Adoption Study of Improved Barley Varieties in Ethiopia

Draft Report

Ethiopian Institute of Agricultural Research (EIAR)
International Center for Agricultural Research in the Dry Areas (ICARDA)

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ACRONYMS

CSA	Central Statistical Authority
EIAR	Ethiopian Institute of Agricultural Research
FGD	Focus Group Discussion
FDRE	Federal Democratic Republic of Ethiopia
FTE	Full Time Equivalent
GTP	Growth and Transformation Plan
HH	Household
ICARDA	International Crops Agricultural Research for Dry Land Areas
NGO	Non-governmental Organizations
PA	Peasant Association
SNNPR	Southern Nations Nationalities and People's Region

1. INTRODUCTION

Poverty eradication is the fundamental development agenda of the government of Ethiopia. In response to this, all the development policies and strategies of the country are oriented towards the achievement of this goal. It is anticipated that effective and efficient implementation of these development polices and strategies using integrated and coordinated approaches is fundamental for eradicating poverty and dependence on food aid.

Agricultural development, in Ethiopia, is the basis for eradicating poverty and ensuring food security. It is also the basis for promoting the development of other sectors of the economy. As a step forward, Ethiopia has set-up a five year (2010/11 – 2014/15) Growth and Transformation Plan (GTP) with a vision of building an economy which has a modern and productive agricultural sector with enhanced technology. One of the seven strategic pillars of GTP is also maintaining agriculture as a major source of economic growth (FDRE, 2010). Therefore, agriculture has been one of the sectors which received special attention for targeting in the GTP period.

In the GTP period, more focus has been directed towards agriculture sector and it has been targeted that the growth of agriculture sector should be doubled. Integrated and coordinated efforts of the key development actors, such as governmental, non-governmental and international organizations are believed to be crucial to head towards achievement of the set development goal. In response to this fundamental development call, Ethiopian Institute of Agricultural Research (EIAR) and International Center for Agricultural Research in the Dry Areas (ICARDA) are endeavoring to contribute their best in enhancing agricultural productivity and addressing food insecurity concerns in Ethiopia.

Within the agricultural sector, cereals are among the important commodities that contribute to food security significantly. Available estimates indicate that cereals account for roughly 60% of rural employments, 73% of total cultivated land, more than 40% of a typical household's food expenditure, more than 60% of total caloric intake of a typical household in the country, and 30% of GDP (Shahidur and Asfaw Negassa, 2011, Diao *et al*., 2007). Among the cereals, barley is one of the top five crops in terms of production. CSA (2012) estimates indicate that about 1.6 million tons of barley was produced in the last three years (2008 – 2010) with per capita availability of 20 kg/annum (Table 1). In the last ten years (2000 – 2010), barley production grew at an average rate of 12% per annum while its area grew at an average annual growth rate of 6% (Figure 1). The growth in production is largely attributed to the use of productive improved varieties of barley and associated packages.

Table 1. Production and per capita availability of major crops, an average of three years (2008 – 2010).

Crop	Average production (tons/annum)	Per capita availability of production (kg/annum) Population=80 million	% share
Maize	4229500	52.9	28
Tef	3213800	40.2	21
Sorghum	3181300	39.8	21
Wheat	2788100	34.9	19
Barley	1619300	20.2	11
Total	15,032,000	187.9	100

Source: CSA (2010)

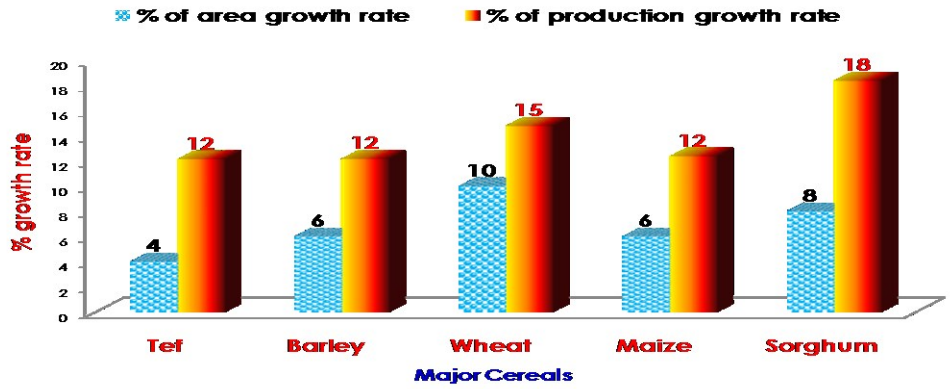

Figure 1. Growth rate of area and production of major cereals, 2000 – 2010.

To enhance production and productivity of barley, national agricultural research systems together with international organizations, such as ICARDA and others, has been executing several years of barley research in Ethiopia. These endeavors have eventually effected to generation of several types of improved barley varieties that are high yielders, disease resistant and widely adaptable. Several of these varieties have been disseminated and promoted to the farmers through various channels of extension. Despite of such relentless efforts for years, there is no adequate information on the status of adoption and utilization of improved barley varieties in the country, in general. Future development planning and research programming will then suffer from lack of up-to-date information on the status of adoption of improved barley varieties and associated packages. As a result, this study was initiated and implemented in the major barley growing regions of the country with the purpose of analyzing the data, synthesizing the information and generating a report mainly on the adoption status of improved barley varieties.

2. Methods and Approaches

Different approaches were utilized in this study for estimation of adoption status of improved barley varieties. These included household survey, assessment of community perceptions and expert estimation. These three approaches were applied at a time during the study all of them to estimate adoption status of improved barley technologies.

2.1 Desk Review

In addition to questionnaire based data collection, desk review was also made for relevant literature. The national trends on barley area and production were exhausted from CSA statistical records. Other related information on adoption were also reviewed from published articles.

2.2 Household survey

This approach used a standard survey methodologies embracing different tools and techniques. A structured and pre-tested questionnaire was developed to collect quantifiable data from randomly selected households. Trained enumerators were also used to administer and fill the questionnaire through direct interviews of respondent households. The sample selection technique was made by applying standard scientific methodologies, such as stratification, random selection and others. Accordingly, three regions, 22 zones, 38 districts, 112 kebeles and 1198 households were selected for the study (Table 2). Out of the total respondent households, almost all of them (98%) were heads of a household, either male headed or female headed household.

Table 2. Sample sizes of zones, districts, kebeles and households for adoption study of barley in Ethiopia, 2010.

Region	No. of zones	No. of Districts	No. of Kebeles	Sample Households	
				n	%
Amhara	7	13	39	410	34.2
Oromiya	6	14	40	447	37.3
SNNPR	9	11	33	341	28.5
Total	22	38	112	1198	100

2.3 Community Perception Assessment

The study has also captured perceptions of the community on the adoption status of improved barley varieties in addition to the estimate made through household surveys. One focus group discussion (FGD) was held per kebele with community leaders and key-informants. Therefore, a total of 112 FGDs were held for assessment of community perception. Community

questionnaire was used to collect the required data through facilitation of team leaders and supervisors.

2.4 Expert Estimation

In this approach, experts embracing mainly of barley breeders from Ethiopian were involved in making estimations of the adoption status of improved barley varieties at zonal levels. An expert questionnaire was also used to capture the estimates made by experts through facilitation of supervisors.

The reason for adopting three approaches to respond for a similar question on the adoption status of improved barley varieties was to make comparisons and assess the extent of divergence on the average estimates. This means that the study is not only making adoption estimates, but also doing research to identify effective and less costly approaches in adoption studies of such a kind.

2.5 Data Analysis and Information Synthesis

The data collected was analyzed using appropriate analytical tools, such as SPSS, STATA and Excel. Data cleaning process was largely employed to ensure validity of figures and data quality. Descriptive statistics was largely employed to summarize and generate the information. The information was presented through descriptions, Tables and Graphs.

This report presents the information the study in 11 sections embracing various sub-sections. The first section deals about introduction revealing the focus of the government on agriculture sector and the roles of national and international institutions towards contributing to the national development goal. The second section was devoted to presentation of brief methodologies and approaches employed in the study. Barley production and research status in the country has also been briefly illustrated in section three. Section four is about selected household characteristics which are believed to have close association with adoption status of households. Section five was largely devoted to presentation of information about farmers' knowledge of improved barley varieties, essential attributes preferred from barley varieties, sources of improved varieties and other perspectives. The information in this section is believed to have close links with adoption status of barley technologies. Information related to household level adoption of improved barley varieties have been largely presented in Sections 6 – 9. The different approaches employed in the study and comparisons between them have also been revealed in these sections. Section 10 depicts brief summary and conclusion of the study while section 11 briefly illustrates some of the references reviewed.

3. National Barley Research and Production Status

Barley is one of the major cereal crops in Ethiopia in terms of area and production. As revealed in Figure 2, barley stands at fifth rank in terms of area with 1.03 mil ha next to tef (2.56 mil ha), maize (1.79 mil ha), sorghum (1.63 mil ha)and wheat (1.52 mil ha). It also stands at fifth rank in terms of production. The last five years' (2006 – 2010) average production of barley was 1.54 million tons. In the recent year of 2010, barley production was reported to be 1.7 million tons produced from 1.05 million ha of land (Table 3).

Three decades barley area and production trend exhibited slower growth rates over years averaging 2% and 3%, respectively (Figure 3). This might be due to shift of farmers from production of one type of cereal to another in response to several factors, such as availability of improved crop variety seeds, market demand and others. This was further illustrated in Figure 4, where barley revealed the least trend in production of the last three decades. Other major cereals usually occupy large area of land than barley and this has contributed for large production over years.

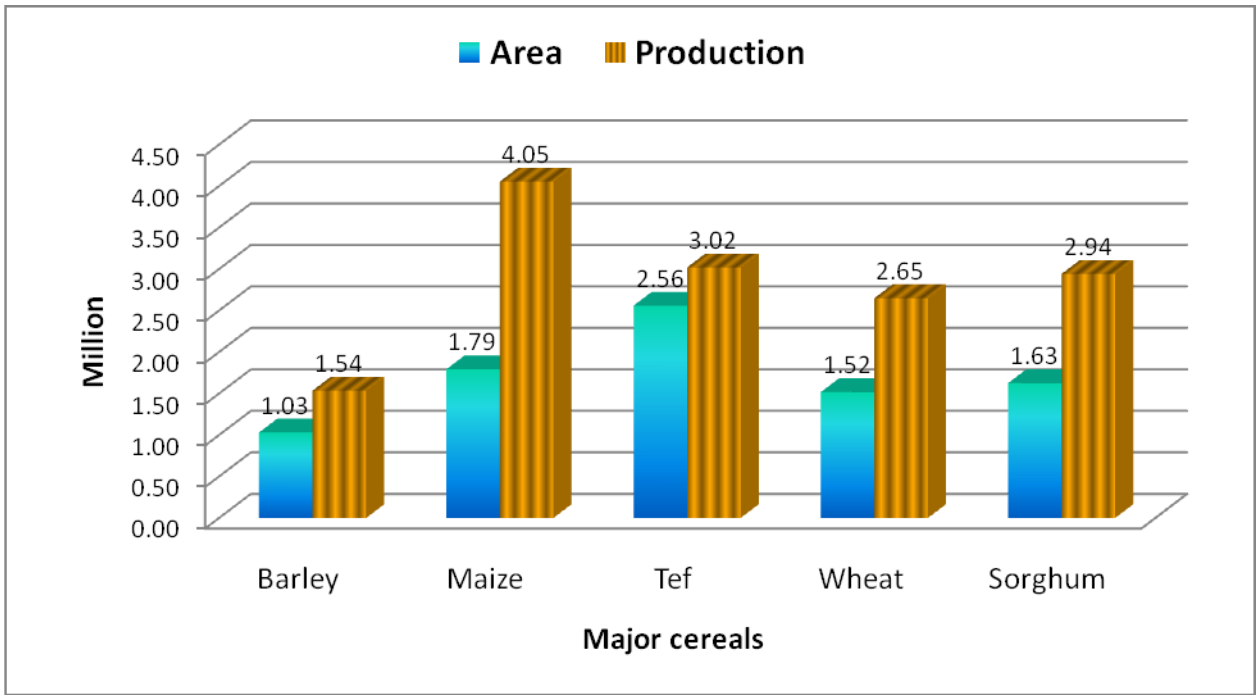

Figure 2. Area ('mil ha) and production ('mil tons) of major cereals in the last five years, 2006 – 2010.

