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Full Length Research Paper

Gendered knowledge and innovation in crop production and management practices: a case study of three rural communities in Ambo district, Ethiopia

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Research on gender in agriculture was conducted in Ambo district, Ethiopia, between July and September 2007 to assess gender roles in crop production and management. During the study period, gendered knowledge and innovation on crop production and management practices was assessed in three rural communities of the district. A key premise of this article is that both males and females are knowledgeable about crop production and management practices in rural Ethiopian context. The paper identifies and examines males' and females' knowledge on crop production and management practices through a thorough analysis of secondary information and primary data collected in Ambo District with the help of questionnaires, interviews, observations, focus group discussions, participatory rural appraisal, gender analysis and case studies (life histories). Statistical package for social science (SPSS) and excel spreadsheet functions were used to treat and analyze the data. The results of the analysis indicate that both females and males are knowledgeable about crop production and management despite the common belief held in the society that females in Ethiopia are not knowledgeable about productive works such as crop production and management but domestic works. From the study undertaken, it is clear that females in rural Ethiopia have important knowledge which must be documented and integrated in multi-stakeholders' agricultural innovation processes if the Ethiopian agricultural research and development system is to be transformed in a sustainable manner.

Keywords: Agriculture, crop production, Ethiopia, gendered knowledge, innovation.

INTRODUCTION

Both females and males have knowledge of crop production and management practices. Since males and females have different roles in crop production and management practices, their knowledge about crop production and management practices differs. For example the study conducted in Ethiopia in the past on farmers' knowledge systems on crop biodiversity management reveals that female farmers have a tremendous wealth of knowledge in the identification and characterization of the various crop plants they are dealing with (Tsegaye, 1997). Grenier (1998) confirms that females and males are socialized differently and often function in different spheres of the community. As a result, females and males often know different things. Males and females also possess different knowledge about similar things, use different communication channels to transfer information, and have different interests and needs. Gender-based differences in regard to responsibility for productive tasks and access to and control over resources, are reasons for gender-based differences of indigenous knowledge (Curry, 1996).

Local innovation refers to the process by which women and men in a community develop new and better ways of doing things-using their own resources, on their own initiative and without stimulation or support from external service providers (Wettasinha and Watters-

Bayer, 2010). The dynamics around different activities and roles that poor communities engage in towards addressing their social and economic needs through agricultural production systems epitomizes the gender dimension of agricultural innovation (Kingiri, 2010). Policy makers, planners and development workers must have a better understanding of the relative and often shifting roles of men and women in agriculture and natural resource management, also with respect to decision-making, use of traditional knowledge, division of labor and traditional practices between women and men (Upadhyay, 2005). In recognizing the contribution of indigenous knowledge systems in the multi-stakeholders' innovation processes, women's indigenous knowledge must not be forgotten. Women as bearers of indigenous knowledge, can—probably better than men—act as bridge builders between representatives of the various knowledge systems. In the area of family health, for example, where women have the distinct advantage of being considered by most people as the leading practitioners, opportunities for integration and mutual learning exist (Ramphele, 2004). Local women are also better positioned to overcome the barriers that harmful traditional practices have imposed on their lives, rather than exogenous approaches. That shows the existence of opportunities for governments and development partners to help facilitate the integration of various knowledge systems for the betterment of the local communities (Ramphele, 2004).

Local innovation refers to the dynamics of IK – the knowledge that grows within a social group, incorporating learning from their own experience over generations but also knowledge gained from other sources and fully internalized within local ways of thinking and doing (Wettasinha and Watters-Bayer, 2010). According to World Bank, (2006), "it is the process through which individuals or groups discover or develop new and better ways of managing resources – building on and expanding the boundaries of their IK". According to World Bank (2001), women in Ethiopia and all other parts of the world continue to have systematically poorer command over a range of productive resources, including education, land, information, and financial resources. Many women can not own land, and those who do generally command smaller landholdings than men. Moreover, Female-run enterprises tend to be undercapitalized, having poorer access to machinery, fertilizer, extension information, and credit than male-run enterprises. Such disparities, whether in education or other productive resources, hurt women's ability to participate in

development and to contribute to higher living standards for their families. Those disparities also translate into greater risk and vulnerability in the face of personal or family crises, in old age, and during economic shocks. Like in all other African countries females in Ethiopia also experience everyday life differently than males. Traditional gender roles corner females into juggling multiple responsibilities in the home, at the workplace and in the community. As a result, females have a unique knowledge of the environment and the importance of sustainability (Women's Environment and Development Organization, 2001).

The objectives of this article are to identify the major crops grown in the study area, to identify the major crop production and management practices in the study area, to analyze the extent to which females and males know about crop production and management practices, to identify gender-intensified constraints in crop production and management practices, and to identify major gender-based farmers' innovations in crop production and management practices in the study area.

