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Field Pea (*Pisum Sativum* L.) Seed System Analysis in Enarj Enawuga and Yilmana Densa Districts, West Amhara Region, Ethiopia

ABSTRACT

The productivity of field pea is low in Ethiopia though the crop has high demand for both local and export markets. The low productivity mainly due to the un availability of quality seed supply system for limited number of improved varieties. Therefore, this study was conducted to understand the functioning of field pea seed system in Enarj Enawuga and Yilmana Densa districts during 2016/17 cropping season. Multi stage purposive and random samplings were employed to select a total of 200 farmers from six kebeles and interviewed using pretested structured questionnaire. The study revealed that 96.7% of field pea area was planted with local varieties showing low adoption of improved varieties. Too low weeding and storage protection practice were also observed at Yilmana Densa than Enarj Enawuga district due to a relative poor extension service provided. Currently, the field pea seed system is dominated by the informal sector and a very wide gap exists between the demand and supply of quality seed of improved field pea varieties. This suggested the need to strengthening extension service to promote the adoption of improved field pea varieties and an integrated field pea seed system is needed to be in place to address the seed delivery system in the future.

Key words: Adoption; Extension, Formal Sector, Informal Seed Sectors, Integrated field pea system, Supply

INTRODUCTION

Field pea is a cool season legume that is grown on 7,881,943 ha with production of 12.5 million tons worldwide. Ethiopia ranked first in Africa and sixth in the world in field pea production with an area of 0.23 million ha and 0.34 million tons (FAOSTAT, 2015). Field pea is an important source of food and feed in developing and developed countries, respectively. Field pea is the major food legume with a valuable and cheap source of protein having essential amino acids (23-25%) that have high nutritional values for resource poor households (Nawab *et al.,* 2009). The crop has important ecological and economic advantage in the highlands of Ethiopia, as it plays a significant role in soil fertility restoration being used as a break crop to minimize the negative impacts of cereal based mono-cropping (Angaw and Asnakew, 1994). It is also used as a source of income for the farmers and foriegn currency for the country (Girma, 2003). In Ethiopia, the pulse crops showed a slow growth in productivity for the last ten years. The average yield of field pea was 1.461 t ha^{-1} in 2015/16 cropping season (CSA, 2016) and it was one of the crop where more work is expected to enhance its productivity (CSA, 2015a).

According to CSA (2016), the Amhara Regional State produced 1,150,035.6 tons (35.57% of the country) on 86,792.1 ha and it was the second major producing region of field pea in Ethiopia next to Oromia Regional state. However, the average yield of the crop was 1.325 t ha^{-1} which was less than the national average yield. Enarj Enawuga and Yilmana Densa are potential districts for field pea production in Amhara Regional state but the productivity of field pea is declining. The total area and production of field pea were decreased by 40% and 25.9% respectively from 2008/09 to 2016/17 (EEDOA and YDDOA, 2016). The limited used of new technologies of field pea production as one of the low productivity in the region and districts mentioned.

Seed is a crucial input for agricultural production and the most affordable external input for farmers (Kumar *et al*., 2014). Seed availability and accessibility by farmers are determined by many factors including the crop breeding systems, institutional/organizational arrangements and socio-economic conditions of farmers (Zewdie *et al*., 2008). It is noteworthy that an effective seed system is relevant to increased productivity and overall agricultural production (Oyekale, 2014).

The formal and the informal systems are in place in Ethiopia. There is also a system that combines the two referred to as an integrated seed system (Abebe and Lijalem, 2011). Seed systems can even vary considerably between crops on a single farm. The seed system may vary as the source of seed for pollinating and vegetative propagated crops like rice and potato than that of maize which is predominately cross pollinated. The seed system may even vary between varieties grown by a single household, when improved and local maize varieties are planted (Almekinders, 2000).

According Bureau of Agriculture (BoA) report (2016), between 2003/04-2006/07 cropping season, the total amount of field pea varieties seed demand in Amhara Region was 21.21 tons per year while the supply was only 1.99 tons. This was only 9.38% of the total improved certified field pea seed requested. From 2007/08 to 2016/17 cropping season, only 0.36 tons of basic seed of improved varieties was supplied by the regional seed enterprise for contractual seed production. In 2016, during survey year of this study, there was no certified seed allocated for field pea to the BoA due to too low supply from the formal seed sector (BoA, 2016).