Table 3. Area, production and yield of cereal crops in Ethiopia (2010/11 production season)

Crop	Number of small holders (million)	Area (million ha)	Production (million tons)	yield (ton / ha)
Barley	4.15	1.05	1.70	1.60
Maize	7.96	1.96	4.98	2.54
Teff	6.24	2.76	3.48	1.30
Wheat	4.59	1.55	2.85	1.84
Sorghum	5.10	1.89	3.95	2.09

Source: CSA (2011)

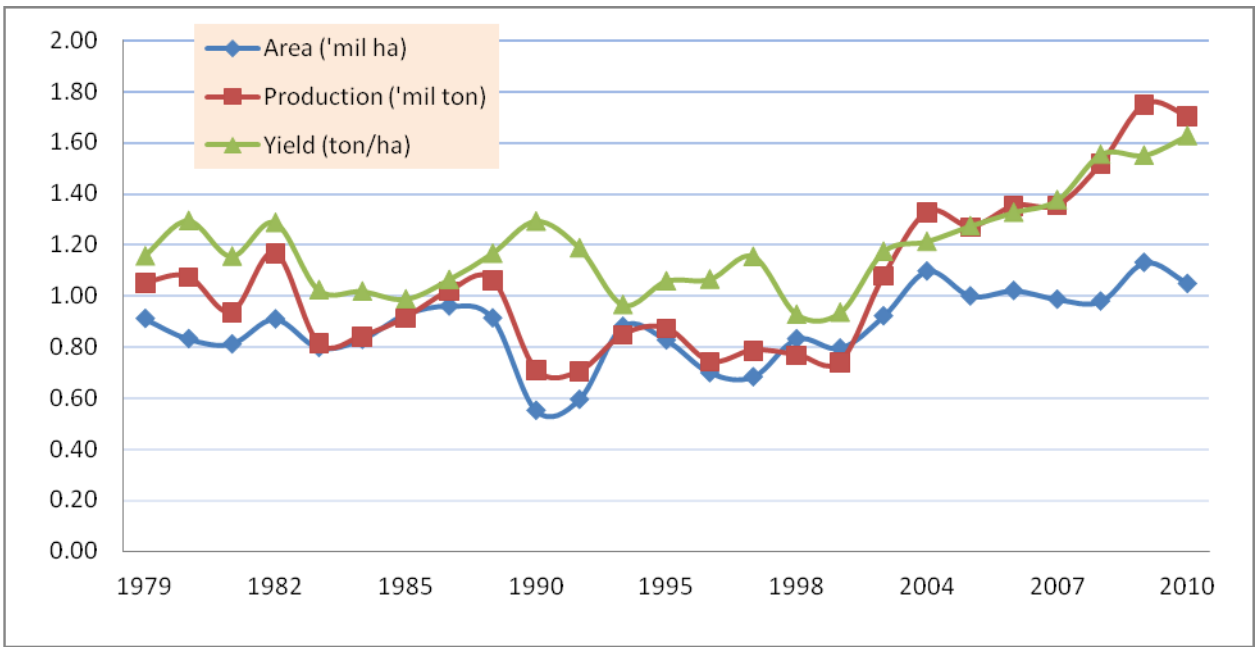

Figure 3. Area, production and yield trend of barley in the last three decades, 1980 – 2010.

Source: CSA (1980 – 2012)

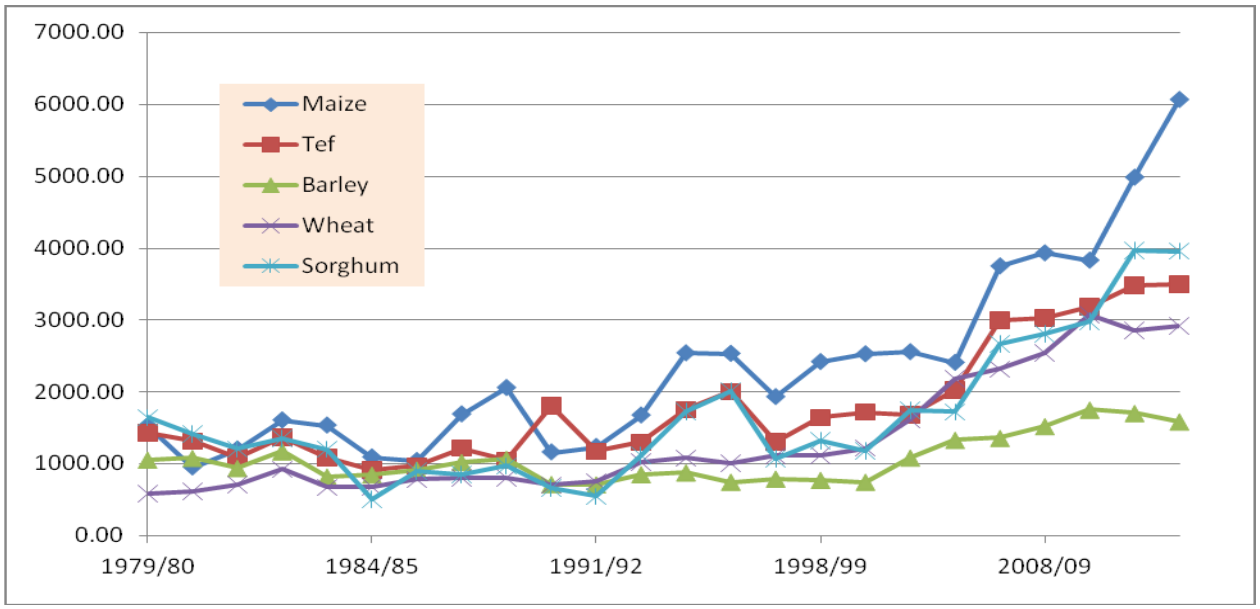

Figure 4. Production ('000 tons) growth trends of major cereals in the last 3 decades, 1980 -2010

Source: CSA (1980 – 2012)

It is believed that the Ethiopian Institute of Agricultural Research (EIAR) is the strongest research institute in East Africa with full time equivalent (FTE) scientists working on barley. It was noted that Ethiopia has relatively engaged considerable numbers of scientists for barley breeding, entomology, agronomy, pathology and seed production as compared other East African countries, such as the Sudan and Eritrea. The establishment of a new Bio-technology lab facility in Ethiopia has also been believed to be prominent in East Africa.

With respect to staff profile working on barley research program, Ethiopia was observed to have less numbers of staff on senior level positions, such as PhD and MSc (Figure 5). In spite of this, Ethiopian Institute of Agricultural Research has generated and released more than 25 varieties of improved barley (Figure 6). Especially, the largest stride was made in the 2000's during which 18 improved varieties were released in the years 2001 – 2010.

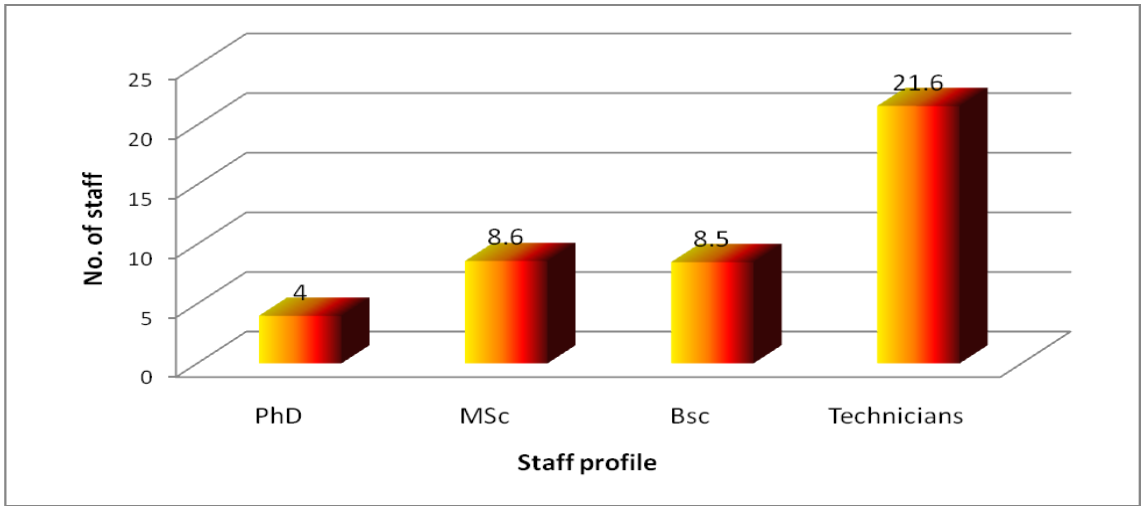

Figure 5. Full time equivalent staff by education working on barley in Ethiopia, 2010.

Source: Yigezu et al. (2010)

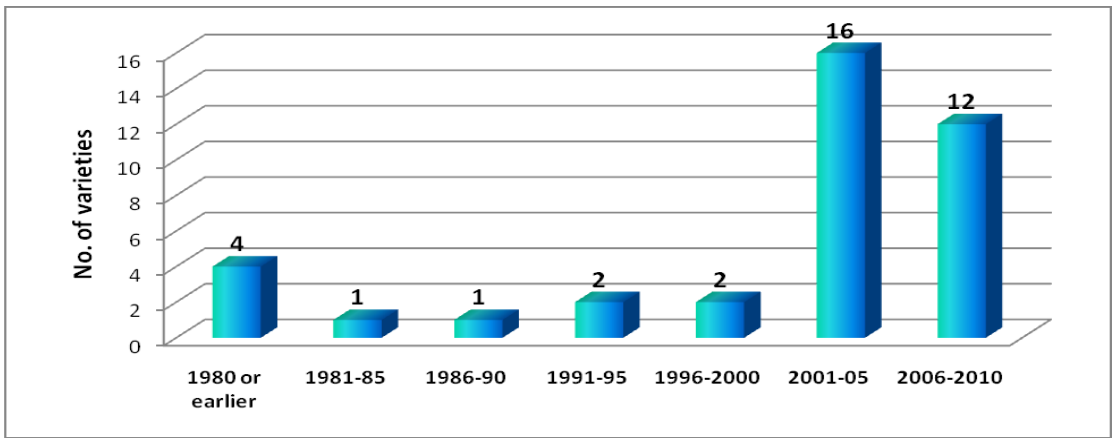

Figure 6. Number of varieties released in Ethiopia since commencement of barley research program

Source: Yigezu et al. (2010)

4. Selected Household Characteristics

4.1 Educational level of the Community

The findings indicate that literacy level of the overall sample respondents was 73%. Among the literate households, the proportion was relatively higher for Oromiya Region (29%) than other regions (Figure 7). Among the literate households (Figure 8) most of them (26%) have attended second cycle education (grades 5 – 6) followed by 22% of the households who attended first cycle education (grades 1 – 4).

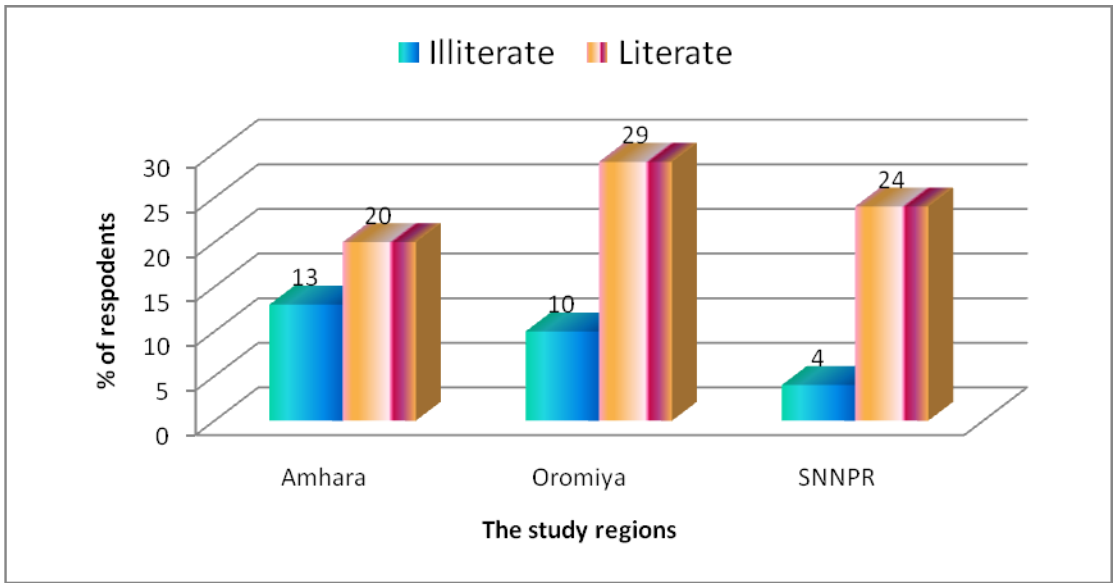

Figure 7. Literacy level of sample households in the study regions, 2011.

