instance, husband or wife alone cannot access credit without consent from each other. This limits women's ability to make independent decisions on how to invest the credit but also guarantees payment.

Secondly, approval has to be granted by group members. The difference that emerged in credit access is the amount of credit accessed, with men taking more credit compared to women. This was attributed to the level of investment whereby men invest in more expensive assets while women invest in smaller businesses. In addition, women are not risk takers so women groups limit the amount of credit that can be taken by members, ensuring that they take amounts that are manageable. In all the sites, no credit programs are designed specifically for women. In Lemo, men had agricultural-based groups such as cooperatives to which they belonged and accessed inputs. A more systematic study will be required to document the current changes in access to and control of credit by men and women and the system of credit provision and how credit is spent.

4.4 Cultural capital

Cultural capital describes the way people perceive the world around them, how they live their lives, their traditions, values and language. Cultural capital helps to determine how creativity, innovation, and influence emerge and are nurtured (Flora and Flora 2013). Cultural capital helps to determine who is allowed to utilize specific resources within a given network and which decision-makers are trusted to preside over the use rights of particular resources (Schneider 2004).

Gender stereotypes, norms, attitudes and perceptions

The issue of access to agricultural inputs and technologies is directly related to the issue of whether or not women are perceived as farmers. Like limited access to information and land, limited access to agricultural inputs and technologies severely constrains the productive ability of women in general, and female-headed households in particular. The reasons as to why women's access to inputs and technologies is limited closely aligns with reasons why their access to land is limited. With few exceptions such as women who head households, women are considered weak farmers and information regarding inputs as well as the actual inputs themselves are rarely distributed to women (Frank 1999).

The overwhelming perception by peasant association leaders is that women are not able to utilize inputs as effectively as male farmers, which impedes women's access to these resources. If resources such as credit/fertilizer/extension services are perceived to be in scarce supply, then applications for inputs from farmers considered to be 'weak' due to resource disadvantages (i.e. poverty), physical disability or gender based disadvantages are most likely to be rejected. A 'weak farmer' is one who is unable to plow – by implication, at best a woman can only be a 'weak farmer' (Frank 1999). In many cases, preconditions for ox ownership or 'cultivation capacity' are observed, thereby presenting direct barriers for access by many female-headed households (CISP 1997). Ownership of oxen and land is considered essential for an effective farming capacity. In most agricultural areas of Ethiopia, ownership of oxen is perceived as synonymous with food security. Women rarely have oxen or the same access to other agricultural resources as men, so they are perceived at best as 'weak farmers' and often as 'non-farmers' (Frank 1999). Even if women do own oxen, it is considered inappropriate for them to engage in plowing activities. Cultural norms in Ethiopia forbid women from using the plow because such work is perceived to be too physically strenuous (Holden et al. 2001; Frank 1999).

Agriculture intensification relies quite heavily on adoption of inputs. Many resource poor farmers perceive that the increasing trend of adoption of inputs increases rural stratification (Masefield 1998). If this perception is correct and female-headed households continue to be denied access to agricultural inputs and other production intensification technologies due to cultural perceptions, these households will quickly fall to the bottom of rural economies and be unlikely to achieve household food security through agricultural activities. Due to limited income generating opportunities and lack of training, female household heads face major constraints obtaining livelihood security through other means (Frank 1999).

The other critical issues to be considered is the identification of a woman as a head of household. In polygamous marriages, the husband is available but may not be living with one of the wives. Thus, planning and monitoring

authorities overlook women who are living under this situation, because they are not identified as heads of households as long as the husband is alive and the couple are still officially married. Women in polygamous marriages, to a large extent, continue to live alone and care for their children and households without the physical presence of a husband at all times. This situation has implications in terms of distribution of land, technology, and contact with extension workers, and access to other support services (Africa Development Bank 2004). Again, this applies to married women.

During validation of literature in Endamehonei (Tigray region), men and women farmer groups argued that both men and women farmers have equal access to inputs and equally capable to use the inputs but variation was in the amount of inputs accessed. However, in other sites, men accessed inputs more than women because men are considered to be the 'farmers'. In Lemo (SNNP), almost all the women who participated in the FGDs were not knowledgeable about agricultural inputs and the price as it is considered to be a domain of men. Although women are increasingly engaged in ploughing fields using the oxen (e.g. in Amhara and SNNP), culturally, it is still the domain of men. Women are also still considered as weak in some communities because they can't use the plough. The attitude was strongly disputed by women within the SNNP region. Culture has defined the role of women and men, with men being considered to be the 'farmers' which keeps women away from fully engaging in agricultural activities or unrecognition of their contribution.

Although Fafchamps and Quisumbing (2002) found no significant effect of religion on asset disposition, in Sinana (Oromia region), muslim women especially in male-headed households are restricted to move far from home and control of household resources.

Although culture may still be constraining to women, there is a transformation in some communities where by women can now plough land, which was previously a taboo e.g. in the Amhara and SNNP regions. The change in perceptions of women being 'weak' is demonstrated by women taking up roles previously assigned to men - roles which require energy. Nonetheless, in other communities within Ethiopia, ploughing is still considered a role of men. The male participants argued that cultural norms in the localities forbid women from using the plow and it's considered inappropriate to engage in plowing activities. Further research will be required to fully understand the effect of culture, norms, religion and agency on agricultural innovation in Ethiopia. There is a trend in change in culture and its effects which will be good to document.