A number of improved varieties of field pea are released by the federal and regional agricultural research institutes but still the seed supply is negligible and unable to satisfy the seed demand of end users. Moreover, there is little information on field pea seed system, seed sources and local knowledge in seed selection, maintenance and management practices. Therefore, baseline information on the current field pea seed system and quality of seed used for production is important to identify the field pea seed supply problem and suggest the establishment/strengthening of field pea seed system. The objectives of this study were to asses: The relative importance of formal and informal field pea seed system in Enarj Enawuga and Yilmana Densa Districts

MATERIALS AND METHODS

Description of the Study Area

The field pea seed system study was carried out in Enarj Enawuga district in East Gojjam Zone and Yimana Densa district in West Gojjam Zone of Amhara Regional States (Figure 1). **E**narj Enawuga has an altitude ranges from 1100 to 3200 masl where 30%, 50% and 20% of the total land area lies in *Dega*, *Weynadega* and *Kolla*, respectively. The area receives a mean annual rainfall of 1228 mm with a mean maximum temperature of 25 $^{0}_{C}$ and a mean

minimum temperature of 22 $^{0}_{C}$. From the total area of 96,095 hectares about 45,053 hectares (46%) is cultivated land and the major crops grown in the district are *teff*, wheat, barely, maize, faba bean, grass pea, field pea and potato. The Enarj Enawuga district consists of 25 rural and three urban (towns) kebele administrations with 165,415 farm households and a total population of 185,124; and over 98% of the population is involved in agriculture (EEDOA, 2016).

Yilmana Densa district has an altitude in the range between 1552 to 3535 masl, and average annual rainfall of 1270 mm with the main rainy season from May to October. The district is classified into three traditional agro climatic zones of which 24%, 57% and 19% of the total area lies in *Dega, Weynadega* and *Kolla* respectively. The Yilmana Densa district consists of 33 rural kebele administrations with a total human population of 217,356. The total area is 99,180 hectares, and about 54,508 hectares (55%) is covered with annual crops. The mixed crop and livestock farming is predominant, since the area is suitable for both rearing of livestock and cultivating crop. The majority of the farmers depend on growing *teff*, maize, wheat, barley, faba bean, field pea, haricot bean, and chickpea as major source of cash income and household consumption (YDDOA, 2016).

Data Collection

Formal Field Survey

The study involved both multi stage purposive and random sampling techniques to select sample farmers. The two study zones, two districts and six Kebele Administrations (KAs) were selected purposively for being a major field pea growing areas. First, two major field pea growing districts (Enarj Enawuga and Yilmana Densa) were selected where some interventions have been made in the dissemination of improved field pea production technologies. Second, three KAs with highest field pea growing areas from each district were selected in consultation with the experts from the Agricultural Offices of the respective districts. Third, a total of 200 sample farmers, of which 120 from Enarj Enawuga and the remaining 80 from Yilmana Densa district were randomly selected for the survey.

The questionnaire was designed and pre-tested in randomly selected farm households before the beginning of the survey and a checklist was prepared for the survey. During the survey, data was collected with the help of trained enumerators. Enumerators were trained on farmers' demographic characteristics, knowledge and source of information on new agricultural technologies, seed supply systems, perceptions on seed quality, timeliness of seed availability, conditions under which the seed is available, appropriateness of variety, seed

management practices, capacity to innovate performed by a seed system to avail high quality seed of varieties preferred by farmers. Group discussions with key informants were also employed in order to acquire supplementary information. Two group discussions one per district was conducted which composed farmers, extension agents and kebele leaders having experience in field pea production. Ten participants from each district were purposively selected. Personal observations were also made as part of the qualitative information appraisal procedure.

Secondary Data Collection

Secondary data was obtained from various sources such as reports, agricultural research centers, Central Statistical Agency (CSA), Amhara Seed Enterprise (ASE), Amhara Bureau of Agriculture (BoA), district agricultural offices, pervious findings, internet and other published and unpublished materials.

Data Analysis

Information collected from the field survey was coded, tabulated and analyzed by using Statistical Package of Social Science (SPSS) version 23. Simple descriptive statistics was used to separate the mean, percentage and standard deviation to describe the socio-economic characteristics of the respondents.

RESULTS AND DISCUSSION

Household Characteristics

Demographic Characteristics and Farming Experience

Data collected from 200 respondents from the two districts showed that 179 (89.5%) of the respondents were male headed households and only 21(10.5%) were female headed households (Table 1).