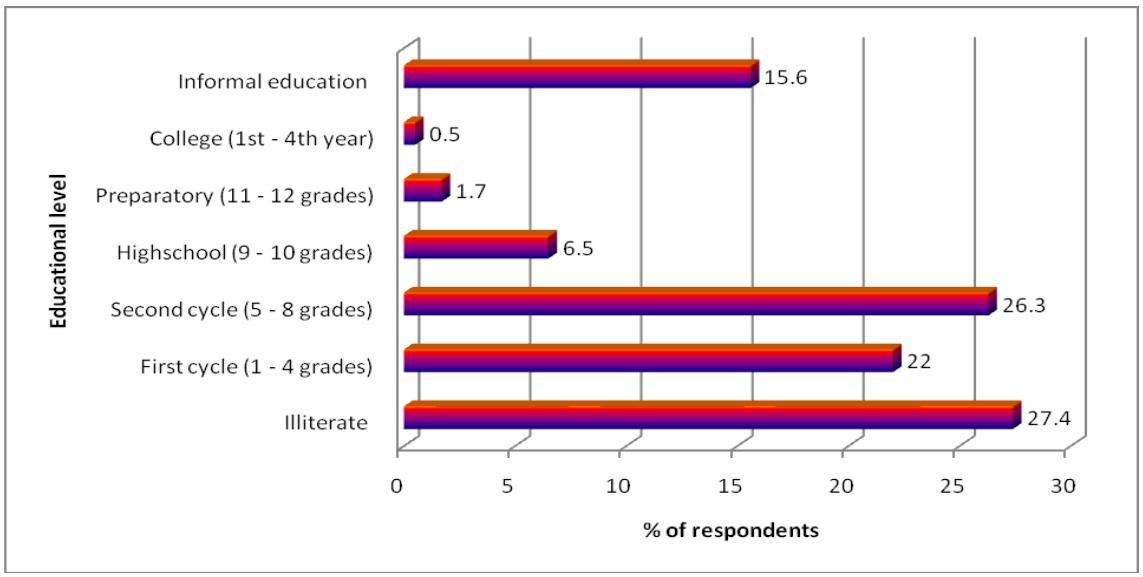

Figure 8. Educational level of sample respondents in the study regions, 2011.

Evidence from various sources indicates a positive relationship between the educational level of the household head and the adoption behavior of farmers (Norris and Bati, 1987; Igoden et al., 1990; Lin, 1991). Yirga et al. (1996) has also reported a positive association between literacy and adoption behavior. These studies underlined that farmers with literacy and higher levels of education are more likely to adopt different types of agricultural technologies than those who do not.

In general, the implication of educational status of the community is that appropriate intervention strategies and extension services need to be designed accordingly based on educational levels of both men and women community members. For instance, for those who are literate, pamphlets, production manuals, posters, different types of printed materials can be prepared and distributed in local languages. During capacity building programs, class room based trainings, presentations and participatory brainstorming sessions can also be held for these categories in addition to practical demonstrations. On the other hand, for illiterate ones, more focus can be given for practical demonstrations and on-the-job visual approaches, such as videos of successful farming practices, interactive discussions, experience sharing visits, on-the-job skill based trainings and other action based programs.

4.2 Occupations of Rural Households

Rural households are engaged in different types of occupations to support their livelihoods. The main occupation of female respondents was farming (74%) followed by different types of domestic activities (21%). Similarly, 96% of men were engaged in farming as their main occupation. In addition to main occupations, rural households are also engaged in different

types of off-farm activities to generate supplementary incomes. For instance, 11% of women respondents were engaged in various types of off-farm activities while this proportion was 19% for men.

5. Farmers' Knowledge of Improved Barley Varieties and Attributes

5.1 Experiences of Farmers in Growing Improved Barley Varieties

Despite farmers largely depend on growing of local varieties, they have also developed experiences of growing improved barley varieties especially since the last 10 years. According to the overall sample, 39% of the farmers claimed that they had experiences of growing improved barley varieties in the last 10 years (Table 4). Significant regional disparity was also noticed on the proportion of farmers with experiences of growing improved barley varieties. It was reported that a large proportion of farmers in Oromiya Region (62%) have experiences of growing barley varieties in the last 10 years as compared to SNNPR (32%) and Amhara Regions (20%).

Out of the farmers who have experiences of growing improved barley varieties, 82% of them perceived that they are certain about the origin and purity of improved varieties (Table 5). What they mean is that they sourced improved varieties from recognized institutions, such as Ministry of Agriculture, Research Organizations, Seed Grower organizations, Private Seed Producers and others. Farmers' also believed that the improved seeds acquired from these sources are pure in nature.

Table 4. Farmers' experiences of growing improved barley varieties in the last 10 years, 2011.

% of households

Farmers' status of growing local varieties	Amhara	Oromiya	SNNPR	Total
Grew improved varieties	20	62	32	39
Did not grow improved varieties	80	39	68	61
Total	100	100	100	100

X^2 = 207.3668, df=2 P< 0.001

Table 5. Farmers' perceptions on their certainty about origin and purity of improved varieties they grow, 2011.

(% of households)

Farmers' perception on purity	Amhara	Oromiya	SNNPR	Total
Very certain	73	86	77	82
Modest	22	9	19	14
Not sure	4	4	4	4
Total	100	100	100	100

X^2 = 14.5473, df=4 P= 0.006

5.2 Gender Perspectives in Barley Technology Use

Barley production in Ethiopia, as that of any other enterprise, has gender dimensions in that household members participate in various roles including decision makings in technology adoption. Especially, the decision either to adopt new technologies or reject requires the consent of both men and women. Out of the overall sample from three of the regions, 65% of the households revealed that both men and women consult each other make a shared decision to adopt the new improved barley technologies (Table 6). Among the three major regions of the country, gender disparity in decision making was largely revealed in Amhara Region. For instance, the proportion of men who make sole decision was higher for Amhara Region (40%) than SNNPR (33%) and Oromiya (17%) regions.

Once they are aware, households make decisions not only to adopt the new technology but also to dis-adopt it. In this study, it was noted that decisions are made in a similar way either to accept or reject new technologies. This was confirmed with the fact that the proportions of households who make decisions to adopt (Table 7) and dis-adopt (Table 8) are almost similar. It was because, once consultative discussions are initiated at home about new technologies, the eventual decision is either accepting or rejecting it.

Table 6. Decision making practices in adopting improved barley technologies, 2011.

(% of households)

Who makes decisions in adoption?	Amhara	Oromiya	SNNPR	Total
Men	40	17	33	26
Women	10	9	5	8
Both men and women	50	74	62	65
Total	100	100	100	100

X^2 = 40.2073, df=4 P< 0.001

Table 7. Decision making practices in dis-adopting improved barley technologies, 2011.

(% of households)

Who makes decisions in dis-adoption?	Amhara	Oromiya	SNNPR	Total
Men	40	16	40	26
Women	11	10	5	9
Both men and women	49	75	55	64
Total	100	100	100	100

X^2 = 54.2511, df=4 P< 0.001

5.3 Sources of Information about improved barley varieties

Farmers acquire information about improved barley varieties from different sources. From three of the study regions, farmers learnt about improved barley varieties from about 13 different types of sources including other farmers, government organizations, private institutions, mass media, traders, NGOs and others. The major ones have been summarized in Table 8 and these included farmer relatives (39%), farmer neighbors (22%), inherited from family (18%) and government extension (16%). In general, the major sources were realized to be farmer based channels either relatives, neighbors or family. Out of formal institutions, government extension was the essential source of information about improved agricultural technologies, in general.

However, it was noticed that the contribution of formal institutions, such as government extension and research organizations, in sharing information to farmers about variety seeds was reported to be very limited.

Table 8. Farmers' sources of information about improved barley varieties, 2011.

Information sources	Amhara	Oromiya	SNNPR	Total
Another farmer relative	59	28	32	39
Farmer neighbors	13	27	25	22
Inherited from family	16	21	16	18
Government extension	8	19	20	16

According to the findings, farmers started cultivating different types of barley varieties since the last six decades. Until the 1970's, it was only 7% of the overall sample farmers who started cultivating different varieties of barley (Figure 9). The proportion of farmers who started growing barley increased steadily over years revealing fast growth in the 2000's. Until the 1990's, the proportion of farmers growing local varieties was higher than improved variety growers. However, this trend reversed in the 2000's where improved variety growers considerably while local variety growers maintained relative stability.

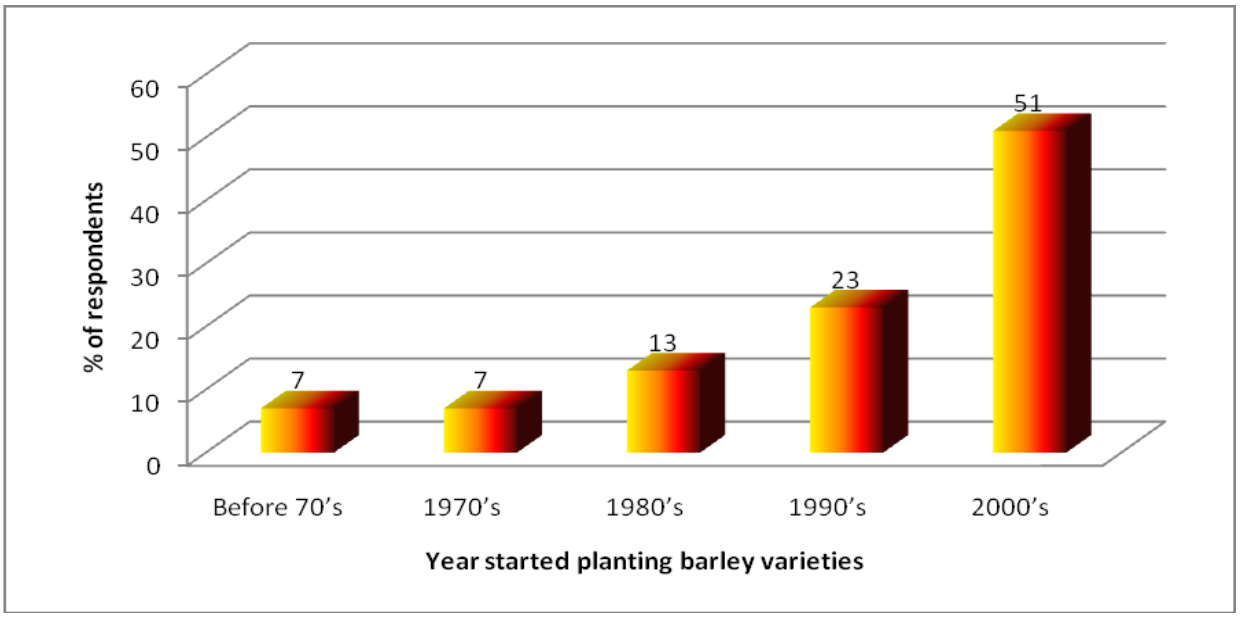

Figure 9. Year farmers started cultivating barley varieties, 2011.

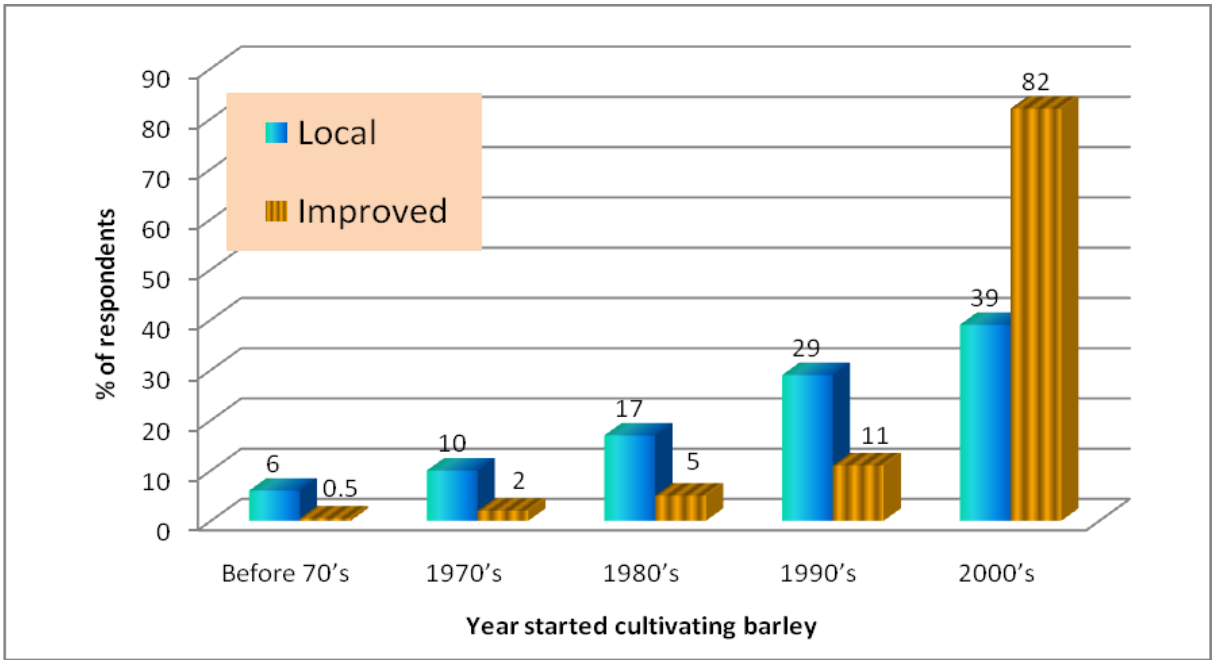

Figure 10. Trends in proportion of farmers started cultivating barley since the last six decades, 2011.