4.5 Social capital

Social capital plays a key role in fostering adoption of sustainable agricultural intensification practices. Social capital includes the networks, norms of reciprocity, and mutual trust that exist among and within groups and communities which can help build a sense of collective identity, shared future and which, in so doing, facilitate cooperative livelihood strategies (Putnam 1993; Flora and Flora 2013). Social capital assists individuals and groups to secure access to the resources that they need for developing their livelihoods. Due to the connections between actors located at different levels, social capital has been categorized as bonding, bridging, and linking. Bonding social capital is the ability to work closely with people closest to us who share similar values. Bridging social capital tends to bring together people across diverse socio-economic groupings (Field 2003) or people who have dissimilar values and goals (Woolcock 2001). Linking social capital pertains to connections with people in power e.g. people in politically or financially influential positions. Linking social capital also includes vertical connections to formal institutions (Woolcock 2001; Mayoux 2001; Pretty 2003). To benefit from social capital, individuals and communities require a balanced mixture of bonding, bridging and linking relationships.

Membership to cooperatives and groups

The wealth of social capital one enjoys can be measured through membership in organizations, but it can be culturally specific (Torkelsson and Tassau 2008). Agricultural cooperatives have great potential to enable the economically weak

farmers to increase their collective bargaining power and individual capacities hence enhance their incomes, provide input services, create market opportunities, and help sell their members' products. Women and men often experience differential access to social resources and networks, and this in turn impacts upon their ability to successfully engage in markets and invest in technologies. Women are typically more reliant on informal local institutions, whereas men are generally more engaged in formal or semi-formal institutions (Narayan 1999).

In Ethiopia, women participation in cooperatives is very low constituting only 20% of cooperative membership and even fewer (18%) are found in management positions. This is attributed to gender biases within households, communities, and cooperatives themselves that favour educated male household heads and land owners over resource-poor women. However, women with higher decision-making power and literacy levels are more likely to be members (Woldu et al. 2013). In a study conducted in Oromia, women had significantly lower membership to organizations than men, and female-headed households even less. The same pattern pertains to connectivity, with women in male-headed households having more connections than women-headed households, and men having the most connections (Torkelsson and Tassau 2008). Social networks facilitate the exchange of information, enable farmers to access inputs and overcome credit constraints (Teklewold et al. 2013). The ability to develop and mobilize social capital is vital for women to develop and deploy their entrepreneurial skills and accumulate other resources required to adopt sustainable agricultural practices.

Women in many parts of Ethiopia have little opportunity to participate in the wider society, especially in educational or extension programs which are dominated by men. Thus, women in Ethiopia engage in *Wobera* groups—groups where women come together to help each other in various activities such as weeding, threshing, cotton spinning, preparing for social occasions such as child birth, etc. The *Wobera* group gives women a platform to discuss problems, exchange information and generally support each other (IIRR 2003).

Validation revealed mixed perceptions about women's level of involvement in cooperatives. However, it was agreed that overall, the number of women is low since they are registered under the husband's name and few are in leadership positions. However, women household heads are registered members and were believed to have larger membership than women in male-headed households. In some communities, there were farmer-based groups for men and none for women. Both men and women groups asserted that more women participated in *Wobera* and *Idri* groups. *Idri* groups are social groups that provide support in times of death of a family member. Registration in *Idri* groups was under the husband's name, except if widowed. This area requires further exploration to understand women's involvement in other groups besides cooperatives, the benefits derived from membership to those groups and the existing opportunities that could foster adoption of improved agricultural practices.

Innovation platforms

Innovation platforms have been used to engage both men and women farmers in agricultural research and improve their access to improved technologies through linking and bridging social capital. An innovation platform is a space for learning and change. It is a group of individuals (who often represent organizations) with different backgrounds and interests: farmers, traders, food processors, researchers and government officials etc. The members come together to diagnose problems, identify opportunities and find ways to achieve their goals. They may design and implement activities as a platform, or coordinate activities by individual members. If well-designed and facilitated, innovation platforms can be a good way for women to communicate their perspectives to other stakeholders and find solutions to the problems they face. The innovation platforms facilitated by ILRI in India enabled stakeholders to identify livestock priority issues and other socio-economic constraints that women livestock keepers faced. Identification of gender disaggregated problems fostered designs of tailor made intervention that solved women's priority problems in livestock production (Mulema et al. 2015). Similar benefits have been realized by women in innovation platforms facilitated by the Humidtropics CRP in Ethiopia, thereby helping them to intensify their farms (Lema et al. 2015).

4.6 Physical capital

Physical capital includes infrastructure that supports other capitals such as processing equipment, roads, health centres, water systems, and electronic communication among others (Flora and Flora 2013). Lack of physical capital increases the cost of production hence producers operate at a comparative disadvantage in the market. The opportunity costs associated with poor infrastructure can impede access to training, health services, inputs and income generation (DFID 1999).

Rural Infrastructure

The recognition that gender equity should be an important aspect of rural infrastructure policies and programs is more recent. Rural infrastructure plays an important role in economic, social as well as human capital development of rural population. Rural infrastructure enables rural populations to increase their productivity, access to markets, improve their welfare, and emerge from isolation (IFAD 2009). In Ethiopia, like other developing countries, women serve as '*living infrastructure*' (a term used by Grieco 2002 cited in World Bank 2009) carrying out reproductive and productive roles without any labour saving technologies. Women also lack access to labour saving processing technologies, preservation and storage techniques and knowledge, and how to diversify the types of foods processed (Africa Development Bank 2004). Women walk up to two to six hours one-way to fetch an average of six litres of water per head-load, which is still not enough for an average family of six persons and in most cases on poor quality. Trekking long distances to fetch water consume a lot of women's time, thereby incapacitating them to engage in other social or economic activities (World Bank 2001).

Availability of good roads enhances access to markets by both men and women. The nature of engagement in markets differs between men and women and also by household wealth. Men usually take the farm produce to the markets (both their own and that of the women) especially in cases where the produce needs transportation, and where women's goods (such as home-made craft-work and pottery, handicrafts) cannot be sold locally. Men from wealthier households often sell major cash crops (e.g. teff, wheat, maize, sorghum and barley) in bulk and travel to more distant markets to secure higher prices. They also tend to sell to private traders and cooperatives. Poorer households and women tend to accept prices at local markets which they can easily reach on foot and tend to sell directly to consumers. This underscores the need for secure and easily accessible markets (Aregu et al. 2010; World Bank 2001). The transaction costs associated with access to markets can negatively influence adoption of sustainable agricultural practices by smallholder farmers through increase in travel time and transport costs. Transaction costs are barriers to market participation by resource-poor smallholder farmers (Sadoulet and de Janvry 1995). Women also tend to sell on the road side and the role of these potential informal markets has not been documented.

