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Common Bean (*Phaseolus vulgaris* L.) Seed Systems in West Hararghe, Eastern Ethiopia

Kedir Oshone

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[1]School of Plant sciences (Seed science and Technology) College of Agriculture and Environmental Sciences Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia.

ABSTRACT

Due to limited availability of improved common bean (*Phaseolus vulgaris* L.) seed from the formal sector, smallholder farmers in the Hararghe highlands of Eastern Ethiopia usually rely on farmers managed seed systems (FMSS). However, detailed information on how different seed systems function, the challenges faced and the opportunities exist to design and implement development interventions are generally limited. The objective of this study was to identify common bean seed systems used by small holder farmers in the study areas. A survey questionnaire was used to gather information by interviewing 120 seed producers household heads either under sole or intercrop. Multistage sampling technique was used to select farmers. The collected data were analyzed using descriptive statistics. The results shown that major criteria of farmers' used to select good quality seed were almost similar across districts and respondents for both cropping systems. Regardless of cropping system, farmers used multiple seed sources. For about 57% of farmers', the initial seed stocks were inherited from their ancestors. In 2011 cropping season, informal seed system was the predominant seed source for about 89% of farmers among which own saved seed (39%) was the dominant. Pre- and post-harvest seed handling practices, criteria used to select good quality seed and perception about seed quality were similar among farmers across districts. On the other hand, slight differences were found among respondents for seed sources and storage practices. Creating awareness and building capacity of farmers and other actors on various issues related to seed production, processing and handling of farmers managed seed systems are suggested to boost the production and productivity of the crop in the study areas.

Key words: Cropping systems, Farmer's seed, Intercropping, Seed storage and Seed sources.

*Corresponding author. E-mail: kedirosh@gmail.com.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is an important food grain legume grown in the tropics and sub-tropics. It is grown for its dry seed and edible immature pods and to a lesser extent for green-shelled beans (Onwueme and Sinha, 1991). Common beans are abundant and relatively cheap sources of protein that have high market value in the world (FAO, 1982). Information on how small-scale varieties (Sperling, 1994; Sperling et al., 1996; David, 2003). Yet, worldwide, local seed systems are poorly understood and few empirical studies on this topic exist (Cromwell, 1990, Almekinders et al., 1994). Seed is a key input for improving crop production and productivity.

Increasing the quality of seeds can increase the yield designing appropriate mechanisms for the delivery of new farmers obtain, manage and share seed is crucial for crop potential of the crop by significant folds and thus, is one of the most economical and efficient inputs to agricultural development (FAO, 2006). Despite the release of several