When farmers start growing either local or improved variety seeds, they acquire improved and local variety seeds from different sources. As revealed in Table 9, the essential source of improved barley variety seeds in all the study regions was purchases from local market (17%) followed by farmer-to-farmer seed exchange (14%). However, the type of variety and purity of improved seeds purchased from the market may not be credible despite farmers depend as their main source. This was largely because, farmers could not have access to other credible

sources of improved variety seeds, such as formal improved seed producer organizations, recognized informal seed producer farmers, government extension demonstrations and scaling-up programs, and others. Instead, farmer-to-farm seed exchange was the alternative source of seed for the farmers, the exchange of which is mainly made in kind.

Table 9. Farmers' main sources of improved barley variety seeds for the first time, 2010.

(% of households)

Sources of improved seeds	Amhara	Oromiya	SNNPR	Total
Local market	5	20	11	17
Farmer-to-farmer seed exchange	13	16	6	14
Inherited from family	11	15	5	13
Local seed producers	3	14	5	11
Extension demonstration trials	3	5	17	7
Farmer groups/coops	19	7	0.5	7

After securing the initial seeds of improved barley varieties from local markets/traders, farmers started saving the seed for their own use from previous season harvests. The findings confirmed this experience and revealed that a large proportion of the overall sample households (42%) started saving seeds for their own use from previous season harvests (Table 10). The second option seed source was acquiring from local market (49%) and the third was farmer-to-farmer seed exchange (68%). After acquiring the initial seed elsewhere for the first time, then farmers started saving their own seed from their own farm produce for next seasons production. Other options were purchasing from local traders and exchanging with other farmers.

Table 10. Farmers sources of improved barley variety seeds after the initial seed source, 2011.

(% of households)

Sources	Priority seed source	Amhara	Oromiya	SNNPR	Total
Own saved seed	1st	41	35	66	42
Local market	2nd	44	56	14	49
Farmer-to-farm seed exchange	3rd	70	81	12	68

5.4 Status and Prospectus of Growing Barley Varieties

The findings have also revealed that a large proportion of the overall sample households (82%) are willing to cultivate improved barley varieties in the future (Table 11). This might be due to the fact that improved barley varieties are high yielders and relatively disease resistant as compared to local ones. On the other hand, 20% of the farmers seem to have lost interests of growing improved barley varieties in the future. Even though several factors have been reported that are responsible for discontinuing improved barley varieties, the major ones (Table 12) included low yields (48%) and lack of adequate land (14%). Other reasons were largely attributed to inability to get inputs at affordable prices, such as improved variety seeds and fertilizer.

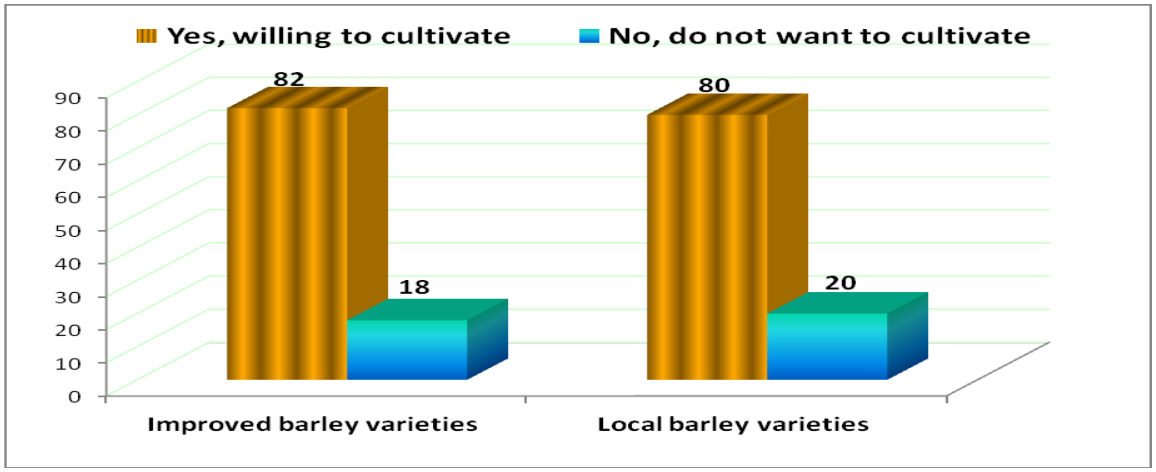

Figure 11. Prospectus of cultivating barley varieties in the future, 2011.

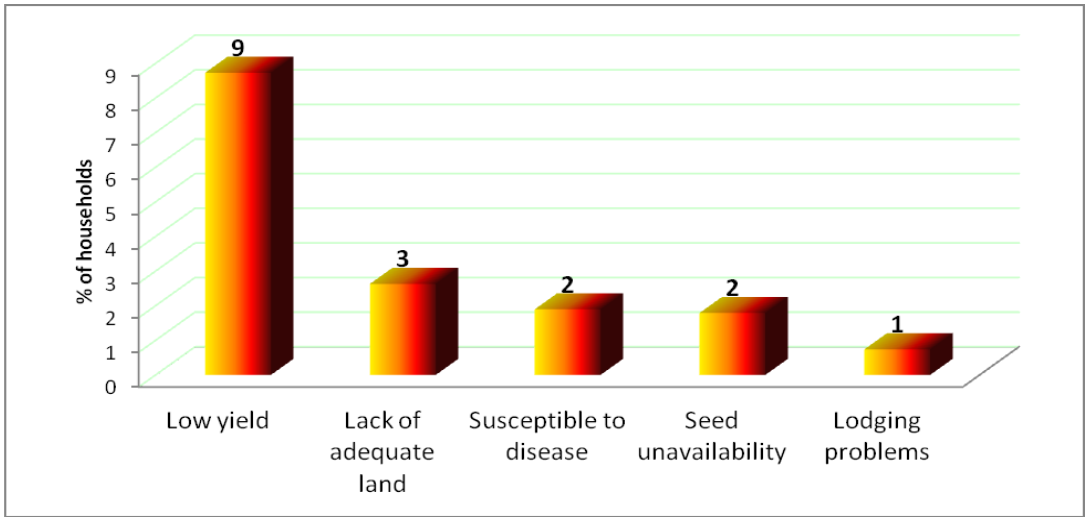

Figure 12. Reasons why farmers did not want to grow improved barley varieties in the future, 2011.

5.5 Variety Attributes of Barley Preferred by Farmers

Farmers have their own quality attributes that help them make a decision in preferring barley varieties. The most crucial quality attribute preferred by large proportions of households (47%) was high yielding ability of a variety. The different barley varieties have varying capacities of productivity ranging from poor to high yielding abilities (Figure 13). Farmers, therefore, prefer the variety that is endowed with high yielding potentials. The second essential quality attribute to prefer barley varieties was marketability (28%). The demand for barley varieties largely depend on different characteristics, such as color, grain size and others. Therefore, farmers prefer the variety that is marketable in addition to high yielding ability. Other quality attributes of barley varieties identified by farmers included food quality, taste and others.

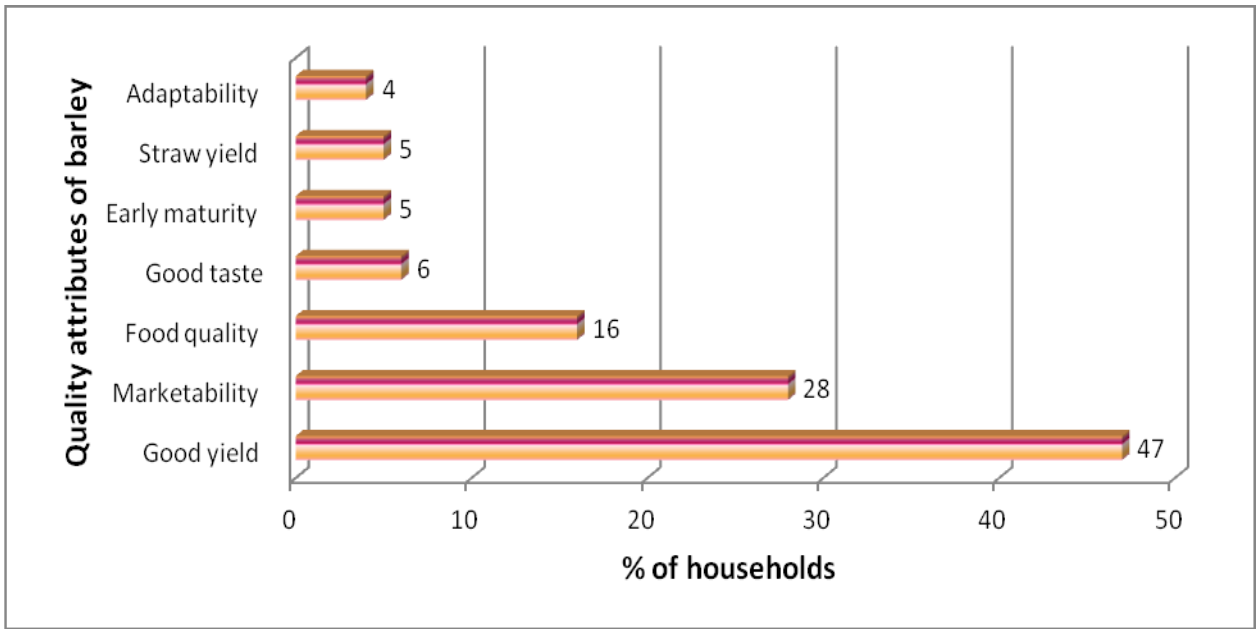

Figure 13. Quality attributes preferred by farmers in selection of barley varieties, 2010.

5.6 The Importance of Traits in Variety Selection

The different traits determine farmers' decisions in the selection of barley varieties. Among the production characteristics, palatability of straw to livestock feed was ranked to be most important by large proportions of farmers (53%) in the selection of barley varieties (Figure 14). One of the reasons could largely be because, farmers in all parts of the country have faced critical feed shortages for their livestock and this problem has been exacerbated from time to time. On the other hand, barley straw is one of the major sources of feed for livestock. Since farmers practice mixed farming systems, they give equal priroity for the management of both crops and livestock. Therefere, farmers give high priority for any option that ensures them

sustainable source of feed for their livestock. Other most important production traits include grain size (45%), threshing quality (45%), grain yield (44%), grain color (42%) and others.

Among the traits related to marketing, marketability of a variety (53%) and its premium prices (47%) are the most important traits preferred by the farmers (Figure 15). Farmers commonly use barley both for consumption and sale. Therefore, they prefer to grow some varieties for home consumption and others for sale. Therefore, high market demand is an essential trait for the farmers in selecting barley varieties.

Traits associated with consumption were also pointed out to be crucial in varietal selection by farmers. For instance, 55% of the overall sample respondents rated taste as most important trait that should be considered in varietal selection (Figure 16). Tastiness of a variety for diversified dishes is highly essential to determine worthiness of a variety. Even local beverage making quality (54%) is also an essential trait that is used by farmers to rate barley varieteis as most important. Local beverages are largely brewed from barley. As a result, a variety should be endowed with quality merits that are required for making quality local beverages. Other consumption related traits ranked to be most important by farmers included storabilty (49%), injera baking quality (47%) and others.