Background

Ethiopia, situated in the Horn of Africa, has a population of about 80 million and a surface area of approximately 1.2 million square kilometres. Agriculture is the core of the economy, contributing about 60% of the country's GDP and employing more than 85% of the working population (Cherinet and Mulugeta, 2003; Tiruneh et al., 2001; Deressa, 2007). The production system is dominated by smallholder farming under rain-fed conditions. The Ethiopian agriculture is traditional by its nature (dominated by traditional farming practices such as oxen- driven plough) and characterized by subsistence mixed farming with crop and livestock husbandry in one farm (Gera, et al., 2010; Deressa and Kelemework, 2005).

The country's diverse agro-ecological conditions enable it to grow a large variety of crops as Deressa (2007) states:

"Most of these are cereals (teff, maize, sorghum, wheat, barley, millet, oats, etc.), pulses (horse beans, field peas, lentils, chickpeas, haricot beans, vetch, etc.), oil seeds (linseed, niger seed, fenugreek, rapeseed, sunflower, castor bean, groundnuts, safflower, etc.), and herbs and spices (pepper, garlic, ginger, mustard, etc). Stimulants (coffee, tea, chat, tobacco, etc.) are the major cash crops. Fruits (banana, orange, grape, papaya, lemon, mandarin, apple, pineapple, mango, avocado, etc.) sugar cane, fibers (cotton, sisal, etc.), vegetables (onion, tomato, carrot, cabbage, etc.), roots and tubers (potato, sweet potato, beets, yams, etc.) are the other crops grown".

Despite the crop and livestock biodiversity, fertile soils, water and other natural resources, and the presence of skilled human resource, the agricultural sector which defines and leads the regional economy is relatively weak. This could be attributed to slow rural innovation processes that are unable to utilize available institutional potential to tackle problems related to erratic rainfall, prevalence of pests, scarcity and shrinkage of arable land, soil erosion and degradation and lack of enough

improved technologies (Gera, et al., 2010; Deressa, 2007). Moreover, shortage of supportive services like credits, research and extension, poor socioeconomic infrastructure and poor institutional arrangements are other reasons for the weak agricultural sector (Gera, et al., 2010). Gender is also critical issue in Ethiopian agriculture given that females' issues are not well addressed in the agricultural development and research interventions and the agricultural extension system was male-biased(Cherinet and Mulugeta, 2003; Suleiman, 2004; Ethiopian Ministry of Women Affairs, 2006; Ogato, 2008; Ogato et al., 2009).

Agricultural training, research and extension have been institutionalized in Ethiopia for more than 50 years, but with low impact on agricultural productivity and rural livelihoods (Gera, et al., 2010). Many poor people have not benefited from technological development, research processes have been dominated by a top-down public sector model, beneficiary participation has been difficult to achieve effectively, and policy and donor pressures are forcing changes in both international and national institutional architecture, research organization management, and stakeholder dynamics (Triomphe et al.,2007; Poole and Buckley, 2006;). Working in partnership implies in many ways a paradigm change for many stakeholders involved in rural and agricultural development (Triomphe et al.,2007; Wageningen University, 2009; Adekunle, 2009; Probst and Hagmann, 2005; Fajber, 2005; Poole and Buckley, 2006).

Adapting innovation systems approach is claimed to transform the African agriculture in general and the Ethiopian agriculture in particular from the present unsustainable state to the future sustainable state. An innovation can be defined as the application of technological, institutional and human resources and discoveries to productive processes, resulting in new practices, products, markets, institutions and organizations that are improved and efficiency-enhancing (Poole and Buckley, 2006; Hounkonnou, 2009; Rippin, 2008; Zerfu and Kuma, 2009; Hall et al., 2010). Agricultural innovation is the result of close interaction between three main functions: planning for, financing of, and implementation of innovation. Three main groups of actors are responsible for the innovation process: Public sector actors, private sector actors and civil society at large (Heemskerk and Wennink, 2004; Neef and Neubert, 2010).

Evolving out of the debate on the multiple sources of innovation has been the question about the centrality of beneficiaries in the innovation process. Recognition of farmers as stakeholders, not only as beneficiaries but also as sources of traditional knowledge (Poole and Buckley, 2006; Boon and Hens, 2007; Farrington and Adrienne, 1990; Grenier, 1998; Warren, 1993; Richards, 1985) and as experimenters, led to 'farmer first' approaches (Poole and Buckley, 2006; Wongtschowski et al., 2010; Selender, 2005; Ashby, 1999; The United Nations Convention to Combat Desertification, 2003;). Local innovation, in regard to gender, refers to the process by which women and men in a community develop new and better ways of doing things-using their own resources, on their own initiative and without stimulation or support from external service providers (Wettasinha and Watters-Bayer, 2010; Kingiri, 2010; Upadhyay, 2005; Ramphele, 2004). Farmers are natural experimenters. They are always trying new ideas and technologies to improve their farming practices. Before government extension services existed, farmers based this experimentation on their own knowledge and the experiences and ideas of other farmers in their area (Horne and Stur, 2005; Reij and Waters-Bayer, 2005; Fanta et al., 2008; Veldhuizen et al., 2005; Altieri, 2005).