Education is expected to increase the probability of the farmers to adopt new technologies. As shown in Table 1, 45% of the total respondents had no formal education while 24.5, 14, 11 and 5.5% were read and write, some primary, completed primary and some secondary respectively. However in Enarj Enawuga district 34% of the respondents were adult education where as in Yilmana Densa 42% of them were read and write. In Yilama Densa district, about 38% of the respondents were illiterate as compared to 11% in Enarj Enawuga. Ideally, educated farmers are expected to display better adoption of a technology because they can process information more rapidly than others. The result is in agreement with earlier

literatures conducted in the country (Zewdie *et al.*, 2010; Solomon *et al.*, 2012; Wuletaw and Daniel, 2015).

Age was one of the demographic characteristics that influenced the decision to adopt new technologies. The mean age of the respondents in Enarj Enawuga and Yilmana Densa districts, respectively were 38.68 (SD=8.52) and 43.09 (SD=8.98) with minimum and maximum range from 22-51 and 33-65 in the same order (Table 1). In Enarj Enawuga younger farmers could be main avenue for introducing new varieties as well as non-varietal technologies in the communities. The result is in agreement with recent adoption studies of Amare (2015) and Odhiambo *et al*. (2016) but in Yilmana Densa could be because age of a farmer was used as a measure of his experience and experienced farmers were often expected to use modern technologies and it is in agreement with recent adoption studies in Amhara region (Solomon *et al*., 2012; Afework and Lemma, 2015).

The mean field pea producing experience of the respondents in Enarj Enawuga and Yilmana Densa were 13.77 years (SD=6.13) and 12.91 years (SD=5.72) respectively (Table 1). In contrast to age, Enarj Enawuga district has relatively higher experience of field pea production than Yilmana Densa district. Farming experience can help the farmers to evaluate the advantage of incorporating seeds of improved field pea varieties in to their field pea production system.

Information on Field Pea Technologies and Use

Source of Information for Agronomic Packages

Among farmers the awareness of field pea production packages were high for for fertilizers (97%), agronomy (93.5%), and storage (86%) but low for improved varieties (39.5%), respectively. The formal BoA extension service was the main source of information for agronomic practices (100%), storage (77.8%) and fertilizers (67.1%) for field pea production but low in improved field pea varieties (34.1%). In contrast, the research centre was main source of information improved varieties (57%). In addition to research centre, farmers had information about improved field pea varieties from different sources such as relatives (5.1%) and neighbors (3.8%) (Table 2).

Generally, Farmers used multiple sources of information as much as possible but the research centre was the main source of information for most of improved field pea packages due to the dissemination system practiced in both districts. Informal source of information such as relatives and neighbors are also important particularly for improved varieties, fertilizer and

grain storage. There is general lack of effective extension information related to seeds. Tesfaye *et al*. (2008) also found that the majority of the farmers (62%) in the central area of Ethiopia obtained information on improved potato technologies from Holleta Research Centre, whereas 33% obtained it from fellow farmers and only 4% from the office of agriculture.

Agronomic Practices Used for Field Pea Production

The majority of the respondents (55%) plough their field pea land twice and the rest (45%) of the farmers plowed one time **to** facilitate crop establishment (Table 3). However, 80% of the respondents in Yilama Densa district plow once where as 78% of Enarj Enawuga plow their field pea land twice. Field pea is large seeded crop that does not require fine tilth as compared to cereals for establishment. The primary objectives of soil tillage are to provide suitable seedbed and adequate weed control (Rao, 2000). The result is in agreement with Fisseha and Tewodros (2014) finding that ploughing twice is economical and profitable for field pea producing farmers.

About 15.5% of the farmers in the study area sowed in mid-May and 31.5% in early June and 53% in late June (Table 3) which is as per recommendation (mid-May to early July) of field pea production packages of BoA depending on the onset of rain and soil type. In both locations the late June was preferred by most farmers. Farmers in the highlands sow earlier (mid-May) than mid altitude particularly where water-logging during vegetative stage and drought during flowering time were a major problem. Appropriate planting time has an impact in improving the productivity of legumes (Berhane *et al.*, 2016). Grubben and Denton (2008) suggested early sowing for optimum yields to overcome low moisture availability and heavy aphid infestation at medium altitudes and frost damage at high altitudes.

About 56.5% of the respondents used as per recommendation of BoA with seed rate of 80-120 kg ha^{-1} while 43.5% used a seed rate of less than 80 kg ha^{-1} which will result to low plant population and productivity per hectare. The quantity of seed sown per hectare determines the density of the plant population and ultimately the productivity of the crop. Similar trend was observed in both locations. It was found that high yields are realized with optimum plant population and planting method (Yayeh *et al.,* 2014).