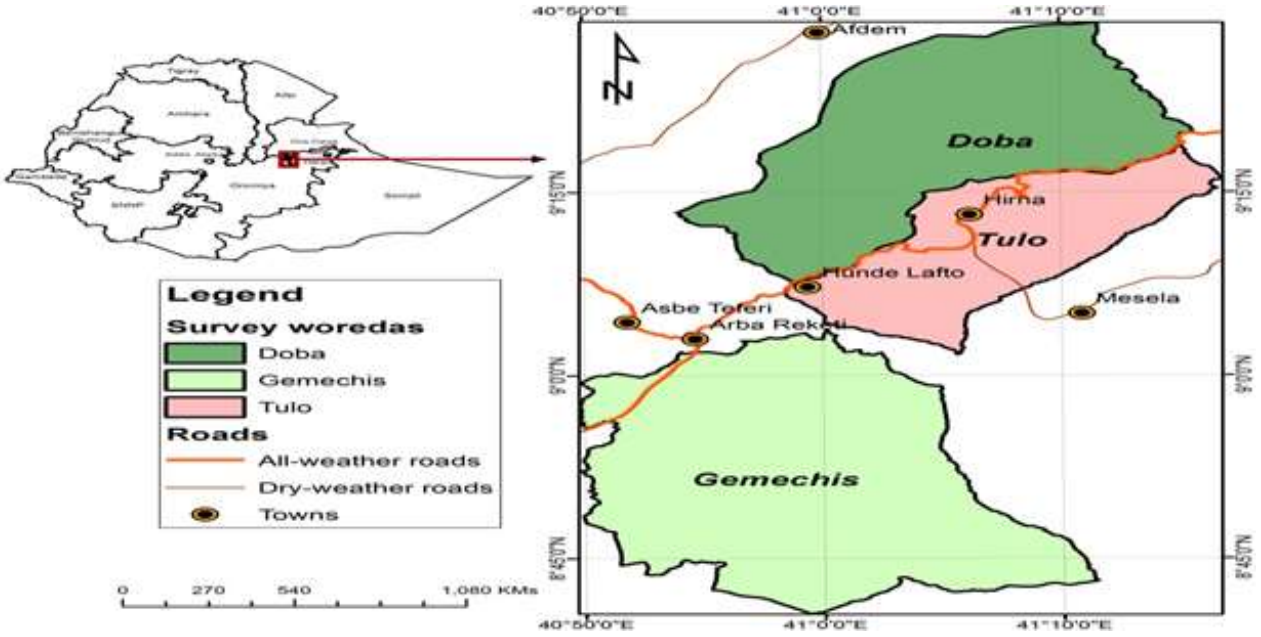

Figure 1. Map locating the study districts in West Hararghe Zone, Eastern Ethiopia.

technologies, particularly of improved seed crop varieties, there has been limited use of improved seeds by the majority of farmers in Ethiopia (CSA, 2010). Well-functioning seed system, providing the farmers with improved seeds of varieties of their choice is of paramount importance.

In Ethiopia, the informal seed system is still the dominant system to deliver seeds of important food security crops including common beans. It is the system in which farmers select their seed crops and varieties, produce their own seeds, and/or locally exchange and purchase grains for seeds from local markets. The formal seed system aims to supply adequate amounts of seed of high quality, at the right time and place with the reasonable prices. The share of the formal seed system is estimated to be about 10 to 20% while the remainder (80 to 90%) is from the informal seed system (Thijssen et al., 2008). The common bean is an important food and cash crop for most Ethiopian farmers', particularly in Hararghe highlands. However, farmers in the area often face major challenges in retaining and accessing improved quality seed due to erratic rainfall in most areas and lack of reliable improved seed producers and/or suppliers. Due mainly to shortage of land, considerable number of farmers in the Hararghe highlands of Ethiopia produce common bean seed under intercrop cropping system. However, detailed information on how the different common bean seed systems function in the area, the challenges faced and the opportunities that exist to design and implement research and development interventions are generally lacking. This study was, therefore, carried out to identify existing common bean seed systems and their bottlenecks, and seed production and post-harvest management practices followed by smallholder farmers in the area.

MATERIALS AND METHODS

Description of the Study Sites

The study was conducted in selected Kebeles of Tulo, Doba and Gemachis Districts during 2011 main cropping season in West Hararghe Zone of the Oromia Regional State, Eastern Ethiopia. The altitude of the three woredas ranged from 1400 to over 2800 masl (DARDO, 2011). The topography consists of complex features of landscape comprising of flat to gentle slope, gorges, hilly and mountainous areas. The soil types are mainly black loam dominated by vertisols. The sites are characterized by a bimodal rain fall pattern with annual rain fall ranged from 650 to 1300 mm. There are two cropping seasons, Belg (March to May) which is light rain season and Meher (June to September) which is main rainy season. The mean annual minimum temperature is 16ºC while the mean annual maximum temperature is 28ºC with an average temperature of 22ºC (DARDO, 2011) Figure 1.

Sampling Techniques

A multi-stage sampling procedure was used to select administrative units from the higher to the lower levels with a common bean seed producing farmers being the respondents. Sampling involved the selection of Districts, Kebeles and common bean producers or farmers in one

Kebele per District. First stage districts were selected through purposive sampling. Second stage: Kebeles was selected through simple random sampling after listed from the list based on the agro-ecology, common bean production and accessibility. Third stage: 120 household heads were randomly selected from out of the 597 bean producers of the three selected districts of Western Hararghe Zone for the interview purpose. One hundred twenty (120) common bean growers consisting of 36, 48 and 36 from Tulo, Doba and Gemechis Districts, respectively were involved in consultation with development agents and Kebeles' leaders for interview.