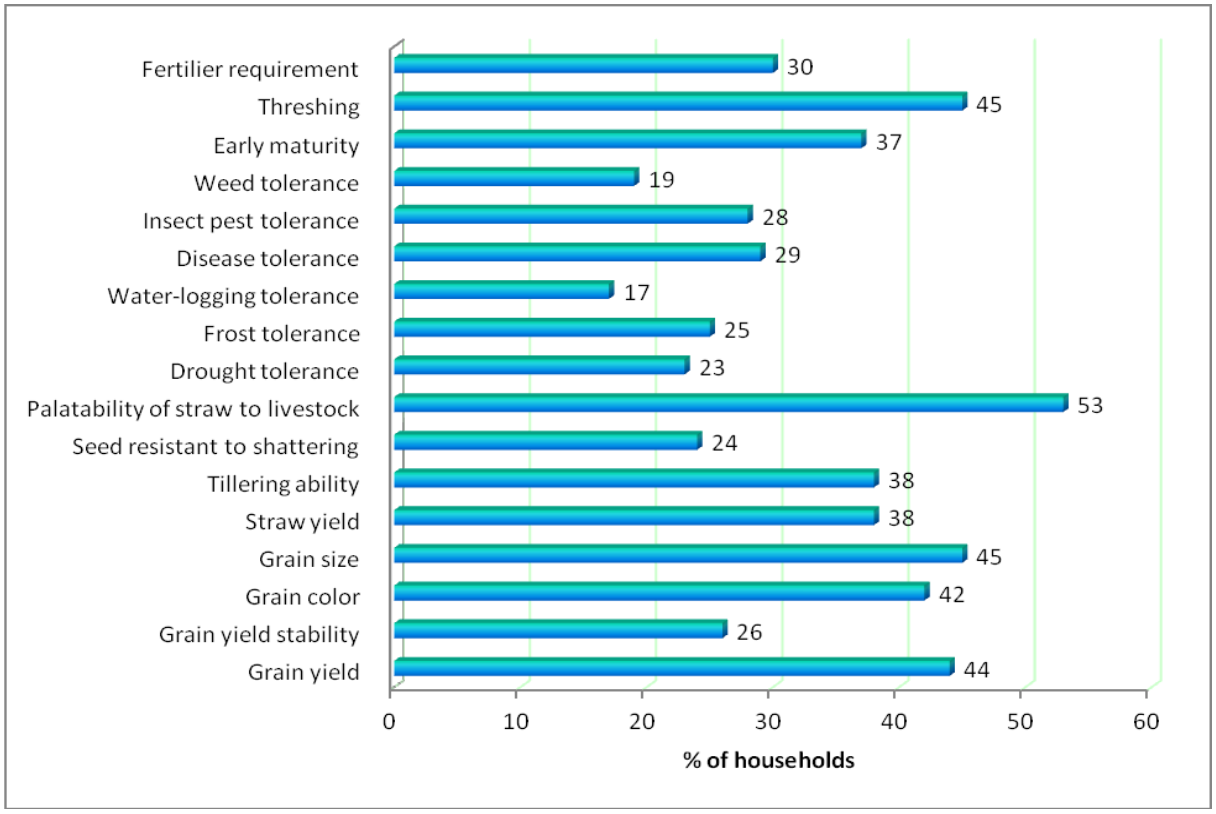

Figure 14. Production related traits that are ranked to be most important in selection of barley varieties as per the farmers' perception, 2010.

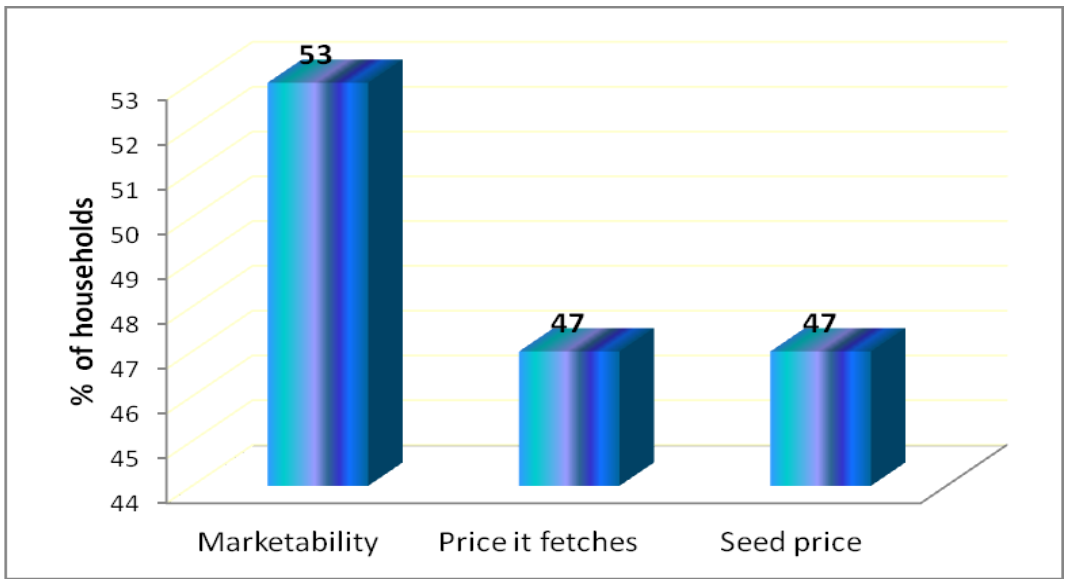

Figure 15. Market related traits that are ranked to be most important in selection of barley varieties as per the farmers' perception, 2010.

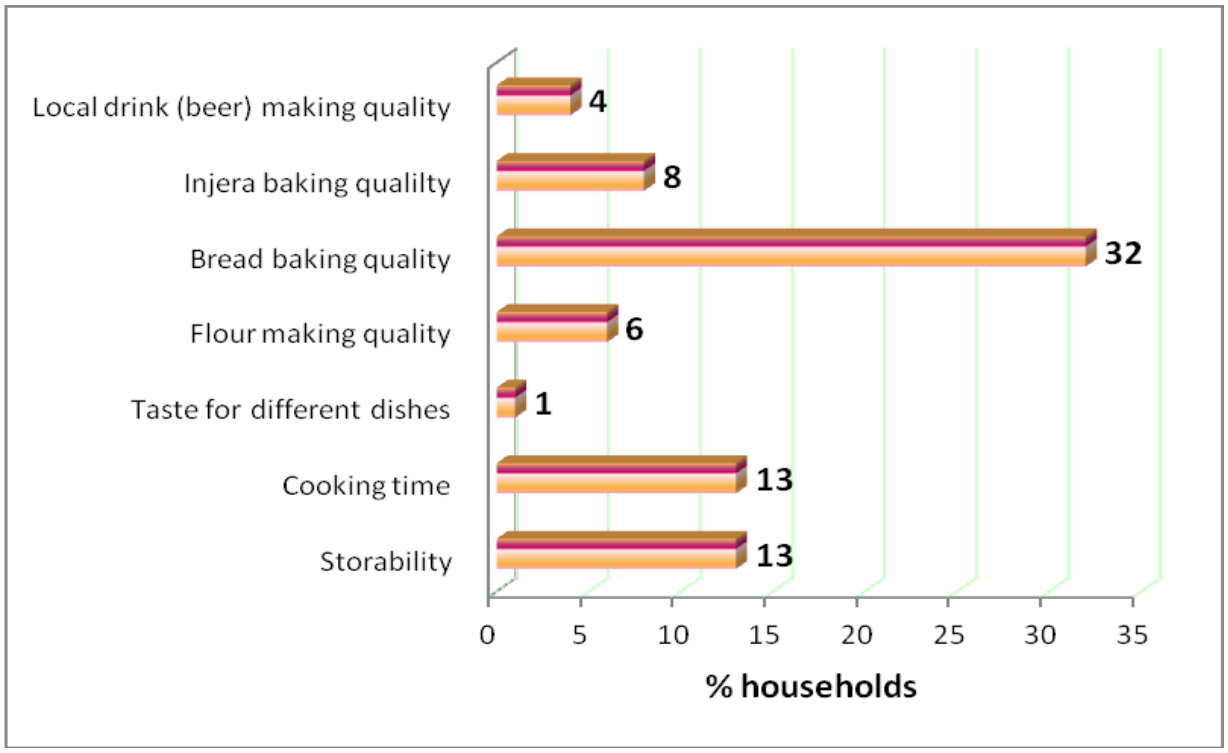

Figure 16. Consumption related traits that are ranked to be most important in selection of barley varieties as per the farmers' perception, 2010.

5.7 Farmers' Perception on Access to Extension Services

In Ethiopia, extension is one of the fundamental services offered to the farmers mainly by Ministry of Agriculture in collaboration with other development partners, such as Ethiopian Insitute of Agricultural Research and Regional Research Institutes. Agricultural technologies generated through research are promoted and disseminated to the beneficiaries largely through this extension services. Moreover, efficiency of extension service provision has significant contributions in facilitating technology adoption processes. It is believed that the more the extension service provision efforts, the higher rates of technology adoption. In this study, assessments were made to realize the status of extension service provision to the households in the major regions of Ethiopia. One of the approaches of extension service provision is through offering trainings to the farmers on various perspectives of agriculture sector. Accordingly, 21% of the overall sample households have received trainings on new improved varieties while 20% received trainings about field pests and diseases (20%) on barley (Figure 17). This implies that extension service provision, especially on barley, is still inadequate and far below expectation. It is also believed to have significant influence on adoption of barley technologies, because, promotion and building of knowledge and skills on improved barley technologies is not yet adequate for the farmers to ensure larger rates of adoption on sustainable basis.

Figure 18 presents extension service providers for the farmers. It is clearly illustrated that the major service provider of extension for the farmers is government extension through Ministry of Agriculture as reported by 86% of the overall sample households followed by farmer-to-farm information exchange (10%). Government extension program is directly mandated to provide extension services for the farmers. It is established at Ministrial levels and it has been structured from Federal to grassroot peasant association (PA) levels. Agricultural technologies generated through agricultural research programs are transferred to government extension program for promotion after the technologies have been verified and demonstrated by the farmers. Government extension offers services through various approaches, such as providing trainings, organizing experience sharing visits and farmer field days, promotion through mass media and other approaches. Farmer-to-farmer exchange is also an essential mechanism for disseminating information during social and other contacts. Farmers exchange new information with their neighbors and other farmers which largely contributes for awareness and demand creation for the farmers. Farmer-to-farm technology exchange was very noticeable practice in Amhara region (20%) than Oromiya (3%) and SNNP (0.4%) regions.

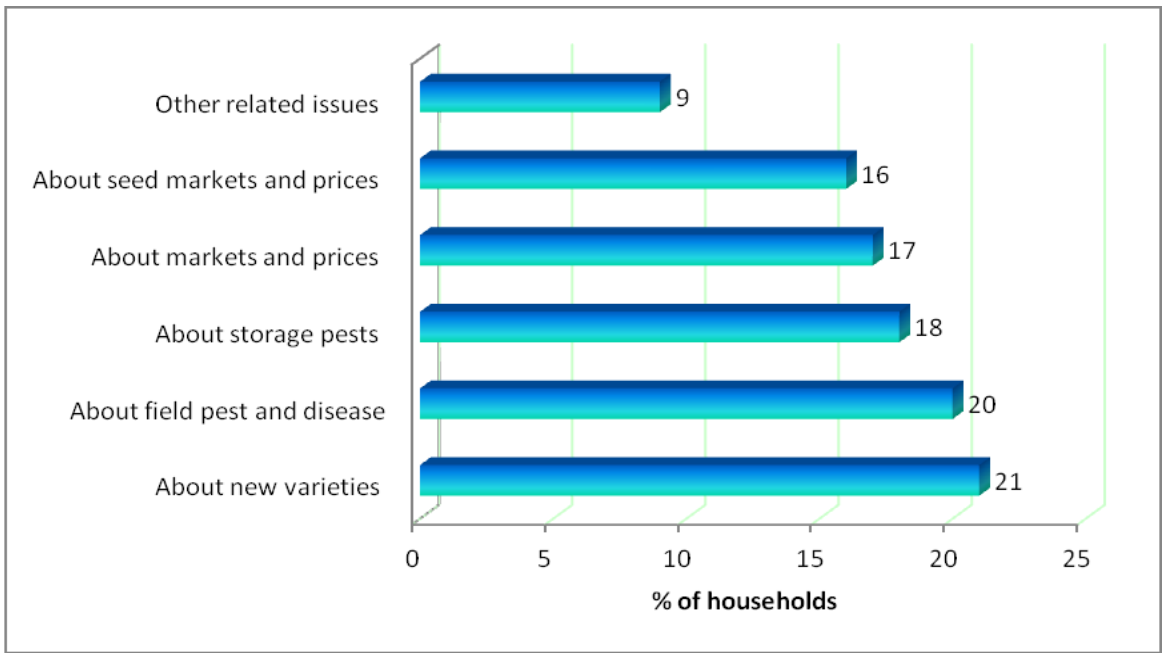

Figure 17. Proportion of farmers who received specific trainings on barley in the last five years, 2011.

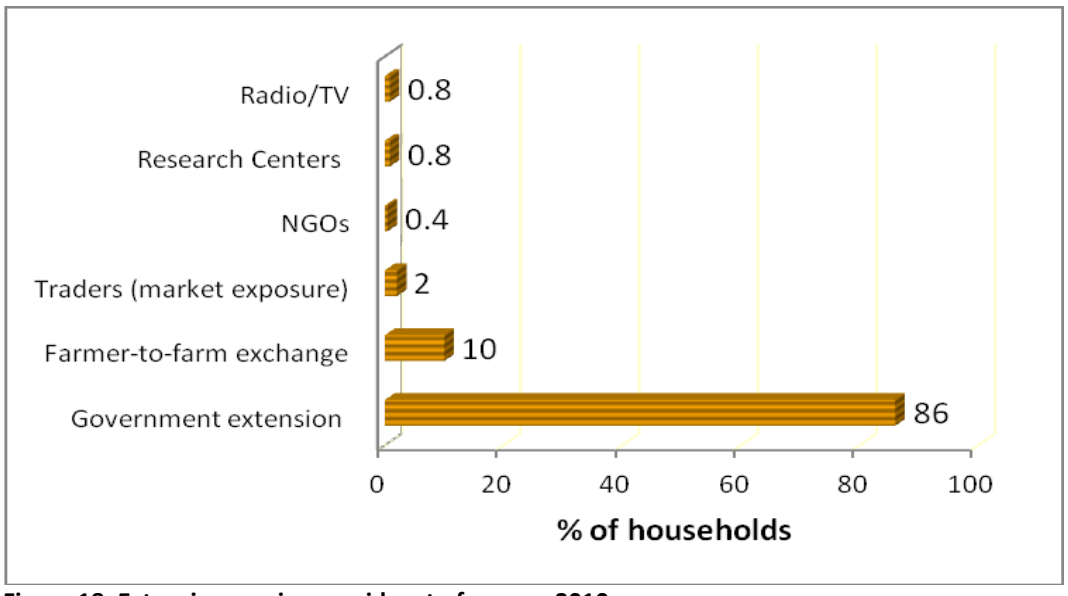

Figure 18. Extension service providers to farmers, 2010.