Mechanization has great potential to increase labour efficiency and effectiveness within households. Agricultural production in Ethiopia relies on increasingly fewer draft animals and low usage of tractors. This causes extreme drudgery of many farm operations, which often falls to women (CIMMYT 2012). Women are less represented in water associations and are not included in training in operations and maintenance of the facilities (Africa Development Bank 2004). A comprehensive gender analysis of factors that shape the demand for and adoption of mechanization by women and men in different types of households has been done in the maize farming system and there is need for similar studies in other farming systems.

Infrastructural factors have not been a focus of much of the literature on intensification. There is still a knowledge gap on the effect of rural infrastructure on agricultural intensification in Ethiopia. More research is needed in this area to explore the role of infrastructure on agricultural intensification amongst men and women farmers. The study conducted by Tesfalem (2014) in the northwestern zone of Tigray revealed that before establishment of infrastructure and institutions (including roads, markets, electricity, schools and cooperatives), farmers were exposed to unnecessary costs, reduction in production especially in teff and maize crops due to the inability to access different trainings on agricultural intensification skills. After establishment of rural infrastructure and institutions, farmers have saved

their time and energy and they are getting different services, like trainings in different agricultural intensification technologies. However, this study did not collect sex disaggregated data. With the current development of infrastructure in Ethiopia, it will be worth exploring the costs and benefits on men and women farmers.

4.7 Political capital

Political capital includes the ability of a category of people, or group, to influence the standards of social institutions (markets, state and civil society), regulations, and the enforcement of those regulations that influence the distribution of and use of resources. Political capital is based on organizations, connections, voice, power and ability to influence the way resources are distributed (Flora and Flora 2013). In this paper, political capital also encompasses the decision-making power within households.

Decision making/power relations

Many studies neglect who exactly participates in decision-making over adoption of a given technology. Most of the studies look at the gender of the household head rather than the specific plot or farm manager within the household (Doss 2001; Peterman et al. 2010a; Quisumbing and Pandolfelli 2010). Since agriculture production in some cultures in Africa occurs at many plots controlled by different household members, heterogeneous roles cannot be easily determined as to who exactly makes specific agricultural investment and managerial decisions (Peterman et al. 2010b). Therefore, assuming that adoption and production decisions are made jointly within a household may neglect the phenomenon of differential farming decisions taken by male and female individuals within the same household especially where access to and control of resources differs significantly among household members (Ndiritu 2014).

In Ethiopia, the household head, regardless of gender, enjoys almost all decision-making capacity over the use and disposal of assets regardless of who within the household may actually own them. This arrangement pertains across the country, despite the enormous diversity of cultures, religions and patrimonial traditions which characterize Ethiopia, both between and within regions (Torkelsson and Tassau 2008; Fafchamps and Quisumbing 2002). Most livestock is held jointly by the husband and wife. Individually held livestock is almost always owned by the household head. Despite overwhelmingly joint ownership, the right to sell livestock and keep the proceeds is the sole prerogative of the household head. However, if a woman brings more livestock to the marriage she can expect to participate more in decisions over their sale (particularly when she is older), thus experiencing more bargaining power vis-à-vis her spouse (Fafchamps and Quisumbing 2002).

The only exception to exclusive headship control is the right of women to keep and control money generated from dairy products such as milk, butter and cheese. This is probably because women add value to the product through processing and therefore require incentives (Fafchamps and Quisumbing 2002) or simply because processing in itself confers ownership through product transformation. Women tend to own and have the right to income from small animals, especially chickens, goats and sheep, but this is not an absolute. Evidence suggests that if there are a small number of these animals, women will maintain control over them. However, if the numbers increase, men will generally take over (Frank 1999).

In one national study, the head was entirely responsible for administering all household finances and incurring all consumption expenditures (including food, clothes, school fees, and medical expenses) in more than half of all cases (Fafchamps and Quisumbing 2002). Most rural women do not have any role in decision-making with regard to purchase or sale of farming implements, land preparation, seed production and determination of type and amount of chemicals (pesticides, herbicides) to use (Mulugeta and Amsalu 2014; Tsegaye et al. 2012). This is attributed to lack of experience, illiteracy, false attitudes toward women's role in agriculture, shortage of technical knowledge/skills, and limited extension service (Mulugeta and Amsalu 2014). The land reform has made modest changes to women's decision-making power over land but the improvement in land related decision-making and asset control has not been accompanied with income control, decision-making on self-earned income and political participation (Tefera 2013). There is information gap on women's political capital at community level.

Enabling policy environments

Agricultural development is amongst the top priority issues of the current Ethiopian government. To increase agricultural development, the government has enacted plans to develop and extend new seeds, chemical fertilizers, new crops and new natural resource management practices (including irrigation). Substantial investment has been made in roads and agricultural extension services as well (Dorosh and Rashid 20013; Dercon et al. 2009; Byerlee and Spielman 2007). The Ethiopian government's development strategy centres on agricultural development-led industrialization (ADLI). Policymakers believe that significant productivity growth can be achieved by improving farmer access to technologies which narrows the yield gap (Gebreselassie 2006).