METHODS AND MATERIALS

Study Location and Characteristics

This study was carried out in three communities in Ambo district: Awaro Kora, Senkele Farisi and Gosu Kora communities. The district is located in West Shewa zone of Oromia Regional State, Ethiopia (Figure 1). It is located between 80 47' N - 90 21' N and 370 32' E - 380 3' E (Ambo District Finance and Economic Development Office, 2007). The capital of West Shewa zone is Ambo town, which is located 125 km away from Addis Ababa, the capital of Ethiopia.

Ambo District has a mean annual temperature ranging between 23-25°C and a mean annual rainfall of 1300-1700mm (WSZBFED, 2007). The lowlands, midlands and highlands respectively cover 17%, 60% and 23% of the district.

A farm in the district is considered as a system that comprises the following: people, crops, livestock, vegetation, and wildlife, socio-economic and ecological factors which interact amongst them and shape the farm system. Mixed agriculture in which livestock are used as a source of draft, transportation, and animal produce is practised in the district. Uses of plough, crop rotation, terracing, irrigation, and soil fertilization have been practised by the farmers for more than 3000 years as part of their traditional farming system (Hunduma 2006). A wide variety of crops constitute the agricultural system of the three surveyed communities. Cereals, pulses, and oil crops are the most important crops in the agricultural system. Cereal crops occupy the largest area. Teff is the most important food crop. However, this crop is highly delicate and fragile and requires a lot of labour and care (Hunduma 2006).

Data Collection and Analysis

Both secondary and primary data were collected from the

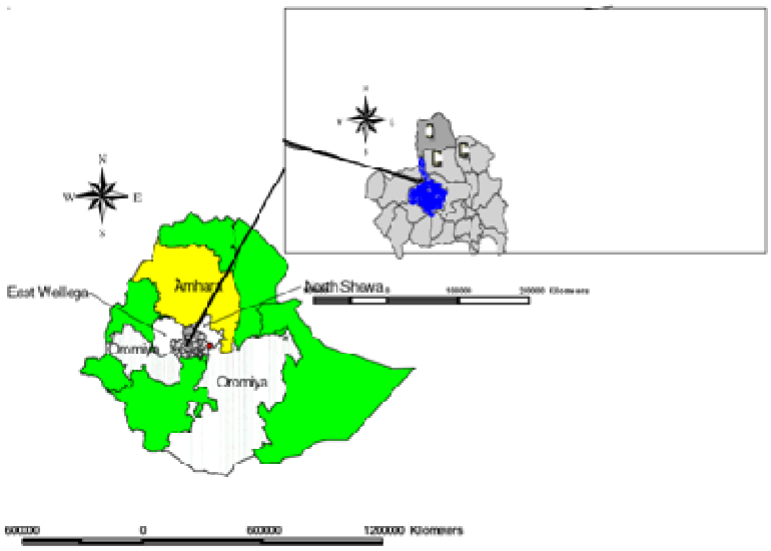

Figure 1. Map of Ethiopia and West Shewa Zone Showing Ambo District (*Source:* Adapted from Hunduma 2006).

three selected communities. An in-depth literature search was conducted to gather information on the scientific, historical, and philosophical aspects of gendered knowledge and innovations in agriculture. This information provided guidance and insights for designing the field data collection instruments and the analysis of the data. The primary data were collected through questionnaires, interviews, observations, focus group discussions, participatory rural appraisal and gender and life history analysis. Purposive sampling was used to select three highly productive rural communities while stratified random sampling was used to select male-headed and female-headed farming households from each community. Farmers from both male- and female-headed households were picked through simple random sampling. An equal number of females (125) and males (125) farmers were interviewed from the three communities.

The collected data were quantified and inputted as nominal or ordinal data into the Statistical Package for Social Science (SPSS) and the results presented through simple descriptive statistics such as cross tabulations, frequencies and graphs. Depending on the appropriateness of the test measurement scale and the relatedness of variables, non-parametric tests of statistical significance (the chi-square test and the Kruskal-wallis test) were performed. The Kruskal-Wallis test was used to analyze multiple independent ordinal variables while differences between nominal variables were determined through chi-square test. To analyze the data collected through focus group discussions, participatory rural appraisal and interviews, content analysis was employed.

RESULTS AND DISCUSSION

The results of the data analysis include the socio-economic characteristics of the respondents, the gendered knowledge on crop production, and management practices and farmers' innovations on crop production and management practices in the three surveyed communities.