It also provides ease for crop management that increases overall production of the crop. The majority of farmers (60.5%) row planted while 39.5% broadcasted field pea (Table 3). In both districts, broadcasting could be due to mixed cropping practice of filed pea with faba

bean to prevent lodging of filed pea. Row planting has more advantages over broadcasting as it reduces labor and costs of production. Yayeh *et al*. (2014) however found that sowing field pea with 25 cm row spacing and 15 cm intra row spacing (or 20 cm row spacing and 5 cm intra row spacing) gave the highest mean seed yield. It was a similar trend between in both districts

The majority of farmers (58%) carry out one time weeding as per the recommendation while 42% did not practice weeding their field pea plot (Table 3) due to the overlapping of agricultural activities with other crops like *teff* and wheat. Weeding practice was too low in Yilmana Densa distirict (83%) than in Enarj Enawuga (14%) due to poor extension service provided in Yilmana Densa district. The extent to which yield is depressed as a result of competition from weeds depend on the resources available and competitive ability of crops (Roberts, 1982). Fisseha and Tewodros (2014) and Getachew and Hailu (2009) found that weeding once is the best option and economical to grow field pea.

Farmers' Perception of Soil Fertility and Fertilizer Use

It was found that, the majority (54%) of the respondents assumes that their land having intermediate fertility while 31 and 15% considered their field pea land having poor and good soil fertility respectively (Table 4). It was also constant in both locations.

The growth and grain yield of field pea is influenced by the application of fertilizers. The majority of the respondents (71%) apply DAP fertilizer and none of the sample farmers use natural fertilizers such as compost in both districts. From those that apply fertilizer, 68.3% use between 60-80 kg ha^{-1} which was lower N and higher P_2O_5 and the remaining 31.7% uses less than 60 kg ha^{-1}which was less in both N and P when compared with the findings of Getachew *et al*. (2003) and Getachew and Hailu (2009) which found the application of 18 kg nitrogen and 20 kg phosphorus per hectare for growing field pea. Lower application was observed could be due to high cost of fertilizer and more attention given to cereals having large area coverage.

Adoption of Field Pea varieties and Farmer's Perception

Adet Agricultural Research Centre together with Bahir Dar University has carried out participatory research for pre-scaling up of field pea varieties three years ago within the watershed project in East and West Gojjam Zones of Amhara region. Seed distribution was officially through BoA. Dissemination of field pea improved varieties therefore seems

concentrated around project areas. There is low average rate of adoption of improved field pea varieties in the region.

Currently, only 3.29% of the area is under field pea production in both districts is covered by improved varieties whereas 96.7% is covered by local varieties (EEDOA and YDDOA, 2016). The ASE and Ethiopian Seed Enterprise (ESE) of Bahir Dar branch have never supplied enough improved certified seed of field pea varieties in both districts and as a result, the majority of farmers depend on the local varieties. Lower adoption rate together with absence of functional agency for field pea seed production makes the formal sector not sustainable.

The local field pea varieties are less resistance to major diseases like blight and less tolerant to pests like pea aphid, bean bruchid, African bollworm and birds; and this caused disappointment among farming communities of both districts. The two adopted improved field pea varieties grown in the districts are Tegegnech (12%) followed by Hassabe (6.5%) by the respondents in the study area. The most desirable characteristics of good quality field pea variety suggested by the respondent farmers were seed size, seed yield, early maturity, disease/insect pest tolerance and seed color and ranked them as 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 5^{th}, respectively (Table 5).

Two local varieties of field pea but with different maturity period and seed size were identified. The early maturing variety is medium in seed size and sown early in May on vertisols and is less resistant to water logging while the late maturing variety is large in seed size and sown in red soil. Farmers prefer the early maturing variety for double cropping with grass pea. Among improved varieties Tegegnech with cream seed color, large seed size, round shape and higher yield is preferred by farmers than Hassabe with light brown color, medium seed size, wrinkled shape and relatively lower yield. Some farmers however prefer Hassabe variety because it matures earlier than Tegegnech. In beans the farmer preferred traits are yield, seed size, early maturity or disease tolerance (Asrat *et al.*, 2013).

Field Pea Seed Sources and Perceptions

Farmer's Seed Sources

Farmers' seed source and acquisition for both local and improved field pea varieties grown is presented in Table 6. Here we can distinguish two aspects: (a) Seed source from where farmers sourced their seed for planting field pea varieties they are growing during 2016/17

cropping season and (b) original source from where farmers sourced or accessed the seed for the first time all field pea varieties currently grown.