Central to this economic policy is improving the productivity of smallholder agriculture by improving existing crop husbandry practices and techniques, developing irrigation, provision of fertilizers and agro-chemicals, increasing farm sizes and making agriculture more suitable for mechanization. However, the emphasis given to women in the ADLI strategy is very minimal and it does not clearly indicate how women's life will be improved (Zewdu 2002). The Ethiopian government has made efforts to improve land tenure for women. However, in southern Ethiopia, improvements in land tenure for women have not brought about changes in socio-cultural and traditional norms which would improve women's decision-making power, control of self-earned income and participation in politics (Tefera 2013). So more analysis needs to be conducted to understand the effect of land reform in other regions, including effect on adoption of improved technologies. Although Gebreselassie (2006) documented the impact of the agricultural-led development strategy, the assessment did not disaggregate the impact by gender.

5. Conclusion and recommendations for further research and actions

Several factors hinder women's ability to apply sustainable agricultural intensification practices to increase productivity. The constraining factors are categorized into seven capitals (natural, human, financial, social, physical, cultural and political capitals). These factors are interrelated and separating them is nearly impossible. Overall, women's limited access to and control over productive resources, income, markets, labour, information, extension services, and education; their low decision-making power and inability to effectively manage the flow of the capitals are key constraining factors. Increase in the stock and flow of capitals improves the capacity of women to adopt new technologies to intensify their farming systems. The interactions between the capitals spurs the momentum to increase men and women's access to resources and exploitation of opportunities to intensify agriculture. Women's lack of capitals gives them less bargaining power, limits their income-earning opportunities and investment in agricultural production.

Addressing gender inequalities in the agricultural sector will require transformation of gender constraining norms and gender capacity development of extension workers and researchers. A recent assessment conducted by Mulema, Tafesse and Kinati (2015) revealed low gender capacities of research and development actors in terms on the capacity to conduct gender analysis and strategic planning; knowledge management and gender responsive monitoring and evaluation; use of innovative gender approaches and gender responsive programming, budgeting and implementation. Attainment of gender equality goals within the agricultural sector will be impossible without sufficient staff capacities to integrate gender within agricultural research and development.

Development and mobilization of social capital is vital for women to access agricultural information, develop and deploy their entrepreneurial skills and accumulate other resources required to adopt intensification practices. Approaches such as innovation platforms, women only research groups have potential to boost women's capitals. Increasing women's access to resources alone is not enough. Women have to increase the returns from their investment and control the benefits.

Although previous studies have investigated the trend in agricultural intensification and assessed the determinants of technology adoption in Ethiopia, the gender specific constraints that affect technology adoption and sustainable intensification are not well documented. Less attention has been paid to understanding how gender issues affect technology adoption within and across households, particularly adoption of multiple technologies. Most of the analyses were undertaken at household level, comparing male and female household heads. This has implications for design of technological combinations appropriate for men and women farmers and adoption of technologies on the farms they manage.

Many studies use the term ownership without clearly defining what the term means. It is not so clear how assets owned jointly (such as land and livestock) are classified and analysed. Most of the data presents ownership e.g. of land by household headship, which underestimates ownership of assets by women in male-headed households. Any claim about the share of assets owned by women needs to be made in comparison with that owned by men in a specific context. Galiè et al. (2015) and Doss et al. (2013) provide definitions of the term ownership which need to be taken into account when designing studies.

Limited data exists on gendered allocation of labour at different stages of intensification. Although use of the plow is known to be a men's domain, FGDs revealed that more women are now using plows to prepare land. More research is needed to understand the trends in labour allocation as more technologies or practices are adopted, the tradeoffs and the effect on household welfare. Variation across regions needs to be captured. Furthermore, mechanization directly affects patterns of labour allocations in households which, in turn, directly affect the well-being of individual household members. Gender analysis is required to uncover the gender dimensions of agricultural mechanization in different farming systems in Ethiopia in order to inform policy and future interventions. Infrastructural factors have not been a focus of much of the literature on agricultural development.

Although studies have been conducted to understand the changes brought about by land reform, there is still more research needed to understand how land reform has enhanced women's decision-making power and control of benefits from their labour in all the regions. The effect of cultural norms on adoption of agricultural technologies and women's agency will require more detailed examination. There is a need to conduct thorough gender analysis to understand the real needs of men and women farmers and underlying factors that enable or hinder women's participation in agricultural research and extension.

The available literature does not cover all regions to aid comparison and assess the trend across the six capitals. Gender analysis has not been sufficiently done to allow for rigorous comparisons across farms managed by women and men. Most of the available studies aggregate the findings and disaggregated data that is available by household headship which makes married women invisible. Gender analysis should be done prior to agricultural interventions, during and after the interventions, and during scaling up to ensure that technologies are tailored to specific gender groups and farm typologies. Gender analysis should go beyond household types to disaggregating data by men and women. Although a number of studies on access to credit by men and women farmers have been undertaken, no studies have reported on the current increase in women farmer's ability to access credit from formal institutions and control of credit within households. Most of the comparisons are by household type, not revealing access by married women.

Although cultural norms may still constrain women, there is a transformation in some communities where by women can now plough land, which was previously a taboo e.g. in the Amhara and SNNP regions. The change in perceptions of women being 'weak' is demonstrated by women taking up roles previously assigned to men. Further research will be required to fully understand the effect of culture, norms, religion and agency on agricultural intensification in Ethiopia. In addition, more studies need to be undertaken to understand the benefits derived from the existing gender enabling policy environment.