Data Collection

Data collection was based on interviews collected from 120 respondents through multistage sampling technique. Set of questionnaires used for interview varied from demographic and socio-economic characteristics of respondents which included; sources of seed, farmers' perception about seed quality, quality seed production and processing, seed selection criteria used by farmers, seed production and post-harvest handling practices, and factors limiting demand and supply of quality seeds. Personal observations of fields and seed stocks were also made as part of the qualitative information appraisal procedure. Triangulations were done to validate collected information using different means and also to look into the same matter from different angles and to include the views of the community from different perspectives. Finally, Secondary data were gathered and validated from different government agencies namely: records and reports of Central Statistical Agency and districts Agricultural and Rural Development Offices data sources to support the present study.

Data Analysis

Descriptive statistics (mean, standard deviation, percentages, frequency and cumulative percentages) were used to analyze primary data collected through household baseline survey using Statistical Package for Social Sciences (SPSS) version 17.0.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Demographic characteristics on the development of technologies in agricultural production practices have their own impact. Out of the 120 respondents, 88 and 12% were men and women, respectively. The average age of the respondents was 39 which ranged from 21 to 67 years old. About one-third of the respondents have 10 to 15 years of experience growing common bean seed/ grain. Farmers with long farming experience appear to have often full information and better knowledge to evaluate the systems and districts, 69% of respondents' had educational background ranging from adult education to high school whereas the remaining 31% were illiterate.

Households Resource Base

Farmers in the study area produce common bean seed/ grains under sole or intercropped with coffee, sorghum, maize and chat. Farmers' undertake different pre and post-harvest seed management practices to obtain good quality seeds and high yield. On average, common bean fields are ploughed twice before planting and two hand weeding are carried out before the crop attains flowering stage. Common bean is produced both during short (*Belg*) and main (*Meher*) seasons. During the Belg season, it is sown mainly through broadcasting and occasionally through row planting (when practicing sole cropping system). Average land holding size per household is 0.55 ha, out of which 0.29 and 0.26 ha are allocated to bean production under intercrop and sole crop systems, respectively (Table 1). In the similar way, reported that intercropping system is important for intensification of crop production and contributes to increased returns to smallholder farmers in the highlands of Hararghe having limited land holdings (CACC, 2001).

Common Bean Seed System and Sources in the Study Area

Seed system is the methods of producing seeds by different producers with or without having technical knowledge's to the availability and potential sources of seed supply. The formal seed system aims to produce and supply adequate amounts of seeds of high quality, at the right time and place with reasonable prices. From initial to 2011 cropping season very few farmers obtained seed from formal seed source (DARDOs). Varieties commonly growing in Ethiopia are several and various based on agro-ecology, market value and consumption manners. The most two preferable and popular commonly growing common bean seed varieties used by farmers in the area were Awash-1 and Mexican-142. Both varieties are similar in color (white) and shape whereas different in size. In 2011 cropping season, among the seven seed sources six of them were from informal seed system (89%) prevails resulting to the poor quality and relatively higher quantity seeds with deprived seed supply channel system (Table 2).

The two major seed sources used by majority of respondents in 2011 cropping season were own saved (39%) and purchased from local markets (29%) (Table 2). Similarly, bean seed system in Kenya is largely informal (Katungi et al., 2010). Farmers obtained common bean seed from different sources including own saved, neighbors, other farmers', relatives, local markets, traders,

Table 1. Major crops grown and an average of land allocation in cropping systems with frequency, mean and standard deviation (N=120).