In 2016/17 cropping season, the majority of respondent farmers (64.5%) used their own stock followed by (19.5%) used seed purchased from market, 6% purchase from farmers and the rest 5.5% and 4.5% of the respondent farmers exchange with other crop seeds and purchase from traders, respectively (Table 6). The majorities of farmers used seed from the informal seed systems and own stock was the dominant one. Farmers considered seeds obtained from their own farm have better quality than purchased but have no any justification for changing the seed unless to acquire a new variety on the market.

Many factors were found to influence farmers' seed sources: economic (as related to wealth), social (ethnic, cultural, and traditional), biological (varietal characteristics, multiple uses, etc.), and ecological (adaptive characteristics, weather factors, etc.) (Friew, 2007). Farmers might use various seed sources for different crops or even for a single crop or variety they grow on the farm for various reasons (Zewdie, 2010). Regassa *et al.* (1998) also found that lack of seeds (42%), followed by seed price (35%), to be the most important seed-supply constraint in southeastern Ethiopia. Similarly, Zewdie (2010) found that 79% of respondents used retained seed of wheat crop. Firew (2007) also found own stock was the dominant seed source in normal years for sorghum.

The original source of the field pea varieties they are growing currently were obtained from own stock (57.5%), gift from research/NGO (18.5%), purchase from market (12%), purchase from farmers (6.5%), exchange with other crops (4%) and the rest 1.5% was purchase from traders. Original source of filed pea varieties were mostly own stock. Many findings indicated that own stock was the dominant seed source in most developing countries. The second important original seed source was from NGO through AARC by disseminating improved varieties in the water shade project areas of two districts. The result in agreement with Zewdie (2010) found that informal sector was an initial source of modern wheat varieties for 58% of the farmers.

Generally farmers use different seed sources for growing field pea on their farm. The four major seed source channels from informal sector were own stocks and exchange with or purchase from other farmers, local markets or traders. Since there was no new improved variety on the market own saved seed was the main seed source of field pea in both districts.

Further, they are familiar with the seed they grow and know that it is adapted to local conditions and preferences. Those who prefer purchasing from market was because local market offers local varieties grown in neighboring areas and the seed price was lower than other sources. They also get chance for exchange with other crops (*teff*) which have same cost as field pea in local markets. Some farmers prefer purchasing seed from other farmers because they know and certain about seed quality. Few grain traders' also potential seed source for field pea due to affordable price higher than grain.

Seed Replacement and Reason for Seed Replacement

Here a regular practice a farmer is following to replace field pea seed and the reasons for seed replacement were assessed.

From the respondents of both districts, it was estimated that the mean number of years farmers used field pea seed without replacement was three to four years. From the total households only 49 (24.5%) replace field pea variety. Seed replacement among field pea variety users was low due to limited availability of seed of new varieties on the market. Reddy *et al*. (2007) found that farmers save seed of local varieties and use this continuously for about 3-4 years with low seed replacement ratio of 2-3% because the proportion of quality seed available each year is only 10-12%.

Most of the respondents (44.9%) replace the variety due to susceptibility to diseases, the rest 32.6, 18.4, 4.1% replace their variety due to low yielding capacity, low pest tolerance and late maturing variety, respectively (Table 7). As discussed above the local varieties are low yielders, less tolerant to disease and pest, and due to those reasons majority of the farmers want to replace their field pea seed stock with new seed of improved varieties and there was no possibility due to availability of limited in the market.

Formal seed source appeared to be one of the strategies for acquiring a new variety or renew old seed of improved variety (Zewdie, 2004). The decision made by farmers to change varieties is termed variety 'replacement', whereas the distinction to obtain fresh seed stocks of the same variety is termed seed 'renewal' (Zewdie and Kugbei, 1997). Simillarly, GTZ (2000) reported that reasons for farmers to use off-farm seed are: loss of seed due to crop failure, the incapability to save seed because of low-yields, need to replace seed because of degeneration or disease contamination, and to obtain new varieties.

Household Seed Security

It was found that the majority of the farmers (83%) were seed insecure. The main underlying reasons for seed insecurity were seed unavailability (43.1%), pests (25.7%), diseases (19.8%), drought (6.6%) and hailstorm (4.8%) as shown in Table 8. The seed unavailability followed by production related problems (insect, disease and bird) and natural calamities (drought and hailstorm) were the major reasons affecting seed security in the study area.

Farm families are seed secure when they have access to seed and (other planting material) of adequate quantity, acceptable quality, and in time for planting. Seed security is best framed within the broader context of food and livelihood security. Helping farmers to obtain the planting materials they need enables them to produce for their own consumption and sale (FAO, 2014). Similar findings reported by Friew (2007) that in a bad cropping season, farmers were forced to use seed sources other than their own (depleted) stock.