6. References

- Abera, M., Tolera, A. and Assefa, G. 2014. Feed resource assessment and utilization in Baresa watershed, Ethiopia. *International Journal of Science and Research*, 3(2):66–72.
- Africa RISING. 2015. Africa Research in Sustainable Intensification for the Next Generation, Ethiopian Highlands Project Technical report, 1 October 2014–31 March 2015.
- African Development Bank. 2004. Ethiopia multi-sector country gender profile. Agriculture and rural development North east and south region (ONAR).
- Aguilar, A., Carranza, E., Goldstein, M., Kilic, T. and Oseni, G. 2014. *Decomposition of gender differentials in agricultural productivity in Ethiopia*. World Bank policy research working paper No. 6764, Washington, D.C., World Bank.
- Allendorf, K. 2007. Do Women's Land Rights Promote Empowerment and Child Health in Nepal? *World Development*, 35(11):1975–1988.
- Antle, J.M. and Diagana, B. 2003. Creating incentives for the adoption of sustainable agricultural practices in developing countries: the role of soil carbon sequestration. *American journal of Agricultural Economics* 85:1178–1184.
- Araya, T., Cornelis, W.M., Nyssen, J., Govaerts, B., Getnet, F., Bauer, H., Amareg, K., Raes, D. Haile, M. and Deckers, J. 2012. Medium-term effects of conservation agriculture based cropping systems for sustainable soil and water management and crop productivity in the Ethiopian highlands. *Field Crops Research* 132: 53–62.
- Aregu, L., Bishop-Sambrook, C., Pusku, R. and Tesema, E. 2010. *Opportunities for prompting gender equality in rural Ethiopia through commercialization of agriculture*. IPMS (Improving Productivity and Market Success) of Ethiopia Farmers Project Working Paper 18. ILRI, Nairobi, Kenya. 84 pp.
- Asfaw, A. and Blair M.W. 2014. Quantification of drought tolerance in Ethiopia common bean varieties. *Agricultural Sciences*, 5(2): 124-139.
- Bezabih, M. and Holden, S. 2006. Tenure insecurity, transaction costs in the land lease market and their implications for gendered productivity differentials. *Invited paper presentation at the International Association of Agricultural Economists Conference*, August 12 – 18, Gold Coast, Australia.
- Byerlee, D., Spielman, D.J., Alemu, D. and Gautam, M. 2007. *Policies to promote cereal intensification in Ethiopia: A review of evidence and experience*. International Food Policy Research Institute Discussion Paper 707. Washington, DC. IFPRI.
- Central Statistical Agency (CSA). 2014. *Ethiopia Mini Demographic and Health Survey*. Central Statistical Agency, Addis Ababa, Ethiopia.
- CIMMYT. 2012. MELISA: *Mechanization for SIMLESA*. Informa no. 1791, 20–27 April 2012.
- CISP (Comitato Internazionale per lo Sviluppo Dei Popoli). 1997. *The female farmer: fertile ground? A gender assessment study of agricultural inputs adoption in eight case study areas in four regions of Ethiopia*. Embassy of the Netherlands, Addis Ababa, Ethiopia.
- Deere, C. D. and J. Twyman. 2012. Asset ownership and egalitarian decision making in dual-headed households in Ecuador, *Review of Radical Political Economics* 44 (3): 313–320.
- Dercon, S. and Christiaensen, L. 2007. *Consumption risk, technology adoption, and poverty traps: Evidence from Ethiopia*. World Bank Policy Research Working Paper 4527. World Bank, Washington, DC, USA.
- Dercon, S., Gilligan, D.O., Hoddinott, J. and Woldehanna, T. 2009. The impact of agricultural extension and roads on poverty and consumption growth in fifteen Ethiopian villages. *American Journal of Agricultural Economics* 91(4):1007–1021.

- Descheemaeker, K., Nyssen, J., Poesen, J., Raes, D., Haile M., Muys, B. and Deckers, S. 2006. Runoff of on slopes with restoring vegetation: A case study from Tigray highlands, Ethiopia. *Journal of hydrology*, 331(1–2):219–241.
- DFID. 1999. *Sustainable livelihoods guidance sheets*, Department for International Development (DFID).
- Dorosh, P. and Rashid, S. (Eds.). 2013. *Food and agriculture in Ethiopia. Progress and policy challenges*. IFPI issue brief no. 74. Access on March 9 2015 at <http://www.ifpri.org/sites/default/files/publications/ib74.pdf>
- Doss, C. 2005. The effects of intrahousehold property ownership on expenditure patterns in Ghana, *Journal of African Economies*, 15(1):149–180.
- Doss, C. R. 2006. Analysing technology adoption using microstudies: Limitations, challenges, and opportunities for improvement, *Agricultural Economics*, 34:207–219.
- Doss, C. R. and Morris, M.L. 2001. How does gender affect adoption of agricultural innovations? The case of improved technology in Ghana. *Journal of Agricultural Economics*, 25(1): 27-39.
- Doss, C., Kovarik, C., Peterman, A., Quisumbing, A.R. and van den Bold, M. 2013. *Gender inequalities in ownership and control of land in Africa: Myths versus reality*. IFPRI Discussion Paper 01308.
- Doss, C.R. 2001. Designing agricultural technology for African women farmers: lessons from 25 years of experience. *World Development*, 29(12):2075–2092.
- Duncan, A.J., Tarawali, S.A., Thorne P.J., Valbuena, D., Descheemaeker, K. and Homann-kee, S. 2013. Integrated crop-livestock systems – a key to sustainable intensification in Africa. *TUI Tropical Grasslands – Forrajes Tropicales*, 1:202–206.
- EEA/EEPRI (Ethiopia Economic Association/Ethiopia Economic Policy Research Institute). 2002. *Land Tenure and Agriculture Development in Ethiopia*, EEA/EEPRI.
- Emery, M. and Flora, C. 2006. Spiraling-up: Mapping community transformation with community capitals framework. *Community Development*, 37:19–35.
- Fafchamps, M. and Quisumbing A.R. 2002. Control and ownership of assets within rural Ethiopian households, *The Journal of Development Studies*, 38(6):47–82.
- FAO. 2001. *Mixed crop–livestock farming: A review of traditional technologies based on literature and field experience*. Animal Production and Health Papers 152. Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).
- Fentie, D.N., Fufa, B. and Bekele, W. 2013. Determinants of the use of soil conservation technologies by smallholder farmers: The case of Hulet Eju Enesie district, East Gojjam zone, Ethiopia. *Asian Journal of Agricultural and Food Sciences*, 1(4):119–138.
- Field, J. 2003. *Social Capital*. London, UK: Routledge.
- Flora, C. and Flora, J. 2013. *Rural communities: Legacy and change*. Fourth ed. Westview Press, Boulder.
- Frank, E. 1999. *Gender, agricultural development and food security in Amhara, Ethiopia: the contested identity of women farmers in Ethiopia*. USAID /Ethiopia.
- Fofanah, M., Lema, Z. and Amede, T. 2015. *Pathways to improved nutrition in the Ethiopian highlands: Policy and institutional issues*. Africa RISING Brief 34. Nairobi, Kenya: ILRI
- Galiè, A., Mulema, A., Mora Benard, A.M., Onzere, S. and Colverson, K. 2015. Exploring gender perceptions of resource ownership and their implications for food security among rural livestock owners in Tanzania, Ethiopia, and Nicaragua. *Agriculture and Food Security* 4:2.
- Gebregziabher, G., Rebelo, L-M., Notenbaert, A., Ergano, K. and Abebe, Y. 2013. Determinants of adoption of rainwater management technologies among farm households in the Nile River Basin. Colombo, Sri Lanka: International Water Management Institute (IWMI). 34p. (IWMI Research Report 154). doi: 10.5337/2013.218.
- Gebresaleessie, K. and Haile, H.B. 2013. The gender dimensions of food insecurity. In Rahmato, D., Pankhurst, A. and van Uffelen, J-G. *Food Security, Safety Nets and Social Protection in Ethiopia*. Forum for Social Studies: Addis Ababa, Ethiopia.
- Gebreselassie, S. 2006. Intensification of smallholder agriculture in Ethiopia: Options and scenarios, Paper prepared for the *Future Agriculture Consortium Meeting at the Institute of Development Studies* 20–22 March 2006.
- Girmay, G.B., Singh, R., Nyssen, J. and Borrosen, T. 2009. Runoff and sediment-associated nutrient losses under different land uses in Tigray, Northern Ethiopia. *Journal of hydrology*, 376(1–2):70-80.