Socio-economic Characteristics of the Respondents

Fifty percent of the respondents were males and the other 50% were females. In terms of age composition, 74.8% of the respondents were between 31-50 years old followed by 51 years old and above (18.8%), and between 18-30 years old (6.4%). Fifty percent of the respondents were married; the widowed (42.8%); divorcees (6.4%); and singles (0.8%). The same proportion of male household heads and female household heads were covered in the survey. The majority of respondents were from Oromo ethnic group (95.2%) while the remaining came from Amahara ethnic group (4.8%). The majority of the respondents were Orthodox Christians (87.2%) followed by 12.4% Protestant Christians and 0.4% indigenous Oromo Religion- "Wakefata" believers.

Table 1. Gender Division of Labour and Cropping Seasonal Calendar of Three Major Crops in Senkele Farisi Community

				A	S	O	N	D	J	F	M	A	M	J	J	Gender Division of Labour	
																Females	Males
Teff	Senkele	Land Preparation														5	5
		Planting														5	5
		Weeding														8	2
		Harvesting														5	5
		Storage														5	5
Seed		Land Preparation														5	5
		Planting														5	5
		Weeding														8	2
		Planting Storage														5	5
Niger 3.		Land Preparation														5	5
		Harvesting Weeding														0	0
		Storage														5	5

Gender division of labour: 10 points were allocated between females and males to reflect their contribution to each activity.
Source: Field data, 2007.

About 44.4% of the respondents had non-formal education followed by primary education (44%) and secondary education (12%). Fifty percent of the respondents have an annual income of between 1,001-5,000 Ethiopian Birr (76-384 Euros), followed by those earning between 5,001-10,000 Ethiopian Birr (385-769 Euros) (28%); those earning below 1,000 Ethiopian Birr (76 euros) (16.8%); and those earning more than 10,000 Ethiopian Birr (769 Euros) (5.2%). About 70% of the farming households earn their income from farming activities while 30.4% of the respondents earn their income from both farming and non-farming activities (See Annex 1).

Major Crops Grown in the Study Communities

Table 1, Table 2, and Table 3 summarize priority crops in each study community, gender division of labour for undertaking major farming activities and seasonal calendars of these activities. Teff, wheat and nigerseed were ranked as major crop number 1, 2, and 3 respectively in Senkele Farisi community. Teff, wheat and horsebean were ranked as major crop number 1, 2, and 3 similarly in both Awaro Kora and Gosu Kora communities (See Table 2 and Table 3).

As it is clearly depicted in the tables (Table 1, Table 2, and Table 3), teff (Erogrostis tef) is the priority crop in all the three communities. Priority is given to this crop because of its market and food values. Moreover, during focus group discussions, key informant interviews, participant observation and life history recording sessions, farmers confirmed that teff is endemic to Ethiopia and cultivated as human food to make the local flat bread, "Budeena''. Moreover, teff straw is valuable fodder for livestock and for construction of houses. Teff production in Ethiopia has the following major advantages for small-scale farmers (Ketema, 1987):

- It can be grown under moisture-stress areas;
- It can be grown under waterlogged conditions;
- It is suitable and is used for double and relay cropping;
- Its straw is a valuable animal feed during the dry season when there is acute shortage of feed. It is highly preferred by cattle and costs higher than the straw of other cereals;
- It has acceptance in the national diet and enables farmers to earn more because of its high price;
- It is a reliable and low-risk crop;
- It is useful as rescue or catch crop in moisture-stress areas;
- It can be stored easily under local storage conditions since it is not attacked by the weevil and other storage pests, thus reducing post harvest management costs;
- It can be stored for a relatively long period of time (a minimum of 3 years) before it loses its viability. It can be stored in moisture-stress areas where more than one

Table 2. Gender Division of Labour and Cropping Seasonal Calendar of Three Major Crops in Awaro Kora Community

				A	S	O	N	D	J	F	M	A	M	J	J	Gender Division of Labour	
																Females	Males
2.Wheat1. Teff	Awaro Kora Community	Land Preparation										■	■	■	■	5	5
		Planting		■											■	5	5
		Weeding		■	■											8	2
		Harvesting						■	■							5	5
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5
3.		Land Preparation										■	■	■	■	5	5
		Planting		■	■											5	5
		Weeding		■	■											8	2
		Harvesting						■	■							5	5
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5
		Land Preparation			■											5	5
		Planting			■											5	5
		Weeding														0	0
									■	■							
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5

Gender division of labour: 10 points were allocated between females and males to reflect their contribution to each activity. Source: Field data, 2007.