One of the indicators for efficiency of extension services is frequency of extension contacts. More frequent contact is believed to positively enhance technology adoption since there would be close supervision and supports of extension personnel. The findings, however, revealed very low extension contacts of farmers with extension personnel. The overall average extension contact is eight days per annum, five days in Amhara and Oromiya regions and 13 days in

SNNPR. This is very low extent of contact and it would be challenging to expect enhanced adoption of technologies under such very contacts of extension personnell with the farmers. One of the reasons is attributed to the fact that the ratio of extension personnel to farmer beneficiaries is very low in Ethiopia.

As a result of efforts in offering extension services to the community, farmers are aware of improved agricultural technologies despite the proportion varieties. For instance, 45% of the overall sample households (52% for Oromiya, 46% for Amhara and 36% for SNNPR) on average have described that fertilizer application rate for improved barley variety is 100 kg/ha of DAP. However, the proportion of farmers who are aware of this is higher for Oromiya region (52%) than Amhara (46%) and SNNP (36%) regions. Moreover, it was noted that 19% of the overall sample households have attended barely demonstration or participatory barley variety selection trials in the last three years (14% for Amhara, 16% for Oromiya and 29% for SNNPR). However, the proportion of sample households who hosted participatory barley selection or demonstration trial was very low, only 8% of the overall sample households (5% for Amhara, 7% for Oromiya and 11% for SNNP regions).

5.8 Constraints in Barley Production As Perceived by Farmers

Several types of constraints were identified that are believed to affect barley production and productivity. As perceived by farmers, high price of fertilizer was relatively identified as a crucial problem that is believed to influence barley production and productivity (Figure 19). Soil fertility decline, timely un-availability and high prices of improved seeds were also perceived to be challenging problems in barley production. In response to soil fertility decline, the practice of using inorganic fertilizer is also increasing from time to time. Farmers noticed that improved varieties of crops cannot give expected yield unless the recommended rate of fertilizer is applied. However, inorganic fertilizers, espcailly DAP and UREA are importable commodities and their price is observed to increase from year to year in response to the world economic condition (Figure 20).

From the point of view of prioritization, timely availability of improved variety seeds and price of fertilizer were reported to be most crucial problems that require due consideration to enhance barlely production and productivity. Despite considerable proportions of farmers are aware of improved barley varieties, they figured out that timely availability of seeds is a fundamental challenge to utilize the opportunity fruther. Because of limited availability improved variety seeds, their price is perceived to be high and unaffordable to smallholder farmers. Therefore, availability and associated prices of improved vareity seeds need also be taken as one of the priority agenda to be adressed and promote barley production technologies to the beneficiaries.

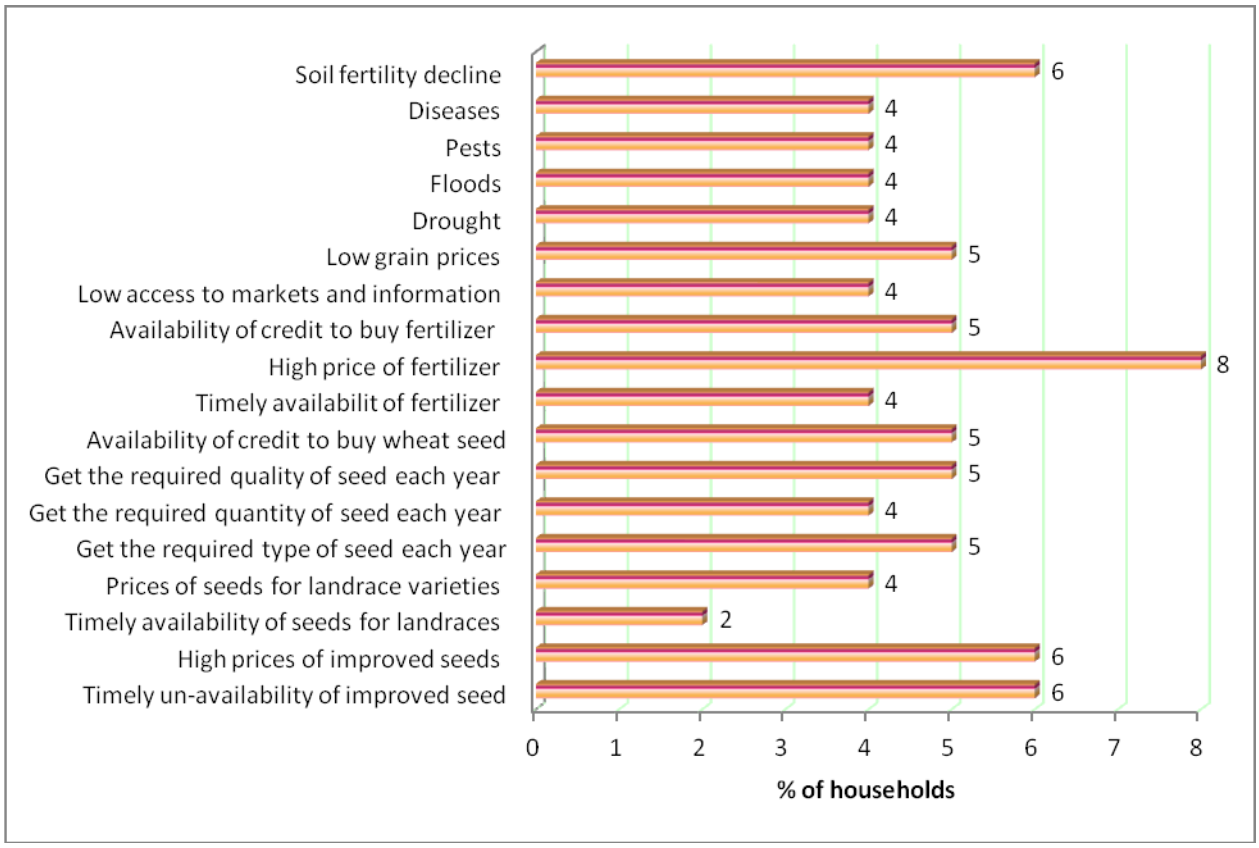

Figure 19. Farmers' perceptions on access constraints to barley production, 2010.

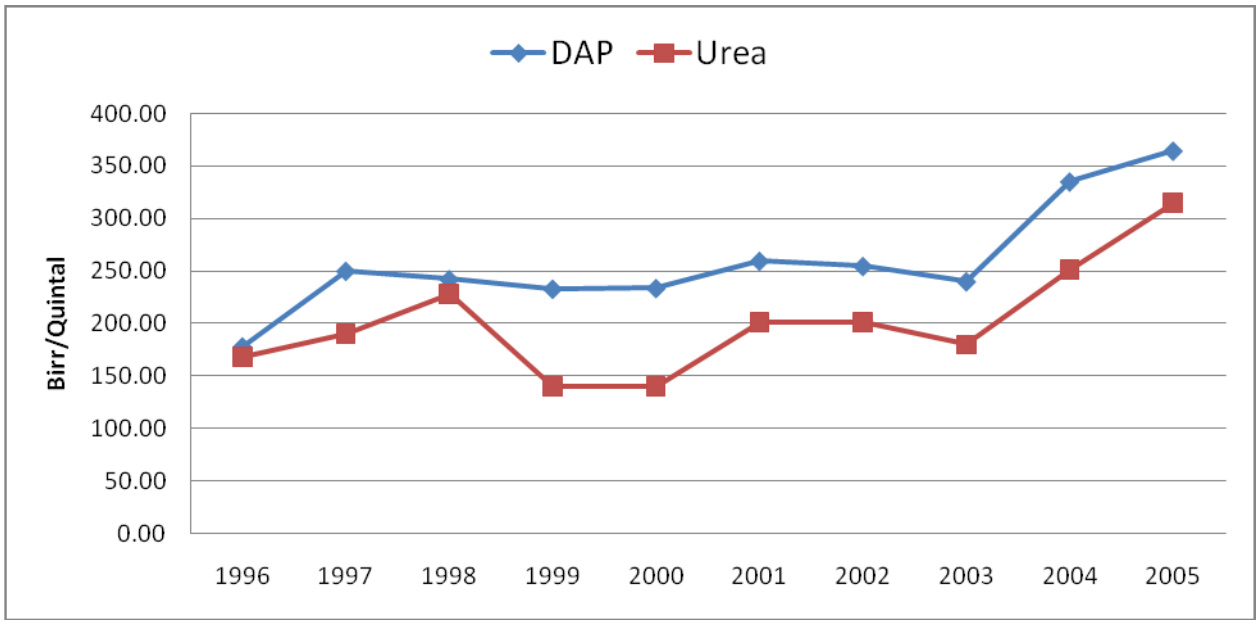

Figure 20. Trend of fertilizer price (1996 – 2005)

6. Adoption Status of Improved Barley Technologies

6.1 Regional Level Simple and Weighted Average Adoption Rates

Barley growers in three of the study regions have been producing different varieties including both improved and local ones. Despite more than 200 barley varieties have been reported by the farmers during the study, the improved varieties grown by the farmers were less than of 15 types. It is also anticipated that several of the varieteis could be genetically similar, but referred with different names across locations.

Since the study regions account for more than 90% of barley production in the country, the findings are believed to reflect the national picture. Accordingly, the overall weighted average adoption rate of improved barley varieties in three of the regions accounted for **41.4%** (Table 11). This adoption rate can also be taken as the national average rate of adoption for improved barley varieties. The largest proportion of adopters accounted for households in Oromiya region (71%) followed by SNNPR (27.4%) and Amhara (17.1%) regions.

Simple average adoption rates were also computed for the study regions. Accordingly, the overall simple average adoption rate of the three regions was **39.6%.** Out of these, **18.7%** of them accounted for the households who grow improved barley varieties only in all of their barley sub-plots. Irrespective of other packages of technologies, these households can be recognized as complete adopters. On the other hand, **20.9%** of the adopters planted both improved and local barely varieties at a time in parts of their sub-plots, and these categories of households can also be recognized as partial adopters inspite of the status of other packages. Comparision between weighted average and simple average adoption rates in this study reveals closely similar figures among them and the average deviation was only 1.8%, which can be perceived as insignificant.

The fact that several agricultural research centers, barley research programs and private sectors are located in Oromiya region, barley technology generation, promotion and dissemination efforts have been made more intensively in this region than others. It has been believed that this might have contributed to better adoption status of barley technologies in Oromiya than other regions. Despite barley is largely grown in Amhara region, the adoption rate of improved barley varieties was still very low and this might be attributed to the fact that technology promotion and dissemination efforts were very slow as compared to other regions.

A unique approach was used in this study to make comparisions of adoption rate estiamtation through various ways, such as through household surveys, expert estimation and community perception as summarized in Table 12. Accordingly, the overall adoption rate of the three regions as per the perception of the community was 26.7%, which is lower by 36% from weighted average adoption rate. The expert estimation of adoption rates was even lower than

that of community perception. Experts estimated that the overall adoption rate of barley in three of the regions is 23.7%, which is lower by 42% than the weighted average adoption rate. Despite of the relatively low cost technique, the comparision illustrates that community perceptions and expert esitmation of adoption rates have considerably under-estimated the actual adoption rate of improved barley technologies. Given the scientific methods and techniques utilized for sampling procedures to minimize biases and data management practices through statistical tools, adoption rate estimation through household surveys is believed to have more credibility than either community perception or expert estimation. Even though this is apparently the first experience in making comparisions of adoption rate esitmation through various approaches, further studies need to be carried out to make a sound conclusion.

Table 11. Regional level simple and weighted average adoption rates of improved barley varieties, 2010.

Region	Total number of barley growers in the regions	No. of barley grower households in the sample	Adoption rate of improved barley varieties				Adopters who planted improved barley varieties only		Adopters who planted both local & improved barley varieties at a time	
			No. of improved variety gorwers	Simple average adoption rate (%) by number of holders (A)	Weighted average adoption rate (%) by number of holders (B)	Deviation (B – A)	n	%	n	%
Amhara	1390949	410	80	19.5	17.1	-2.4	29	7.1	51	12.4
Oromiya	1517997	447	306	68.5	71.0	2.5	174	38.9	132	29.5
SNNPR	790658	341	89	26.1	27.4	1.3	21	6.1	68	19.9
Overall	3699604	1198	475	**39.6**	**41.4**	**1.8**	224	**18.7**	251	**20.9**

Table 12. Adoption rates of improved barley varieties as per the perception of the community and expert estimation, 2010.