Farmers indicated different ways to cope and reduce seed insecurity include: increasing availability of seed (43.1%), proper pest and agronomic management (31.8%) and changing the variety (25.1%) of the crop (Table 8). FAO (2014) recommended that communities can be capacitated to produce/multiply, store and market seed of desired crops and varieties.

SUMMARY AND CONCLUSIONS

Field pea can play an important role for household food security and sustainable farming systems**.** Availability of quality seed of improved field pea varieties at suffient quantity is one of the major constraints to increase productivity. This study was conducted to quantify the relative importance of formal and informal seed system in Enarj Enawuga and Yilmana Densa districts during the 2016/2017 cropping season.

Multi stage purposive and random samplings were employed to select a total of 200 farmers from six kebeles and interviewed using pretested structured questionnaire.

In Yimala Densa district, majority of the respondents were read and write, aged, plow their field pea land one time, no weeding practice, low seed storage protection measure and males were responsible for seed selection while in Enarje Enawuga district, most of them were adult education, young, plow their field pea land two times, one time weeding practice, better seed storage protection and females were more responsible for seed selection.

About 3.45 % of field pea area is covered by improved field pea varieties in both Enarj Enawuga and Yilmana Densa districts during 2016/17 cropping season. The study revealed that the adoption of improved field pea variety was very low. Low adoption of improved varieties could be related to ineffective seed extension and popularization. Inadequate sowing methods, low seed rates and poor weeding practices were contributed to lower field pea productivity in both districts.

The two improved field pea varieties namely, Tegegnech, and Hassabe were grown in the study districts. Farmers had originally obtained seed of these varieties from AARC and Bahir Dar University through pre scaling up program under watershed project in two districts. Farmers in both districts were preferred in new field pea varieties for having such as large seed size, high grain yield, early maturity, disease and insect tolerant and creamy seed color.

To date, there are 35 improved field pea varieties released by the regional and federal agricultural research institutes but many improved field pea varieties were not known by the farmers and the regional seed production was limited to only one variety (Tegegnech). In both study areas few farmers still use the two improved field pea varieties that are more than 20 years old after release by National Variety Release Committee. This indicates that there was a limited linkage among seed value chain actors in the Amhara Region.

The existing seed system of field pea in both districts is dominated by the informal seed system and a very limited supply of seeds of field pea was available from limited activity of the formal seed system. The continuous use seeds of farmers' cultivars from the informal seed system may be one of the reasons for low production and productivity of field pea in both districts. Low efficiency of the current field pea formal system and due to poor support to strengthening the in formal seed system was one of the major reasons that most of the farmers in both districts to produce the crop from farm saved seeds of farmers' cultivars.

Generally, there is a potential for expanding field pea production in the two districts due to the favorable agro ecology and interest of farmers to produce the crop. If this potential can be linked with the existing increased demand for export and domestic consumption of field pea in a fertile ground to increase the yield and productivity of the crop. The main challenge was the lack of an effective seed system capable of producing and supply certified seed of field pea to improve varieties of the required amount.

The farmers in the study districts experienced some good practices to keep the field pea seed quality to the national standard for the crop. This could be strengthened through good

agricultural extension service to become as a source of quality seed supply. Therefore, based on results of the current reseach it could be possible to forward the following recommendation:

1) The improved field pea varieties need to demonstrated and promoted by the respective responsible government and non-government organization to improve the adoption of varieties in both districts.
2) Extension should play a crucial role in training farmers in on-farm quality seeds of the field pea crop production and is therefore a prerequisite for the improvement of the informal seed system in both districts and a special focus also needed for Yilmana Densa district.
3) National and regional policy should promote integrated field pea seed system through participation of effective community seed production and marketing in both districts.

Strengthen coordination between stakeholders in the seed value chain specially the regional research centers with regional public (ASE) and private seed producers