Crops Produced In The Study Sites	Cropping Systems And Average Of Covered Area (ha)							
	Intercrop HHs (n=96)				Sole crop HHs (n=24)			
	Freq.	Perc.	Mean	SD	Freq.	Perc.	Mean	SD
Maize	88	92	0.13	0.16	22	92	0.27	0.11
Common bean	96	100	0.66	0.32	24	100	0.53	0.39
Sorghum	96	100	0.53	0.39	24	100	0.28	0.18
Sweet potato	29	30	0.17	0.13	8	33	0.27	0.11
Chat	71	74	0.28	0.18	13	54	0.23	0.18
Teff	37	39	0.22	0.12	7	29	0.17	0.13
Wheat	46	48	0.23	0.19	9	38	0.28	0.26
Barley	24	25	0.18	0.14	7	29	0.19	0.17
Coffee	52	54	0.28	0.26	10	42	0.17	0.13
Faba bean	36	38	0.19	0. 17	6	25	0.18	0.14
Total average			0.29				0.26	

† Do not add up to 100 because of multiple responses, SD=Standard deviation, Freq. = Frequency, Perc. = Percentage, HHs= house hold heads, N= number of farmers.

Table 2. Sources of seeds for respondents in successive four cropping seasons (N=120).

Sources of seeds	Respondents seeds sources in successive four years			
	Initial	2008/2009	2009/2010	2010/2011
	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
Own saved	14 (11.67)	32 (26.67)	30 (25)	47 (39.17)
Relatives	11 (9.17)	8 (6.67)	11 (9.17)	3 (2.5)
Neighbors	5 (4.16)	9 (7.5)	9 (7.5)	7 (5.83)
Other farmers	3 (2.5)	15 (12.5)	10 (8.33)	10 (8.33)
Gift from parents	68 (56.67)	7 (5.83)	8 (6.67)	5 (4.17)
Local markets	13 (10.83)	37 (30.83)	36 (30)	35 (29.17)
MOA/DARDO	6 (5.0)	2 (1.67)	4 (3.33)	13 (10.83)
Research centers	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Traders	0 (0.0)	8 (6.66)	10 (8.33)	0 (0.0)
ESE	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Cooperatives(Unions)	0 (0.0)	0 (0.0)	2 (1.67)	0 (0.0)
NGOs	0 (0.0)	2 (1.67)	0 (0.0)	0 (0.0)

† Freq. = Frequency, N= number of farmers.

gift from parents, MOA/ DARDOs, NGOs and farmers' Importance of improved technologies. Across cropping cooperative unions (Table 2). In the similar way, in Kenya most small scale farmers' plant farm saved bean seed that are saved from previous harvest, borrowed from neighbour or purchased from local markets (Opole et al., 2006; Makelo, 2010). Among various initial seed sources, majority of the farmers (57%) have obtained the initial seeds as a gift from their parents. In the 2008/2009 cropping season, local markets (31%) and own saved seeds (27%) were the major sources of seeds for farmers in the area (Table 2). Similarly, studies in Eastern Africa showed that a historical decline in the amount of seed bean farmers obtain from other farmers and suggest some degree of correlation between commercialization and gift giving (Sperling and Loevinsohn, 1993; David and Sperling, 1999; David, 2003).

Farmers Criteria of Good Quality Seed

The study has identified many technological and socio-economic factors affecting the production of high quality seeds by farmers. Intercropping common bean seeds with other crops is traditional practice in the study area as strategies for crop diversification, resource use maximization, shortage of farm land, disease control and/or maintenance of household food security. Among the several seed and plant attributes, seed yield, food quality (taste while eat as roast and wot), marketability, disease resistance and drought tolerance are the most important characters considered by farmers in choosing bean varieties (Table 3). Importance of these traits in the development and dissemination of improved common bean varieties are further asserted by key informants interviews (KII) such as NGOs, Development agents (DAs)

Table 3. Farmers' criteria to select good quality seed by cropping systems, frequency and percentage.

Farmer's seed selection criteria	Intercropping		Sole cropping		Both systems	
	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
Seed size	57	59	6	25	63	53
Seed/Grain yield	89	93	22	92	111	93
Seed color	72	75	9	38	81	68
Food quality	87	91	21	88	108	90
Marketability	82	85	20	83	102	85
Early maturity	62	65	14	58	76	63
Disease tolerance	86	90	19	79	105	88
Good quality (intact seed)	61	64	15	63	76	63
Drought tolerance	80	83	16	67	96	80
Shattering tolerance	76	79	15	63	91	76
Climbing ability	64	67	19	79	83	69

† Do not add up to 100 because of multiple responses, Freq.= Frequency, Perc. = Percentage.