- GIZ. 2013. *Gender and Food & Nutrition Security*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
- Godfray, C., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S. M. and Toulmin, C. 2010. Food security: The challenge of feeding 9 billion people, *Science* 327, 812-818.
- Harrison, L., Huntington, S. and Samuel, P. 2000. *Culture Matters: How Values Shape Human Progress*, Basic Books, New York.
- Headey, D., Dereje, M. and Taffesse, A. S. 2014. Land constraints and agricultural intensification in Ethiopia: A village-level analysis of high-potential areas, *Food Policy*, 48: 129–141.
- Holden, S., Shiferaw, B. and Pender, J. 2001. Market imperfections and land productivity in the Ethiopian highlands. *Journal of Agricultural Economics*, 52(3):53 –70.
- IIRR. 2003. *Culture and change: Ethiopian women challenging the future*. Addis Ababa: Ethiopia, International Institute for Rural Reconstruction (IIRR).
- IITA, IFPRI, ILRI. 2012. *Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) Program framework 2012–2016*. Nairobi, Kenya: ILRI.
- Jhamtani, H. 2011. *The green revolution in Asia: Lessons for Africa. Climate change and food systems resilience in sub-Saharan Africa*. Rome, Italy: FAO.
- Josephson A.L., Ricker-Gilbert, J. and Florax, R.G.M. 2014. How does population density influence agricultural intensification and productivity? Evidence from Ethiopia. *Food Policy*, 142–152.
- Kassa, H. 2005. *Historical development and current challenges of agricultural extension with particular emphasis on Ethiopia*. Addis Ababa, Ethiopia: Ethiopia Economic Association.
- Kassie, M., Zikhali, P., Manjur, K. and Edwards, S. 2009. Adoption of sustainable agriculture practices: Evidence from a semi-arid region of Ethiopia. *Natural Resources Forum*, 33:189–198.
- Kassie, M., Zikhali, P., Pender, J. and Köhlin, G. 2010. The economics of sustainable land management practices in the Ethiopian Highlands, *Journal of Agricultural Economics*, 61(3):605–627.
- Keeley, J. and Scoone, I. 1999. *Understanding environmental policy processes: A review*. IDS working paper 89, Brighton, IDS.
- Lee, D.R. 2005. Agricultural sustainability and technology adoption: issues and policies for developing countries, *American Journal of Agricultural Economics* 87:1325–1334.
- Lema, Z., Mulema, A.A., Le Borgne, E., Duncan, A. 2016. Innovation Platforms for improved natural resource management and sustainable intensification in the Ethiopian Highlands. In Dror, E., Cadilhon, J., Schut, Marc, Misiko, M., and Maheshwari, S. (eds). *Innovation platforms for agricultural development: evaluating the mature innovation platforms landscape*. UK: Routledge, pp.117–132.
- Lvova, E. 1997. Forms of Marriage and the Status of Women in Ethiopia. In Fukui, K., Kurimoto, E. and Shigeta, M. (eds) *Ethiopia in broader perspective*, vol. III, pp. 577–584. Papers of the 13th International Conference of Ethiopian Studies held in Kyoto, Japan.
- Masefield, A. 1997. *Placing gender issues within the national context of agricultural strategies and policies in input adoption*. Addis Ababa, Ethiopia: USAID.
- Mayoux, L. 2001. Talking the downside: Social capital, women's empowerment and micro-finance in Cameroon. *Development and Change* 32:435–464.
- Meinzen-Dick, R., Johnson, N., Quisumbing, A., Njuki, J., Behrman, J., Rubin, D., Peterman, A. and Waitanji, E. 2011. *Gender, assets, and agricultural development programs: A conceptual framework*. CAPRI Working Paper No. 99. Washington DC, USA: International Food Policy Research Institute. <http://dx.doi.org/10.2499/CAPRIWP99>
- Merrey, D.J. and Gebreselassie, T. 2011. *Promoting improved rainwater and land management in the Blue Nile (Abay) basin of Ethiopia*. NBDC Technical Report 1: Nairobi, Kenya.
- MoA. 2010. Ethiopia Animal Health Year Book (2009/10). *Federal Ministry of Agriculture Animal and Plant Health Regulatory Directorate (APHRD)*. Addis Ababa, Ethiopia: Ethiopia's Agricultural Sector Policy and Investment Framework, MoARD.
- Moraes, A., Carvalho, P., Lustosa, S., Lang, C. and Diess, L. 2014. Integrated crop-livestock system in Brazil. *Revista Ciência Agronômica*, 45(5):1024–1031.