Table 3. Gender Division of Labour and Cropping Seasonal Calendar of Three Major Crops in Gosu Kora Community

Type ofCrop	Communities	Key Farming Activities	Months	A	S	O	N	D	J	F	M	A	M	J	J	Gender Division of Labour	
																Females	Males
Teff	Gosu Kora Community	Land Preparation										■	■	■		5	5
		Planting		■										■	■	5	5
		Weeding		■	■											8	2
		Harvesting					■	■	■	■						5	5
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5
Wheat		Land Preparation										■	■	■		5	5
		Planting		■	■									■	■	5	5
		Weeding		■	■											8	2
		Harvesting					■	■	■							5	5
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5
Horsebean		Land Preparation			■											5	5
		Planting			■	■										5	5
		Weeding														0	0
		Harvesting							■	■						5	5
		Storage		■	■	■	■	■	■	■	■	■	■	■	■	5	5

Gender division of labour: 10 points were allocated between females and males to reflect their contribution to each activity. Source: Field data, 2007.

sowing in a season is a common practice or where the rains can fail for more than one year. If it is required for food, it can also be stored for more than 5 years, and perhaps indefinitely;

Table 4. Respondents' Knowledge on Crop Production and Management Practices

Crop Production and Management Practices	To what Extent do you know?						X^2	P
	Very High (%)		High (%)		Low (%)			
	Male	Female	Male	Female	Male	Female		
Land preparation	92.8	55.2	7.2	34.4	0	10.4	47.17	<0.05
Choice of seeds	92.0	61.6	8.0	30.4	0	8.0	33.85	<0.05
Planting	92.0	60.0	5.2	35.2	0.8	4.8	35.11	<0.05
Choice of fertilizers	89.6	56.8	6.4	36.0	4.0	7.2	36.15	<0.05
Fertilizers application	90.4	57.6	4.8	35.2	4.8	7.2	38.57	<0.05
Weeding	94.4	52.0	4.8	39.2	0.8	8.8	57.30	<0.05
Choice of herbicides	91.2	56.8	6.4	36.0	2.4	7.2	38.82	<0.05
Herbicides application	92.8	56.8	3.2	36.8	4.0	6.4	46.80	<0.05
Harvesting	92.0	60.0	5.6	33.6	2.4	6.4	35.69	<0.05
Selecting Best Crop Variety	89.6	57.6	6.4	36.0	4.0	6.4	35.21	<0.05
Water Conservation and Management	91.2	55.2	5.6	36.8	3.2	8.0	42.33	<0.05
Soil Conservation and Management	85.6	58.4	12.0	33.6	2.4	8.0	22.98	<0.05
Seed Storage and Processing	88.8	57.6	8.0	35.2	3.2	7.2	31.64	<0.05
Crop Storage	90.4	59.2	8.0	33.6	1.6	7.2	32.28	<0.05
Food Processing	90.4	52.8	8.0	37.6	1.6	9.6	43.50	<0.05
Marketing	92.8	57.6	5.6	32.8	1.6	9.6	41.52	<0.05
Traditional Cropping Calendar	88.8	55.2	9.6	34.4	1.6	10.4	35.33	<0.05

It has less disease and pest problems than any other cereal.

Another very important cereal crop reported in all the three communities was wheat (Triticum aestivum). Wheat is a very important cereal and food crop in the Ethiopian farming system. Wheat straw is used for animal feed and as roof cover in rural areas of Ethiopia, as confirmed by farmers contacted during the research.

Another priority crop in the study communities is horsebean (Vicia faba). The indigenous horsebean variety grown in the study communities is locally called "Gaayyoo". "Gaayyoo" is a legume crop variety used as a source of protein for food purposes. The crop variety is also used in rotation sequence, planted after wheat and teff to enhance soil fertility.

Nigerseed (Guizotia abyssinica) is another priority oil crop in the study communities. "Nugii", an indigenous nigerseed variety, is grown in the study communities for the purposes of both cash and soil fertility enhancement.

Gendered Knowledge on Crop Production and Management Practices

Through the participatory rural appraisal exercises, focus group discussions, key informant interviews, participant observation, life history and household survey undertaken in the study communities in Ambo district, Ethiopia, farming (land preparation, planting, weeding, herbicide application, fertilizing, harvesting, storage and pest management); soil and water management (soil management and conservation, water management and conservation); food/plant processing and preparation (harvesting of crops, collection of edible and medicinal plants, processing of food crops and wild plants in to edible forms and cooking); marketing (sale of crops or seeds to local or regional markets); and seed selection and preservation (on-farm seed selection, seed drying, seed storage and seed exchange) were identified as the crop production and management practices of major crops grown in the target communities. The crop production and management practices tend to be similar in all the three villages including the contribution of males and females in undertaking them.