Region	Adoption rate (%)				Extent of adoption		
	Simple average adoption rate as per HH survey (%) (A)	Simple average adoption rate as per perception of the community (%)	Simple average adoption rate as per expert estimation (%)	Weighted average adoption rate as per HH survey (%)	Simple average extent of adoption as per HH survey (%)	Weighted average extent of adoption as per HH survey (%)	Extent of adoption as per expert estimation (%)
Amhara	19.5	14.5	9.65	17.1	11.8	13.5	10.28
Oromiya	68.5	42.5	46.36	71.0	59.2	62.7	55.22
SNNP	26.1	17.3	2.54	27.4	27.0	24.6	2.31
Overall	**39.6**	26.7	23.72	**41.4**	40.0	41.3	32.64

6.2 Zonal Level Simple and Weighted Average Adoption Rates

Considerable zonal variation was observed in adoption rates of improved varley varieties (Table 13). Out of the zones embraced in this study, West Arsi (97.3%) zone accounted for the highest rate of weighted average adoption followed by Arsi (90.7%) and Bale (77.8%) zones. It can be attributed that these zones have received enormous extension services in introduction, demonstration and promotion of improved barley varieties, especially malt barley. Moreover, these zones are located in close proximity to Assela Malt Factory, which is one of the major Malt Factories in Ethiopia. Expansion of existing ones and installation of new Malt Factories is being given due focus by the government investment program, which apparently creates favorable opportunities for further expansion and adoption of malt barley, and more and stable demand for malt barley growers in the country. As a result, malt barley is becoming an essential cash crop and dependable source of on-farm income for the farmers. Moreover, these zones are believed to be the largest barley producers in Oromiya Region, in particular, and in the country, in general. Kulumsa and Sinana Research Centers responsible for generation of highland crop technologies including barley are also located in close proximity to these zones which creates a favorable opportunity to the farmers to have easy access to improved barley technologies. On the otherh hand, barley technologies have not been adequately promoted in West Wollega zone which is revealed by the fact that no households have ever grown improved barley varieties in the sample district (Nejo) until the time of this study (2010).

According to community perception, adoption rate of improved barley varieties was 42.5%, which is less by 38% from weighted average adoption rate. Experts have also estimated adoption rate to be 46.4%, which is still less by 32% from weighted average adoption rate.

Comparison of adoption rate estimation from household surveys, community perception and expert estimation in Oromiya region reveals that despite the the figures vary, the ranks are almost similar and all the three estimates have identified West Arsi and Arsi to be zones with relatively highest rates of improved barley variety adoption.

In SNNP region, Gedio zone accounted for the largest proportion of weighted average adoption rate (47.2%) followed by Silte (44.4%) and Sidama (38.9%) zones. The reasons might be that these zones have relatively received better extension services in introduction, demonstration and promotion of improved barley varieties. Community perception has estimated average adoption rate of improved barley varieties in SNNP to be 17.3%, which is less by 37% from weighted average rate of adoption. However, the case of expert estimation is too low (only 2.5%), which is by far less by 91% from weighted average rate of adoption. It even apparently illustrates that experts of SNNPR did not have adequate information about adoption rate of barley in the region. This is because, they estimated that improved barley variety has not been introduced to seven out of nine sample zones in SNNPR. This might be because, introduction and promotion of improved barley varieties is a recent phenomenon in the region and most of the experts did not even recognize this recent progress. On the other hand, the community has

made better estimates in that they believed Sidama zone to have better adoption rate than others, which is closely in line with estimation of household survey.

Amhara region, with the rank of the second highest barley growing region in the country, have demonstrated a very low adoption rate of improved barley varieties. North Wollo zone revealed relatively better weighted average adoption rate (38.1%) followed by South Gonder (31.1%) and North Gonder zones (22.1%). It has been observed that malt barley varieties are still the ones with highest rates of adoption. This might be because, these zones are located in relatively closer location to Dashen Brewery, which is one of the largest Breweries in the country. Technology promtion and adoption are believed to be effective in locations with access to sustainable demand for the product. According to community perceptions, adoption rate was estimated to be 14.5%, which is less by 15% from estiamation of houseold survey. On the other hand, experts estimated that average adoption rate of Amhara region is 9.6%, which is by far less (by 44%) from estimation of household survey. However, community estimation is still in line with estimation of household survey in that both identified North Wollo and North Gonder zones to have better adoption status, despite the figures vary.

In general, it was recognized that the overall estimation of adoption rates through community perception is relatively closer to estimation of household survey. In almost three of the regions, the community perception of zones with highest rate of adoption is closely similar with estimation of household surveys. Especially in SNNP and Amhara regions, the community perception is by far better than expert opinions in estimating adoption rates of improved barley varieties in the zones. It will be a hasty conclusion to generalize that one approach is a better proxy than another despite household survey is always a dependable one given its scientific articulation of methodologies and statistical tools. The problems associated with household surveys are mainly high cost and long time it requires to process the data and generate the informaiton. On the other hand, community perception and expert estimation are largely dominated by subjectivity in the absense of scientific tools and techniques to ensure representativeness and objectivity. As a result, from the experience of this study, inference can be made that the information generated through community perception and expert estimation are less useful for the consumption of policy formulation and strategy design.

Table 13. Zonal level simple and weighted average adoption rates as per household survey, community perceptions and expert estimation, 2010.

Region	Zone	Total No. of barley growers from National Census	Total No. of barley growers from HH survey	No. of improved barley growers from HH survey	Simple average adoption rate (%) as per HH survey (A)	Weighted average adoption rate (%) as per HH survey (B)	Deviation (B - A)	Simple average adoption rate as per community perception (%)	Simple average adoption rate as per expert estimation (%)
Oromiya		**1517997**	**447**	**306**	**68.46**	**71.0**	**1.5**	**42.5**	**46.4**
	Bale	111638	36	28	77.8	77.8	0	3.3	15
	West Arsi	167617	96	93	96.9	97.3	0.4	75.5	80
	Arsi	233474	139	124	89.2	90.7	1.5	65.0	75
	West Shewa	147523	131	39	29.8	27.5	-2.3	14.0	35
	West Wollega	40201	11	0	0	0	0	0.0	0
	South West Shewa	81099	34	22	64.7	64.7	0	46.7	10
SNNPR		**790658**	**341**	**89**	**26.10**	**27.4**	**1.3**	**17.3**	**2.54**
	Gurage	119041	93	28	30.1	31.0	0.9	11.2	10
	Welayta	9045	24	0	0	0	0	0.0	0
	Kefa	55603	26	3	11.5	11.5	0	0.2	0
	Gamogofa	131445	34	3	5.9	8.8	2.9	0.0	0
	Silte	96577	36	16	44.4	44.4	0	14.0	0
	Sidama	141680	36	14	38.9	38.9	0	48.2	0
	South Omo	27298	34	0	0	0	0	0.0	0
	Kembata	26006	22	7	31.8	31.8	0	30.0	5
	Gedio	36047	36	17	52.8	47.2	-5.6	16.7	0
Amhara		**1390949**	**410**	**80**	**19.51**	**17.1**	**-2.4**	**14.5**	**9.65**
	South Gonder	182748	99	28	28.3	31.1	2.8	6.4	15
	South Wollo	255135	59	5	8.5	0.3	-8.2	2.5	5
	North Wollo	168025	21	8	38.1	38.1	0	50.0	10
	West Gojam	103450	22	1	4.5	4.5	0	1.0	2
	North Shewa	187177	65	8	12.3	9.6	-2.7	10.1	10
	North Gonder	202951	70	17	24.3	22.1	-2.2	38.1	20
	East Gojam	174553	74	13	17.6	16.3	-1.3	0.3	5

6.3 District Level Simple and Weighted Average Adoption Rates

District level adoption rates of improved barley varieties have also been summarized in Table 14. In Oromiya region, highest average adoption rates were reported from districts of Arsi and west Arsi zones. Districts which had 100% adoption rates included Arsi Negelle and Kofele from West Arsi zone, and Digelu from Arsi zone. Even the adoption rates of most other districts in these zones is well above 85%, the lowest being 77.8%. These districts are located in a typically highland agro-ecology whith barley dominated farming systems and malt barley varieties have been promoted and disseminated with better scales than other districts. On the other hand, districts with lower rates of adoption included Chelia (16.7%) and Dendi (24.1%). However, adoption rate was nil in Nejo district of West Wollega zone, indicating that improved barley varieties have not yet been introduced and promoted in this district. There can also be other districts in the region with similar status of not yet getting access to improved barely varieties.

In SNNP Region, Mihur Akl district from Gurage zone had relatively highest rate of average adoption (65.7%) followed by Bule district (52.8%) from Gedio zone and Alicho Weraro district (44.4%) from Silte zone. It indicates that better promotion and dissemiantion activities of both food and malt barley varieties have been made in these districts than others. On the other hand, Boloso district from Welayta zone and South Ari district from South Omo zone illustrated nil rates of adoption revealing that these districts did not yet had access to improved barley varieties.

Estimation of adoption rates through community perception was also closely in line with rankings of household surveys. For instance, the community has identified Hula district (45%) from Sidama zone, Kacha Bir (30%) from Kembata Tembaro zone and Mihur Akl (25%) from Gurage zone to have relatively better rates of adoption despite the figures vary with household surveys. Especially, the community has also recognized the nil adoption rates for Boloso and South Ari districts, which is in line with observations of household surveys.

In Amhara region, relatively highest rate of weighted average adoption was reported from Meket district (38.1%) of North Wollo zone followed by Lay Gaiynt (37.5%) and Farta (35.3%) districts from South Gonder zone. On the other hand, Sekela district (4.5%) from West Gojam zone and Baso district (3.3%) from North Shewa zone revealed lowest rates of adoption while Were Illu district did not have access to improved barley varieties until the time of this study. The perception of the community on adoption rates is also similar in identifying districts with better status of adoption as does by household survey.

Table 14. District level adoption rates as per household survey and community perceptions, 2010.

Zone	District	Total No. of barley growers from National Census	No. of barley growers from HH survey	No. of households growing improved barley varieties from HH survey	Simple average adoption rate using household survey (%)	Simple average adoption rate as per community perception (%)
Oromiya Region						
Bale	Dinsho	21973	36	28	77.8	3.3
West Arsi	Arsi Negelle	5990	27	27	100	98.3
	Gedeb Asasa	18687	34	31	91.2	31.7
	Kofele	35403	35	35	100	96.7
Arsi	Chole	7468	36	31	86.1	78.3
	Digeluna	17991	35	35	100	76.6
	Tiyo	10500	32	30	93.8	45.0
	Tena	12692	36	28	77.8	60.0
West Shewa	Chelia	16186	36	6	16.7	6.7
	Tikur Enchini	10632	35	15	42.9	15.7
	Dendi	20251	29	7	24.1	22.5
	Welmera	9743	31	11	35.5	11.6
West Welega	Nejo	3619	11	0	0	0.0
South West Shewa	Seden Sodo	7722	34	22	64.7	46.6
SNNPR						
Gurage	Enemore	7129	26	2	7.7	
	Endegagne	5186	32	3	9.4	1.7
	Mihur Akl	8009	35	23	65.7	25.0
Welayta	Boloso	4700	24	0	0	0.0
Kefa	Chena	9676	26	3	11.5	0.2
Gamogofa	Kocha	10379	34	2	5.9	0.0
Silte	Alicho Weraro	18248	36	16	44.4	14.0
Sidama	Hula	19520	36	14	38.9	45.0
South Omo	South Ari	6049	34	0	0	0.0
Kembaba Tembaro	Kacha Bir	2656	22	7	31.8	30.0
Gedio	Bule	11580	36	19	52.8	16.7
Amhara Region						
South Gonder	Farata	30358	34	12	35.3	
	Ebinat	15705	33	4	12.1	1.2
	Lay Gayint	26468	32	12	37.5	7.7
South Wollo	Were Illu	19119	26	0	0	0.0
	Kuta Ber	15367	33	5	15.2	3.3
North Wollo	Meket	29443	21	8	38.1	50.0
West Gojam	Sekela	17867	22	1	4.5	1.0
North Shewa	Angololana Tara	13140	35	7	20	30.0
	Basona Wo	21605	30	1	3.3	0.1
North Gonder	Wogera	25098	32	6	18.8	15.3
	Debark	12383	38	11	28.9	54.0
East Gojam	Hulet Eju	22150	38	6	15.8	0.7
	Awobel	3631	36	7	19.4	0.0

7. Extent of Adoption of Improved Barley Varieties

7.1 Regional level simple and weighted extents of adoption

The extent of adoption was also assessed in this study from the perspective of area coverage under improved barley varieties. Accordingly, the weighted average extent of adoption of improved barley varieties was 38% (Table 15). This implies that out of the total area covered under barley, 38% of it was occupied by improved barley varieties. The simple average extent of adoption was 36.2% and the deviation from weighted average extent of adoption is only 1.8%. Even though weighted average depicts a more credible estimate, its deviation from simple average does not seem to be significant.