- Mulema, A.A., Tafesse, S. and Kinati, W. 2015. *Gender capacity assessment report of Ethiopia small ruminant value chain research and development partners*. ILRI. Addis Ababa, Ethiopia.
- Mulugeta, M. and Amsalu, T. 2014. Gender, participation and decision making process in farming activities. The case of Yilman Densa District, Amhara Region, Ethiopia, *Journal of Economics and Sustainability Development*, 5(1):28–34.
- Ndiritu, W.S., Kassie, M. and Shiferaw, B. 2014. Are there systematic gender differences in the adoption of sustainable agricultural intensification practices? Evidence from Kenya. *Food Policy* 49(1):117–127.
- Nega, M., Mazengia, H. and Mekonen, G. 2012. Prevalence and zoonotic implications of bovine tuberculosis in Northwest Ethiopia, *International Journal of Medicine and Medical Sciences* 2(9):188–192.
- Ogato, G.S., Boon, E.K. and Subramani, J. 2009. Improving Access to Productive Resources and agricultural services through gender empowerment: a case study of three rural communities in Ambo district, Ethiopia. *Journal of human Ecology*, 27(2):85–100.
- O’Sullivan, M., Arathi, R., Raka, B., Kajal, G. and Margaux, V. 2014. *Levelling the field: improving opportunities for women farmers in Africa*. Vol. 1 of *Levelling the field: Improving opportunities for women farmers in Africa*. Washington DC: World Bank Group. <http://documents.worldbank.org>.
- Pender, J. and Gebremedhin, B. 2007. Determinants of agricultural and land management practices and impacts on crop production and household income in the Highlands of Tigray, Ethiopia, *Journal of African Economies*, 17(3):395–450.
- Peterman, A., Behrman, J. and Quisumbing, A. 2010a. *A review of empirical evidence on gender differences in non-land agricultural inputs, technology and services in developing countries*. Washington DC: International Food Policy Research Institute (IFPRI)
- Peterman, A., Quisumbing, A., Behrman, J. and Nkonya, E. 2010b. *Understanding gender differences in agricultural productivity in Uganda and Nigeria*. The International Food Policy Research Institute (IFPRI) Discussion Paper 01003.
- Pretty, J. 2003. Social capital and the collective management of resources, *Science* 302:1912–1915.
- Pretty, J. 2008. Agricultural sustainability: concepts, principles and evidence, *Philosophical Transactions of the Royal society of London, Series B* 363(1491):447–466.
- Pretty, J. 1999. Can sustainable agriculture feed Africa? New evidence on progress, process and impacts. *Environment and sustainability* 1:253–274.
- Pretty, J., Toulmin, C. and Williams, S. 2011. Sustainable intensification in African agriculture. *International Journal of Agricultural Sustainability* 9:5–24.
- Putnam, R. 1993. *Making democracy work: Civic traditions in modern Italy*. Princeton, Princeton University Press.
- Ragasa, C., Berhane, G. Tadesse, F. and Taffesse, A.S. 2012. *Gender differences in access to extension services and agricultural productivity*. Ethiopia Strategy Support Program II, IFPRI Working Paper 49. Washington, DC: International Food Policy Research Institute.
- Rashid, S. and Negassa, A. 2012. Policies and performance of Ethiopian cereal markets. In Dorosh, P. and Rashid, S. (eds) *Food and Agriculture in Ethiopia: Progress and Policy challenges*. Philadelphia, USA: University of Pennsylvania.
- Rashid, S., Tefera, N., Minot, N. and Ayele, G. 2013. *Fertilizer in Ethiopia: An assessment of policies, value chain and profitability*. Discussion Paper 01304. Washington, USA: IFPRI.
- Royal Society. 2009. *Reaping the benefits: Science and the sustainable intensification of global agriculture*, London, UK: Royal Society.
- Sadoulet, E. and de Janvry, A. 1995. *Quantitative development policy analysis*. Baltimore, USA: The Johns Hopkins University Press.
- Schneider, J. 2004. *The role of social capital in building healthy communities*. Annie E. Casey Foundation, Making Connections Initiative. www.aecf.org.
- Snapp, S.S., Blackie, M. J., Gilbert, R. A., Bezner-Kerr, R. and Kanyama-Phiri, G.Y. 2010. Biodiversity can support a greener evolution in Africa. *Proceedings on the National Academy of Sciences (PNAS)*.
- Spielman, D.J., Mekonne, D.K. and Alemu, D. 2012. Seed, fertilizer and agricultural extension in Ethiopia. In Dorosh, P. and Rashid, S. (eds) *Food and agriculture in Ethiopia: Progress and policy challenges*. Philadelphia, USA: University of Pennsylvania