Cross-tabulating the gender of the respondent with the responses given to knowledge of each of the major crop production and management practices, to what extent they know, indicated that there were significant differences between males and females for all major crop production and management practices (Table 4). That means males and females have no the same level of knowledge about the crop production and management

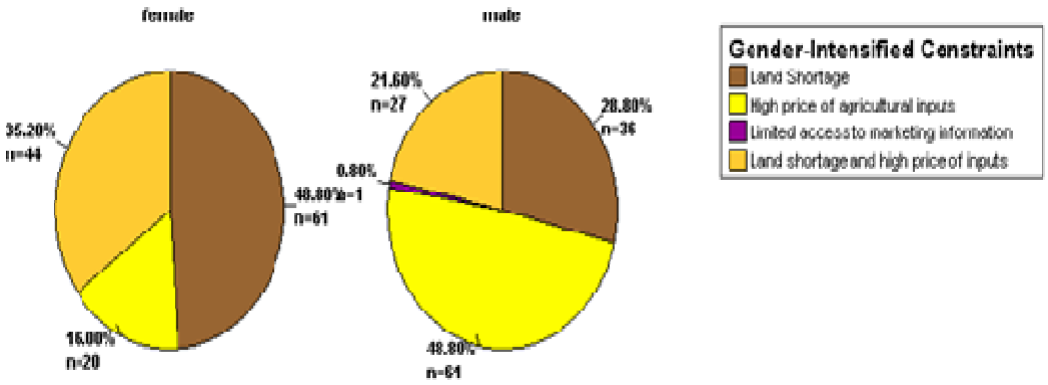

Figure 2. Gender-intensified Constraints for Crop Production and Management Practices in the Three Communities (Source: Field data, 2007).

practices since there are many contributing factors for the significant difference between their knowledge (Table 4). Respondents were asked to outline influencing factors for their knowledge of each major crop production and management practice. Accordingly, headship, access to information, participation in the practices, access to extension services, and access to training were listed as the major influencing factors for gendered knowledge on crop production and management practices. As a head of the household, a person is expected to know all matters of his/her household. Participation in the crop production and management practices and access to training, information and extension services also gives a chance for a person to know more about the crop production and management practices.

Gender Related Constraints in Crop Production and Management Practices

49% (n=61) of female respondents reported land shortage to be a major constraint for crop production and management practices compared to 29% (n=36) by the male respondents. 49% (n=61) of male respondents reported high price of agricultural inputs to be a principal constraint compared to 16% (n=20) by the female respondents. With regard to land shortage and high price of agricultural inputs, 36% (n=44) of female respondents confirmed land shortage and high price of agricultural inputs compared to 22% (n=27) by male respondents (Figure 2). There is a statistically significant difference between constraints of female farmers and male farmers in crop production and management practices in the surveyed communities (χ^2=32.267, df=3, $p<0.05$). There is an urgent need for gender responsive agricultural and rural development interventions to address the needs of male and female farmers in the surveyed communities.

With the help of pair-wise matrix ranking technique in the participatory rural appraisal exercise both male and female farmers similarly prioritized erratic rainfall, high price of agricultural inputs, shortage of land, lack of irrigation, lack of oxen, lack of knowledge, weeds and pests from priority constraints one to seven (Table 5). The base for the prioritization of the constraints was the importance of the constraint as a limiting factor for productivity of both male and female farmers in the study communities.

Erratic rainfall was prioritized as priority constraint number one because of the fact that small-scale farmers in Ethiopia fully depend on the availability of adequate and timely rainfall. As confirmed by the participants of the PRA exercise, farmers in the study communities really suffer from this constraint and no other constraint could be compared to erratic rainfall. High price of external agricultural inputs (cost of improved seeds, fertilizers and pesticides) was prioritized as priority constraint number two because of the fact that soils in the study communities are highly degraded and indigenous agricultural production and management practices are no more reliable to meet the needs of a human population growing at an alarming rate. Lack of farming and grazing land was prioritized as priority constraint number three because of rapidly growing human population while the farming and grazing land are fixed and even highly degraded as confirmed by the participants of the discussions. As a result, the number of landless citizens is increasing, while marginalizing women disproportionately..

Lack of irrigation was prioritized as priority constraint number four because of the fact that a majority of the farming households in the study communities have no access to irrigation water which could have played complementary role to support the rain-fed agriculture during dry seasons of the year when farmers could have

Table 5. Pair-wise Ranking of Major Constraints in Cop Production and Management Practices in the Three Communities

Problem	Erratic rainfall	Pests	Weeds	Costs of inputs	Lack of land	Lack of irrigation	Lack of Knowledge	Lack of oxen	Scores	Ranks
Erratic rainfall		Erratic rainfall	Erratic rainfall	Erratic rainfall	Erratic rainfall	Erratic rainfall	Erratic rainfall	Erratic rainfall	7	1
Pests			Weeds	Costs of inputs	Lack of land	Lack of irrigation	Lack of Knowledge	Lack of oxen	0	8
Weeds				Costs of inputs	Lack of land	Lack of irrigation	Weeds	Lack of oxen	2	6
Costs of inputs					Costs of inputs	Costs of inputs	Costs of inputs	Costs of inputs	6	2
Lack of land						Lack of land	Lack of land	Lack of land	5	3
Lack of irrigation							Lack of irrigation	Lack of irrigation	4	4
Lack of knowledge								Lack of oxen	2	7
Lack of oxen									3	5

produced different vegetable crops with the help of irrigation to insure food security. Lack of oxen was prioritized as priority constraint number five because of the fact that oxen contribute significantly to land preparation and weeding of the traditional crop livestock mixed farming system prevailing in the study communities, as well as most parts of Ethiopia.