Table 4. Perception of respondents about seed quality (own saved (N=47)) and time of seed selection.

Farmers' perception about seed quality	Own saved seed users	
	Frequency	Percentage
Colour/plumpness	27	58
Free from weeds or other crops	47	100
Good quality (intact seed)	42	89
Big seed size	21	445
No disease/insect damage	47	100
No mixture of the other varieties	46	98
No. broken seeds	37	79
Seed selection time	Frequency	Percentage
Select plots (pre harvest)	7	15
Select plants (pre harvest)	9	19
Select pods (pre harvest)	4	9
Select seeds from balked (post-harvest)	27	58

† Do not add up to 100 because of multiple responses, N= number of farmers.

and District Agricultural experts and researchers operating in the area.

Perception about Seed Quality

Majority of the farmers did not recognize the difference between seed and grain crops. Even though limited awareness creation has been giving to farmers by woredas agricultural extension on perception of seed quality most of them have used indigenous knowledge to select good quality seeds at different selection time. Quality seed means seeds having high physical and genetic purity, physiological quality and free from associated seed-borne pathogens when tests carry out at laboratory and field based on the working seed samples taken from seed lots or fulfills the national seed quality standard. However, most of the farmers did not link their perceptions about seed quality to the physical purity components, physiological quality and health test of the seeds (Table 4). According to Cromwell (1990) and Tripp and Van der Burg (1997) seed quality is a sum total of many aspects including genetic, physical purity and physiological quality. Farmers who usually keep own saved seed select their good quality seed through critical observation of the seed, select seed plot or section of seed plots which performed well on the field as well as select plants which contain high number of pods per plant and big seed size (Table 4).

Post-Harvest Seed Handling Practices

Seed growers generally carry out pre- and post-harvest seed management practices aimed at improving quantity and quality of the seed. Common bean post-harvest seed management operations practiced by farmers are harvesting, threshing, cleaning, germination test, treating and storing separately from food grains (Table 5). Traditional methods of seed treatment include dressing the seed with ash and hot pepper powders to control storage pests, particularly in Doba and Tullo districts. In Gemechis

Table 5. Post-harvest seed handling and seed treatments practiced by farmers for own saved seed (N= 47) in the three districts.

Post-harvest seed handling practices	Name of Districts							
	Gemechis		Doba		Tullo		Total	
	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
Cleaning seeds	16	100	16	100	15	100	47	100
Select seeds from pods	3	19	8	50	6	40	17	36
Storing seed separately	13	81	15	94	14	93	42	89
Checking seed germination	1	6	14	88	10	67	25	53
Seed treatments	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
Mixed seed with ash and powder of peppers	-	-	5	31	2	13	7	15
Treat seed with phospho-toxin tablets	8	50	-	-	-	-	8	17

† Not add up to 100 because of multiple responses, Freq. = Frequency, Perc. =Percentage, N= number of farmers.