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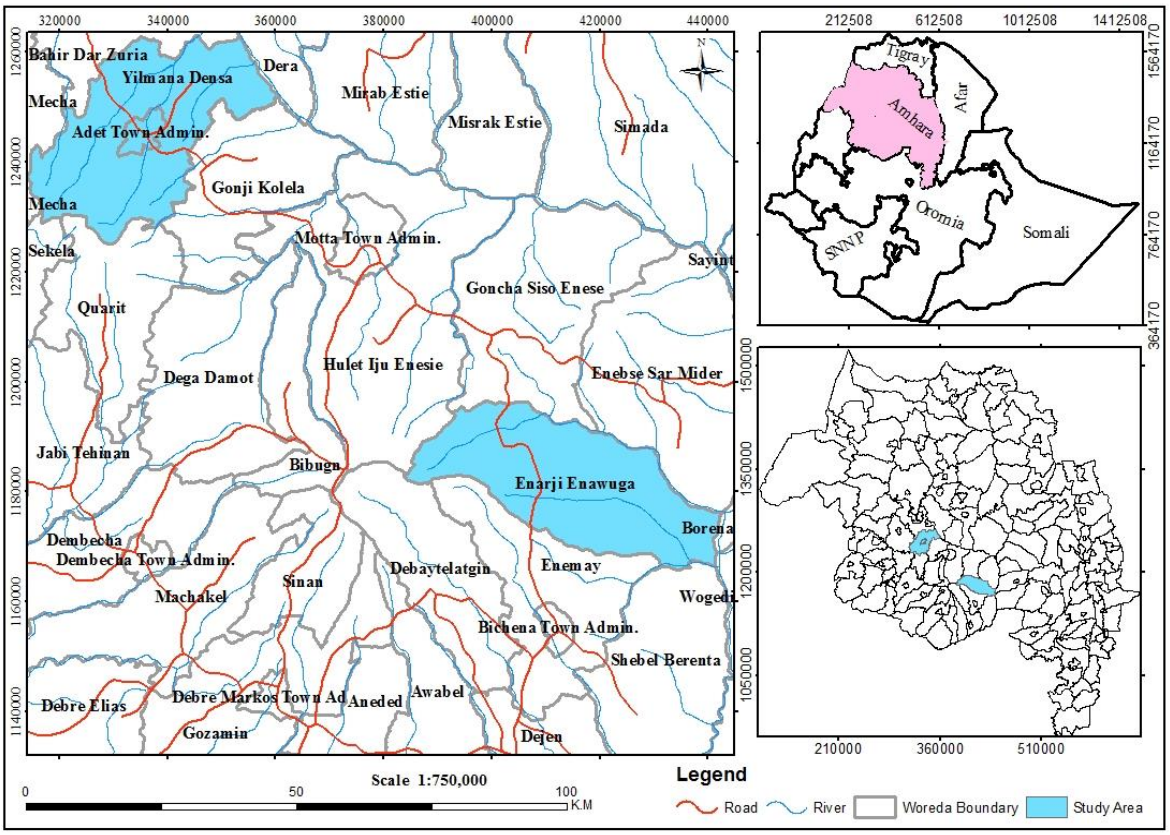

Figure 1. Location map of Enarj Enawuga and Yimana Densa Districts in Amhara Regional State Ethiopia.

Table 1. Sex, education, age and farming Experience of sample farmers

	Enarj Enawuga		Yilmana Densa		Total	
Indicators	n	%	n	%	n	%
Sex of respondents						
Male	105	87.5	74	92.5	179	89.5
Female	15	12.5	6	7.5	21	10.5
Total	120	100	80	100	200	100
Educational level						
Illiterate	14	11.6	31	38.8	45	22.5
Read and Write	15	12.5	34	42.5	49	24.5
Adult Education	41	34.2	4	5	45	22.5
Some Primary (1-4)	24	20	4	5	28	14
Completed Primary (5-8)	15	12.5	7	8.7	22	11
Some Secondary(9-12)	11	9.2	0	0	11	5.5
Age						
Mean	38.68		43.09		40.45	
SD	8.52		8.98		8.951	
Minimum	22		33		22	
Maximum	51		65		65	
Farming experience						

Mean	13.77	12.91	13.43
SD	6.13	5.72	5.97

Source: own survey data, 2016/17 cropping season

Table 2. Farmers' source of information on agronomic packages for field pea production (n=200)

Source of information		Improved variety		Agronomy		Fertilizers		Storage	
		n	%	n	%	n	%	n	%
Have information	Yes	79	39.5	187	93.5	194	97	172	86
Sources of information									
BoA		27	34.1	87	100	63	67.1	56	77.8
Research Centre		45	57	0	0	5	5.3	0	0
Relatives		4	5.1	0	0	19	20.2	10	13.9
Neighbors		3	3.8	0	0	7	7.4	6	8.3

Source: own survey data, 2016/17 cropping season. Note: BoA= Bureau of Agriculture

Table 3. Agronomic practices used for field pea production by sample farmers in Enarj Enarj Enawuga and Yilmana Densa districts (n=200)