Problem of weeds was prioritized as priority constraint number six because of the fact that weeds have the potential to reduce the production of crops as reported by the participants. Lack of knowledge and problem of pests were prioritized as priority constraint number seven and eight respectively. These complex and interrelated crop production constraints need holistic and systemic approach of problem solving to be tackled on sustainable basis.

Gendered Farmers' knowledge and Innovations in Crop production and Management Practices

Males and females in the study area have good participation in land preparation, planting, weeding, harvesting, storing, transporting and marketing of different crops produced and managed. They participate in all these practices to sustain their lives. Nevertheless, females' participation by far outdoes that of males in some crop production and management activities such as weeding, crop protection, and storage and seed management. As a result, females tend to know more than males about indigenous weeding practices of some crops, developing indigenous storage structures, and indigenous crop protection measures. This entails the need to integrate female's knowledge on crop production and management practices to promote sustainable agricultural development in the study area.

Soil erosion prevention practices, crop rotation, cropping system, harvesting and storage practices are some of the areas where gendered knowledge and innovation on crop production and management practices were identified in the study area. Some of the gendered knowledge and innovations are discussed hereunder.

Indigenous Techniques of Soil Erosion Prevention

Farmers of the study area control water-induced soil erosion by:

- Making small oxen driven furrows in between their fields across the slope/ gradient of their farms, and by leaving border lines uncultivated;
- Horizontal ridges are made at upper and lower edges and diagonal ones in the center of the farm,
- Allowing grasses to grow on highly eroded parts of the farm, and
- Leaving borders against the slope between different owners.

Understanding the relationship amongst crop production, natural resources management and gender roles is very important in sustainable agricultural and rural development efforts. Upadhyay(2005) confirms that throughout the developing world, females are significantly involved in the use and management of natural resources. In other words, females clearly outdo males in terms of involvement. For example, they have more significant contribution than males in soil and water conservation practices, forest resource management, and agro-biodiversity management practices, and manage-

ment of renewable energy resources. This was found to be true in the study areas as well. Yet, females are generally, always underrepresented in natural resource decision-making and programmes. The emergence and establishment of local and community organizations and reducing the work burden of women in key tasks and improving their decision-making ability in natural resources management and overall status in rural society are the two critical preconditions for a move toward gender empowerment in Rural Ethiopia (Dejene, 2003).

Crop Rotation Practices in the Study Areas

Crop rotation is practiced in the study area. The sequential arrangement varies depending on the type of the soil.

- Teff---Maize---Wheat---Teff on well drained soil
- Teff---Niger Seed---teff---Niger Seed on water logged soil.

Crops like faba bean, field pea, linseed, niger seed and rapeseed were reported by the farmers to enhance soil fertility when frequently rotated. Farmers of the study area confirm that rotating crops on their farmlands greatly helps in managing different crop production and management related multi-faceted problems. These crops are planted either when the land tends to lose fertility or the farmer needs to plant cereal after them. In other words, they have fertility regenerating potential through natural process by their nature and their fertility restoring capacity is well known by local farmers in the study area. What is missed in crop production and management intervention in relation to crop rotation in the study area is proper understanding of farmers' innovations on crop rotation practices and integrating them into formal agricultural development interventions. That will transform the Ethiopian agriculture on sustainable basis.

The Indigenous Seed Selection and Multiplication of Teff Crop

According to Tesfaye and Chaltu (husband and wife) in a model farming household for gender equality, the following procedures are followed in the selection and multiplication process of quality seed for teff crop cultivation:

1. The teff plants with white seed color, long stalk, early maturing, and big seed size are selected on the farm;
2. The selected quality seeds are planted separately on a small plot of land for subsequent year plantation;
3. The quality seed is harvested and threshed separately; and
4. The harvested quality seed is stored in a container separately for plantation.

Seed color, stalk length, early maturity and seed size are used as the main criteria for seed selection for teff. As marked by the innovators, quality seeds are selected both from improved varieties and local varieties. In the entire cases white color is preferred because of its market value.

Indigenous Seed Storage Technique for Indigenous Maize Variety

As elaborated by Gudine Gonfa-model diligent female headed household head, the following procedures are followed in indigenous seed storage of maize variety called "Bokolo Oromo":

1. The maize plant with big seed size is selected on the farm;
2. The grain will be harvested from the selected plant;
3. The selected quality grain is hanged in open roof where it could be accessed by air or fire smoke. Access to air or smoke has an advantage of preventing attack by weevils; and
4. The hanged grain of maize is taken for plantation during planting season.