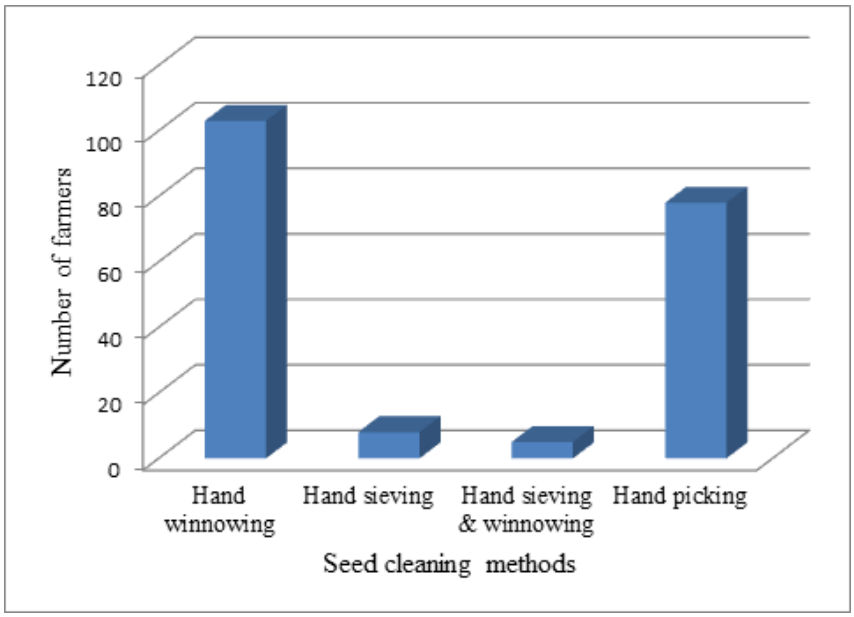

Figure 2. Seed cleaning methods used by smallholder farmers in the study area.

district, nearly half of the farmers who keep own saved seed use phospho-toxin tablets to control storage pests. Even though the rate and frequency of application are not based on research recommendations, treated seeds were less damaged by insects than untreated seeds.

Seed Cleaning Methods

Seed cleaning is practice used by farmers manually to improve the physical purity of the seed by removing inert matters, weeds and other crop seeds, broken seeds, diseased/ insect damaged seeds and other particles from seed. Majority of the farmers clean their seeds by hand-winnowing (N=103) during threshing and at planting time whereas hand-picking (N=78) ranked as second common practice of seed cleaning during planting. Few farmers also use both hand sieving and winnowing (N=5) and only hand sieving (N=8) methods to clean their seed for marketing, planting and consumption purposes (Figure 2). Several farmers also use more than one seed cleaning methods immediately after threshing or before planting.

Lengths of Seed Storage

Majority of farmers uproot dried common bean plants and heap in bundles in the field for a brief period until seed moisture content decreases to allow threshing. After threshing, seed is stored using different storage structures for varying period of time. Occurrence of storage pests' increase as storage period increase, particularly when seeds are not treated. Majority of own saved seed farmers store their seeds for a period of three to six months (N=25) while few of them keep for as long as 11 months (N=3) to ensure seed security if in case failure of early planted crop occur (Figure 3). Also a small number of farmers store their seed less than three months (N=9) and six to ten months (N=10) to use seed for marketing, consumption and planting purposes (Figure 3). Most of the farmers stored

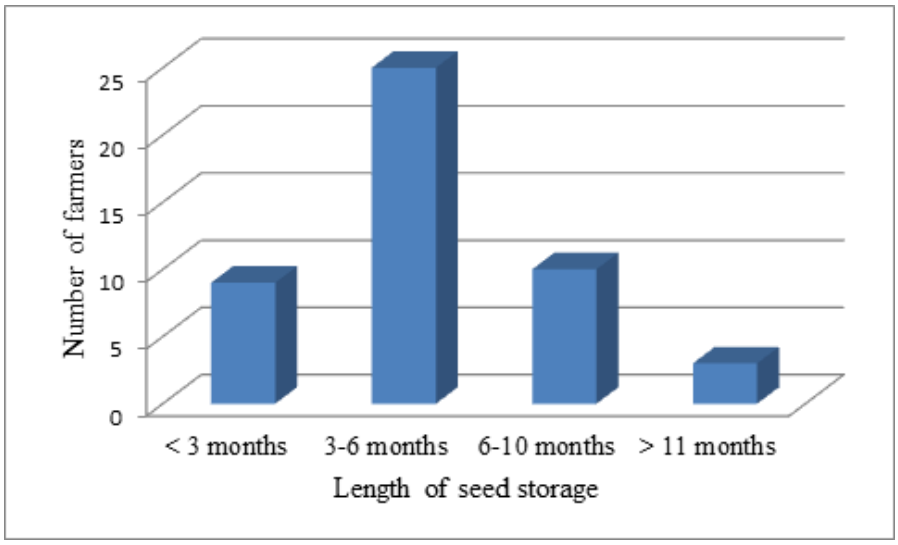

Figure 3. Seed storage duration practiced by farmers (own saved seed) in the study area.