Agronomic practice	Enarj Enawuga		Yilmana Densa		Total	
	n	%	n	%	n	%
Plowing time						
One	26	21.7	64	80	90	45
Two	94	78.3	16	20	110	55
Panting date						
Mid May	24	20	7	8.8	31	15.5
Early June	45	37.5	18	22.4	63	31.5
Late June	51	42.5	55	68.8	106	53
Weeding frequency						
No weeding	17	14.2	67	83.8	84	42
One weeding	103	85.8	13	16.2	116	58
Seed rate kg/ha						
<80	56	46.7	31	38.8	87	43.5
80-120	64	53.3	49	61.2	113	56.5
Planting method						
Row planting	74	61.7	47	58.8	121	60.5
Broad casting	46	38.3	33	41.2	79	39.5

Source: own survey data, 2016/17 cropping season

Table 4. Farmers' perception of soil fertility and fertilizer use on field pea in Enarj Enawuga and Yilmana Densa districts (n=200)

Interviewed items	Enarj Enawuga		Yilmana Densa		Total	
	n	%	n	%	n	%
Soil fertility status						
Good	23	19.2	7	8.8	30	15
Medium	60	50	48	60	108	54
Poor	37	30.8	25	31.2	62	31
Apply fertilizer						
Yes	103	86	39	48.8	142	71
No	17	14	41	51.2	58	29
Fertilizer type						
DAP	103	86	39	48.8	142	71
No Fertilizer	17	14	41	51.2	58	29
DAP Kg ha^{-1}						
<60	34	33	11	28.2	45	31.7
60-80	69	67	28	71.8	97	68.3

Source: own survey data, 2016/17 cropping season

Table 5. Farmers' criteria of good seed in Enarj Enawuga and Yilmana Densa districts (n=200)

Characteristics	Enarj Enawuga		Yilmana Densa		Total		Rank
	n	%	n	%	n	%	
Seed yield	30	25	9	11.2	39	20	2
Seed size	55	45.8	33	41.3	88	44	1
Seed color	7	5.8	9	11.2	16	8	5
Disease/ insect pest tolerance	11	9.2	10	12.5	21	10	4
Early maturity	17	14.2	19	23.8	36	18	3

Source: own survey data, 2016/17 cropping season

Table 6. Farmers' field pea seed sources in Enarj Enawuga and Yilmana Densa districts (n=200)

Seed Source	Enarj Enawuga		Yilmana Densa		Total	
	n	%	n	%	n	%
Survey Year						
Purchase from farmers	8	6.7	4	5	12	6
Purchase from traders	7	5.8	2	2.5	9	4.5
Purchase from Market	25	20.8	14	17.5	39	19.5

Own stock	75	62.5	54	67.5	129	64.5
Exchange with other crop seeds	5	4.2	6	7.5	11	5.5
Original Source						
Purchase from farmers	9	7.5	4	5	13	6.5
Purchase from traders	0	0	3	3.75	3	1.5
Gift from NGO/research Centre	22	18.3	15	18.75	37	18.5
Purchase from Market	16	13.4	8	10	24	12
Own stock	70	58.3	45	56.25	115	57.5
Exchange with other crop seeds	3	2.5	5	6.25	8	4

Source: own survey data, 2016/17 cropping season

Table 7**.** Farm households' reasons for varietal and seed replacement of field pea varieties in Enarj Enawuga and Yilmana Densa districts (n=49)

	Enarj Enawuga		Yilmana Densa		Total	
Reasons for seed replacement	n	%	n	%	n	%
Susceptible to diseases	15	45.5	7	43.75	22	44.9
Low pest tolerance	5	15.1	4	25	9	18.4
Low yielding capacity	11	33.3	5	31.25	16	32.6
Late maturing	2	6.1	0	0	2	4.1
Total	33	100	16	100	49	100

Source: own survey data, 2016/17 cropping season

Table 8. Farmers' perception of seed security in Enarj Enawuga and Yilmana Densa districts (n=200)

Seed security	Enarj Enawuga		Yilmana Densa		Total	
	n	%	n	%	n	%
Seed insecure farmers	105	87.5	62	77.5	167	83.5
Reasons for seed insecurity						
Drought	9	8.6	2	3.2	11	6.6
Hailstorm	8	7.6	0	0	8	4.8
Seed unavailability	31	29.5	41	66.2	72	43.1
Diseases	21	20	12	19.3	33	17.8
Pests	36	34.3	7	11.3	43	25.7
Suggestion to reduce seed insecurity						
Proper agronomic and pest management	37	35.2	16	25.8	53	31.8
Change varieties	28	26.7	14	22.6	42	25.1
Avail seed through seed production	40	38.1	32	51.6	72	43.1

Source: own survey data, 2016/17 cropping season