The empirical evidences on gendered knowledge and innovations on crop production and management practices at local level entails the need to explore more the available gendered knowledge and innovations in other sub-agricultural sectors such as natural resource management sector, rural energy sector, and livestock sector. Despite rich farmers' knowledge and innovations at local level, previous and ongoing agricultural research and development endeavors tend to ignore the potential contribution of gendered local knowledge and innovations for sustainable rural and agricultural development. Nevertheless, there are good starts by proponents of sustainable agricultural development practices in supporting local knowledge and innovation processes.

No agricultural researcher or development professional should have the view that scientific knowledge systems are panacea for agricultural development problems at local level. The future of local farmers in general and local female farmers in particular is bright if more attention is going to be given in supporting gendered local knowledge and innovations in all dimensions. Supporting local knowledge and innovations by encouraging local farmers to undertake research on local knowledge and innovations, documenting the existing wealth of knowledge and innovations and integrating them into sustainable rural and agricultural development endeavors are some of the foreseen areas were different stakeholders can join their hands, minds, and hearts to support gendered knowledge and innovations in rural sector in general and crop pro duction and management practices in particular at local level.

CONCLUSION AND RECOMENDATIONS

The results of the analysis indicate that both females and males are knowledgeable about crop production and management despite the common belief held in the society that females do not have/ contribute significantly to knowledge and practice on crop production and management in the rural Ethiopian context. From the study undertaken males and females in rural Ethiopia have important knowledge and innovations which must be documented and integrated in multi-stakeholders agricultural innovation processes if the Ethiopian agricultural research and development system is to be transformed in a sustainable manner.

A gender responsive agricultural research and development intervention should be in place in Ethiopia to support local knowledge and innovations in all dimensions. In other words, there is a need for gendered education, gendered training, gendered budgeting, and gendered rural and agricultural development interventions for sustainable rural livelihood in Ethiopia. Failure to engender all rural development interventions in the country will continue to contribute for existing unsustainable rural local livelihood. On the other hand, if all rural and agricultural development interventions in general and crop production and management interventions in particular are going to be engendered, there is a great hope for the country as gender equality and women's empowerment is a prerequisite for sustainable rural development. In line with engendering rural and agricultural development interventions, exploring gendered knowledge and innovations on crop production and management, documenting them, and integrating them into formal agricultural research and development systems is of paramount importance.

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Annexes

Annex 1: Characteristics of the sample in three surveyed communities (Awaro Kora, Gosu Kora and Senkele Farisi)

Category	*Variables*	Total		Communities					
		Count	%	Awaro Kora		Gosu Kora		Senkele	
				Count	%	Count	%	Count	%
Gender	Male	125	50.0	30	50.0	58	50.4	37	49.3
	Female	125	50.0	30	50.0	57	49.6	38	50.7
Age	18-30	16	6.4	4	6.7	12	10.4	---	---
	31-50	187	74.8	32	53.4	90	78.2	65	86.7
	51 and above	47	18.8	24	40.0	13	11.3	10	13.4
Marital Status	Single	2	0.8	---	---	2	1.7	---	---
	Married	125	50.0	30	50.0	58	50.4	37	49.3
	Divorces	16	6.4	2	3.3	14	12.1	---	---
	Widowed	107	42.8	28	46.7	41	35.6	38	50.7
Household Title	Male Headed Household	125	50.0	30	50.0	58	50.4	37	49.3
	Female Headed Household	125	50.0	30	50.0	57	49.6	38	50.7
Ethnicity	Oromo	238	95.2	56	93.3	108	93.9	74	98.6
	Amahara	12	4.8	4	6.7	7	6.1	1	1.3
Source of Income	Farming Activities	174	69.6	41	68.3	76	66.1	57	76.0
	Farming and Non-farming activities	76	30.4	19	31.7	39	33.9	18	24.0

Source: Field Data 2007.

Annex 1 (Continued)

Category	*Variables*	Total		Communities					
		Count	%	Awaro Kora		Gosu Kora		Senkele	
				Count	%	Count	%	Count	%
Religion	Orthodox Christianity	218	87.2	60	24.0	85	73.9	73	97.3
	Protestant Christianity	31	12.4	---	---	29	25.2	2	2.7
	Indigenous Oromo Religion (Wakefata)	1	0.4	---	---	1	0.9	---	---
Education Level	Non-formal	111	44.4	39	65.0	27	23.5	45	60.0
	Primary	110	44.0	20	33.4	63	54.7	27	45.0
	Secondary	29	11.6	1	1.7	25	21.7	3	5.0
Annual Income	Less than 1000 Birr	42	16.8	9	15.0	14	12.1	19	25.4
	1001-5000 Birr	125	50.0	34	56.6	55	47.8	36	48.0
	5001-10000 Birr	70	28.0	17	28.4	40	34.7	13	17.4
	Greater than 10000 Birr	13	5.2	---	---	6	5.2	7	9.3

Note: 1 euro= 13 Ethiopian Birr.
Source: Field Data 2007.