- Taffesse, A.S., Dorosh, P. and Gemessa, S.A. 2012. Crop production in Ethiopia: Regional patterns and trend. In Dorosh, P. and Rashid, S. (eds) *Food and Agriculture in Ethiopia: Progress and Policy challenges*. Philadelphia, USA: University of Pennsylvania.
- Tefera, T.T. 2013. Participatory variety selection of potato (*Solanum tuberosum* L) in Southern Ethiopia. *Journal of Agri-Food and Applied Sciences*, 1(1):1–4.
- Tefera, T. 2013. Land ownership-the path towards rural women empowerment: A case from southern Ethiopia. *International Journal of Sociology and Anthropology*, 5(8):330–338.
- Tegebu, F., Mathijs, E., Deckers, J., Mitiku, H., Nyssen, J. and Tollens, E. 2012. Rural Livestock Asset Portfolio In Northern Ethiopia: a microeconomic analysis of choice and accumulation. *Tropical Animal Health and Production* 44:133–144.
- Teklewold, H., Kassie, M. and Shiferaw, B. 2013. Adoption of multiple sustainable agricultural practices in rural Ethiopia. *Journal of Agricultural Economics* 64(3):597–623.
- Teklu, A. 2005. *Land registration and women's land rights in Amhara region, Ethiopia*. IIED Research Report no. 4. London: International Institute for Environment and Development.
- Tesfalem, M.G. 2014. *The role of rural infrastructures and institutions on agricultural intensification of major crops (Teff and Maize): Tahtay-Koraro Woreda, Tigray*, Thesis. Mekelle:MU.
- Tigre, W., Alemayehu, G., Abetu, T. and Deressa, B. 2011. Bovine Tuberculosis in Jimma town, South Western Ethiopia, *Global Veterinarian*, 6(4):369–373.
- Tiruneh, A., Tesfaye, T., Mwangi, W. and Verkuil, H. 2001. *Gender differentials in agricultural production and decision-making among smallholders in Ada, Lume, and Gimbichu Woredas of the central highlands of Ethiopia*. Mexico DF, Mexico: International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural research organization (EARO).
- Torkelsson, A. and Tassau, B. 2008. Quantifying women's and men's rural resource portfolios – empirical evidence from Western Shoa in Ethiopia. *The European Journal of Development Research* 20(3):462–481.
- Tsegaye, D., Dessalegn, T., Yimam, A., and Kefale, M. 2012. Extent of rural women participation and decision making in seed production activities, *Journal of Agricultural Science*, 1(7):186–190.
- Wale, A., Collick, A.S., Rossiter, D.G., Langan, S. and Steenhuis, T.S. 2013. Realistic assessment of irrigation potential in the Lake Tana Basin, Ethiopia. Presented at the *Nile Basin development challenge science meeting*, 9–10 July.
- Williams, L. 2004. Culture and community development: Towards new conceptualizations and practice. *Community Development Journal*, 39(4), 345–359.
- Woldu, T., Tadesse, F. and Waller, M. 2013. *Women's participation in agricultural cooperatives in Ethiopia*. ESSP working paper 57.
- Woolcock, M. 2001. The place of social capital in understanding social and economic outcomes. *ISUMA Canadian Journal of Policy Research* 2(1):11–17
- World Bank. 2014. *Levelling the field. Improving opportunities for women farmers in Africa*. The World Bank
- World Bank. 2001. *Engendering development through gender equality in rights, resources, and voice*. A World Bank policy research report. Washington DC, USA: World Bank/Oxford University Press. Accessed on 18 Feb. 2015 at <http://documents.worldbank.org/curated/en/2001/01/891686/engendering-development-through-gender-equality-rights-resources-voice>.
- World Bank. 2009. *Gender in agriculture sourcebook. Agriculture and rural development*. Washington DC, USA: The International Bank for Reconstruction and Development / The World Bank.
- Zewdu, M. 2002. *Sustainable development in Ethiopia, Report of assessment of activities and issues relevant to the review process of the Earth Summit 2002 in Ethiopia for Heinrich Boell Foundation*.

Annex: Methodologies of key studies

Author	Methodology or data source	Gap
Josephson, L., Ricker-Gilbert, J. and Florax, R.J.G.M. 2014	Household-level data on smallholder farms in Ethiopia. GIS data, collected from the Global Rural–Urban Mapping Project (GRUMP) and global land cover (GlobCover 2009) databases Qualitative data collected in Ethiopia in May of 2012 during focus group discussions conducted by the authors.	Authors do not distinguish land size, fertilizer use and yield by household type, land owners or farm managers The data only considers rural, and non-pastoral households, hence is not nationally representative
Ndiritu et al. 2014	Survey of 578 farm Households and farming 2687 plots. Compares men and female-headed households Compares plots managed by men, women and both	Does not explore the effect of institutional factors on intensification
Tefera 2013	Household survey in two regions A total of 394 households which comprise 5% of the total population were randomly selected	Study does not disaggregated women empowerment levels in the different household types.
World Bank 2001	Compare men and women farmers Multidisciplinary literature review Follow-up survey Analyses done across the developing world – Africa, Asia and Middle East	Very broad study and does not fully analyse all the gender issues in Ethiopia. Results are also generalized.
Torkelsson and Tassau 2008	Two formal surveys undertaken in 2006 in rural Ethiopia Uses probability sample comprising 604 farming women and men. Ethnography is used to assist in the identification of the locally relevant resources Compares asset gap between men and women with a specific focus on women household heads.	Does not correlate asset gap with women empowerment levels and how this contributes to intensification. Does not reveal asset ownership by married women
Teklewold et al. 2013	Farm household survey, 898 farm households and 4,050 farming plots	Focus on maize crop, a male dominated crop Does not draw comparisons across household types and plot owner or managers
Doss et al. 2013	Literature review and empirical evidence Analyses of demographic and health surveys and living standard measurement surveys: Integrated surveys on agriculture Compares land ownership by men and women farmers	Aggregate data for all women

ISBN: 92-9146-481-3



The International Livestock Research Institute (ILRI) works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. ILRI is a CGIAR research centre. It works through a network of regional and country offices and projects in East, South and Southeast Asia, Central, East, Southern and West Africa, and in Central America. ilri.org



CGIAR is a global agricultural research partnership for a food-secure future. Its research is carried out by 15 research centres in collaboration with hundreds of partner organizations. cgiar.org