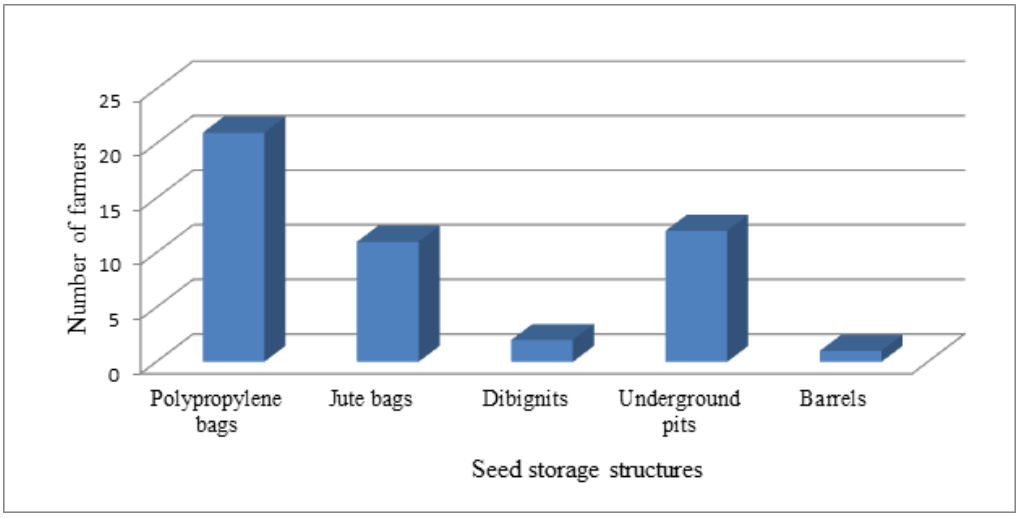

Figure 4. Storage structures used by smallholder farmers (own saved seed) in the study area.

their seed for three to six months because majority of them have low income and sold their seed when shortage of money faced and money is required for different social and economical events whereas the left consumed as roast or wot without focusing on the source of seed for the subsequent cropping season. Farmers often mentioned that the risk of seed loss is high due to poor storage facilities used and when storage period is longer.

Seed storage Structures

Seeds stored in the poor storage structures often contribute to seed insecurity, particularly in a situation where appropriate seed care is not made and the dry season is too long. Immediately after threshing, common bean growers store their seeds using different storage structures such as Jute bags (N=11), Polypropylene bags (N=21), Underground pits (N=12), Dibignits (4%) and Barrels (N=1) (Figure 4). Dibignits are storage structures made up from fresh/ wet cow dung used in the rural area of country that is similar with barrel. Majority of own saved seed farmers use polypropylene bags as it is widely available in the local markets and is also relatively cheaper whereas farmers using underground pits ranked in the second place.

CONCLUSIONS

Common bean growers in West Haraghe zone of Eastern Ethiopia generally source their seeds primarily from informal sources such as own saved, from relatives and

neighbors, or purchase from local markets. Improved common bean seed from the formal sources is rarely available in the study areas. Among the many varieties introduced, adopted and released in the country Mexican-142 and Awash-1 (both small white pea types) were are the most familiar varieties among farmers in the area. In the farmers managed seed production processes farmer often one or more pre and/or post-harvest practices even though the frequency and quality of practices vary across districts and respondents. These variations could be attributed to several factors such as the differences in the level of awareness among farmers as a consequence of capacity development interventions implemented by districts and grass root level extension officers. Production and distribution of quality seeds by formal seed actors in the area is very limited. Therefore, the study recommended that the government should be emphasized on the quality seed multiplication, commercialization and distribution through public and private seed enterprises, farmers' cooperative unions and model farmers to increase the availability and accessibility of improved seeds in bean growing regions of the country including West Hararghe zone. Moreover, detailed information is required on a number of issues including how farmers seed network operate, quality control and assurance system, seed storage conditions, agro-ecological effect on seed quality, perception of seed quality and actions to be taken to improve good quality seed required for different locations.

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