It is believed that malt barley accounts for the largest proportion of area coverage under improved varieties. Regional comparision reveals that the extent of adoption was higher for Oromiya region (59.7%) followed by SNNPR (17.4%) region. Even though Amhara regions accounts for the second largest area next to Oromiya, its extent of adoption was only 11%. This can be attributed to the fact that the largest malt factory in the country (Assela Malt Factory) is geographically located in Oromiya region which offers a stable market demand for malt barley producers. The factory has established experience of contracting outgrower farmers to ensure adequate supply of malt barley for its processing industry. Moreover, SNNPR is located in relatively closer location to the factory than Amhara region. It is believed that the farmers from the highlands of SNNPR have closer access to stable markets for their malt barley in Assela Malt Factory.

Table 15. Household level simple and weighted average extent of adoption of improved barley varieteis, 2010.

Region	Total area under barley (ha)			Extent of adoption (%)		Deviation (%) (B-A)
	Total area under barley from National census (ha)	Total barley area from HH survey (ha)	Barley area under improved varieties from HH survey (ha)	Simple average extent of adoption (%)	Weighted average extent of adoption (%)	
Amhara	328268.73	198.53	23.36	11.8	11.0	-0.8
Oromiya	513707.03	403.79	222.57	55.1	59.7	4.6
SNNPR	111756.36	156.60	28.53	18.2	17.4	-0.8
Overall	953,732.12	758.92	274.46	36.2	38.0	1.8

7.2 Zonal level simple and weighted extents of adoption

Zonal level adoption extents were also summarized in Table 16. Wide disparity was observed in adoption extents between zones in Oromiya Region. For instance, weighted average extent of adoption was high for West Arsi zone (90.5%) followed by Arsi (67.4%) and Bale (63.1%) zones. These zones are geographically located in the proximity of Malt Factory and they are known producers of malt barley in the country. As a result, more than 60% of the barley area in these zones accounts for malt barlely and in some zones, it is even more than 90%. The farmers largely supply their produces to the processing industry and malt barley is their crucial source of income. On the other hand, there are also zones in Oromiya region where improved barley varieties have not yet been introduced, such as West Wollega zone. Even though only one district was embraced in this study from West Wollega zone, it signifies that there are still districts which did not get access to improved barley varieties and associated packages.

7.3 District level simple and weighted extents of adoption

Among the districts in Oromiya region, Kofele (96.6%) and Arsi Negele (94.4%) districts both from West Arsi zone accounted for the highest weighted average extent of adoption (Table 17). The weighted average extent of adoption of the districts from Arsi zone ranged from 49.4% - 79.8%, the lowest being from Chole district and the highest from Tena district. These districts are almost neighbors of Malt Factory and they took advantage of strategic location for stable market. On the other hand, the districts from West Shewa zone revealed lowest extent of adoption (such as 5.6% from Chelia district and 17.5% from Dendi district). Even Nejo district from West Wellega zone illustrated nil extent of adoption for improved barley varieties. The reasons might be that introduction, promotion and dissemination of improved barley varieties have not been made adequately in these districts.

In general, highest adoption extents in Oromiya region was largely attributed to the fact that the region accounts for the largest proportion of barley area coverage in the country and its agro-ecology is also more favorable for barley than other regions. Private sectors, such as seed growers and malt factories are also located in Oromiya region which contribute for expansion of barley enerprise. Barley promotion and dissemination has started long time ago in Oromiya and SNNP regions through development programs, such as ARDU (Arsi Rural Development Unit in Oromiya Region) and WADU (Wolayta Agricultural Development Unit in SNNPR), which might have eventually contributed to enhancement of adoption rates and extents. Several Research Centers and Barley Research Programs located in Oromiya Region have also been promoting verification, demonstration, scaling-up and other out-reach programs on farmers' fields which largely contributed to higher extents of adoption than other regions.

Table 16. Zonal level simple average and weighted average extents of adoption, 2010.

Region	Zone	Total area under barley (ha)			Extent of adoption (% of area under improved varieties)		
		Total Area under barley from national census (ha)	Area under barley from HH survey (ha)	Area under improved varieties from HH survey (ha)	Simple average extent of adoption (%) (A)	Weighted average extent of adoption (%) (B)	Deviation (%) (B-A)
Amhara Region		**328268.73**	**198.53**	**23.36**	**11.8**	**11.0**	**-0.8**
	South Gonder	35861.26	36.89	7.09	19.2	21.6	2.4
	South Wollo	41352.63	31.28	0.66	2.1	1.36	-0.74
	North Wollo	41985.68	6.27	1.27	20.3	20.3	0
	West Gojam	24648.77	5.51	0.38	6.8	6.8	0
	North Shewa	63003.60	60.41	2.88	4.8	4.0	-0.8
	North Gonder	44673.15	29.66	3.24	10.9	9.7	-1.2
	East Gojam	49483.17	28.53	7.86	27.5	15.6	-11.9
Oromiya Region		**513707.03**	**403.79**	**222.57**	**55.1**	**59.7**	**4.8**
	Bale	47251.06	50.38	31.77	63.1	63.1	0
	West Arsi	77362.74	80.43	72.93	90.7	90.5	-0.2
	Arsi	103139.19	129.64	83.81	64.7	67.4	2.7
	West Shewa	70440.35	113.38	22.15	19.5	20.0	0.5
	West Wollega	2164.99	2.88	0	0	0	0
	South West Shewa	20439.68	25.10	9.91	39.5	39.5	0
SNNP Region		**111756.36**	**156.60**	**28.53**	**18.2**	**17.4**	**-0.8**
	Gurage	18253.97	38.76	8.54	22.0	25.3	3.3
	Welayta	433.94	5.33	0	0	0	0
	Kefa	7480.85	13.35	1.50	11.2	11.2	0
	Gamogofa	21725.46	20.45	0.75	3.7	3.7	0
	Silte	10666.07	11.58	2.81	24.2	24.2	0
	Sidama	26219.26	17.40	3.83	22.0	22.0	0
	South Omo	6084.18	22.10	0	0	0	0
	Kembata Tembaro	1631.69	4.15	0.86	20.6	20.6	0
	Gedio	4438.17	23.48	10.25	43.7	43.7	0

Zonal and district level disparities in extents of adoption were also evident in SNNP Region. The highest weighted average extent of adoption was reported from Gedio zone (43.7%) followed by Gurage (25.3%) and Silte (24.2%) zones. On the other hand, the least weighted average extent of adoption was recorded from Gamo Gofa zone (3.7%) and Kembata Tembaro zones (20.6%) while it was nil in Welayta and South Omo zones. Among the districts in SNNPR, Bule from Gedo zone has relatively highest weighted average extent of adoption (43.7%) followed by Mihur Akl district (34.5%) from Gurage zone, Alicho Wer (24.9%) from Silte zone and Kacha Bir (23%) from Kembata Tembaro zone. On the other hand, Boloso district from Welayta zone and South Ari district from South Omo zone did not yet get access to improved varieties of barley. In general, it can be attributed that extension efforts and promotion services were stronger in zones and districts with higher extents of adoption while such efforts have not been strong in districts with the lowest extents of adoption. It was also evident that there are districts to which barley technologies have not been introduced at all. This alerts the fact that further efforts need to be strengthened to introduce, promote and disseminate improved barley varieties and associated packges with a focus on areas which did not yet get access to such benefits and on those areas with lowest rates of adoption.

In Amhara region, South Gonder (21.6%), North Wollo (20.3%) and East Gojam (15.6%) zones have illustrated a relatively better weighted average extents of adoption than others. Among the districts, Meket (37%) from North Wollo zone, Farta (25.6%) and Lay Gayint (25.4%) from South Gonder zone have relatively higher weighted average extents of adoption than others. On the other hand, Baso district (0.2%) from North Shewa zone, Kutaber district (1.3%) from South Wollow zone and Wogera district (8.3%) from North Gonder zone have exhibited lowest extents of adoption while Wereillu did not yet have access to improved barley varieties. Location of Adet Research Center which also deals with barley research might have contributed for highest extents of adoption in North Wollo and East Gojam zone. Since Dashen Brewery is installing a Malt Factory, it is expected that adoption of improved barley varieties, especially malt barley, will be enhanced significantly in the near future in Amhara region.

Comparison between simple and weighted average extents of adoption reveals that an almost insignificant variation among them. Most of the deviations of weighted average extent of adoption from simple average were less than 5%.

Table 17. District level simple average and weighted average extents of adoption of improved barley, 2010.

Zone	District	Total area under barley (ha)			Extent of adoption (% of area under improved varieties)		
		Total area under barley from national Census (ha)	Area under barley from HH survey (ha)	Area under improved varieties from HH survey (ha)	Simple average extent of adoption (%) (A)	Weighted average extent of adoption (%) (B)	Deviation (%) (B - A)
Oromiya Region Zones and Districts							
Bale	Dinsho	19959.77	50.38	31.77	63.1	64.5	1.4
West Arsi	Arsi Negelle	1955.75	30.51	28.76	94.3	94.4	0.1
	Gedeb Asasa	12884.05	24.04	18.98	78.9	79.2	0.3
	Kofele	20731.06	25.88	25.19	97.3	96.6	-0.7
Arsi	Chole	3596.02	42.23	23.46	55.6	49.4	-6.2
	Digeluna	9587.45	34.65	25.63	74.0	76.9	2.9
	Tiyo	6587.26	26.44	15.50	58.6	58.7	0.1
	Tena	6499.86	26.33	19.23	73.0	79.8	6.8
West Shewa	Chelia	5948.20	35.27	2.88	8.2	5.6	-2.6
	Tikur Enchini	4633.58	29.34	8.75	29.8	32.9	3.1
	Dendi	10973.61	24.53	4.90	20.0	17.5	-2.5
	Welmera	7450.84	24.25	5.63	23.2	31.5	8.3
West Welega	Nejo	202.91	2.88	0	0	0	0
South West Shewa	Seden Sodo	2611.46	25.10	9.91	39.5	39.5	0
SNNP Zones and Districts							
Gurage	Enemore	222.44	4.80	0.31	6.5	8.1	1.6
	Endegagn e	392.45	8.05	0.40	5.0	4.7	-0.3
	Mihur Akl	2459.96	25.92	7.83	30.2	34.5	4.3
Welayta	Boloso	225.09	5.33	0	0	0	0
Kefa	Chena	2012.01	13.35	1.50	11.2	10.3	-0.9
Gamogofa	Kocha	1301.87	20.45	0.75	3.7	3.2	-0.5
Silte	Alicho Weraro	2714.26	11.58	2.81	24.2	24.9	0.7
Sidama	Hula	1849.76	17.40	3.83	22.0	20.6	-1.4
South Omo	South Ari	1105.90	22.10	0	0	0	0
Kembaba Tembaro	Kacha Bir	184.09	4.15	0.86	20.6	23.0	2.4
Gedio	Bule	2182.42	23.48	10.25	43.7	43.7	0
Amhara Region Zones and Districts							
South Gonder	Farta	7796.09	12.01	2.53	21.0	25.6	4.6
	Ebinat	3424.17	14.44	1.25	8.7	13.4	4.7
	Lay Gayint	4744.70	10.44	3.31	31.7	25.4	-6.3
South Wollo	Were Illu	4881.71	14.78	0	0	0	0
	Kuta Ber	2491.49	16.50	0.66	4.0	1.3	-2.7
North Wollo	Meket	8630.79	6.27	1.27	20.3	37.0	16.7

West Gojam	Sekela	5163.91	5.51	0.38	6.8	3.0	-3.8
North Shewa	Angololana Tara	11115.44	38.75	2.81	7.3	7.6	0.3
	Basona Wo	9486.65	21.66	0.06	0.3	0.2	-0.1
North Gonder	Wogera	8633.01	13.73	1.04	7.6	8.3	0.7
	Debark	4472.36	15.93	2.20	13.8	13.4	-0.4
East Gojam	Hulet Eju	6285.83	12.81	1.63	12.7	17.0	4.3
	Awobel	762.24	15.72	6.23	39.6	25.1	-14.5

8. Varietal Level Adoption Rates and Extents

8.1 Varietal Level Simple Average Adoption Rates

In this study, more than 200 types of barley varieties were reported to be grown by the farmers. Out of these, 34 of them were believed to be improved varieties, both food and malt barley. The findings of this study have revealed that out of all types of barley varieties grown in the study regions, 69% of them were local varieties while 31% of them were improved ones (Table 18). All the local varieties are believed to be food barley vareties since there is no local malt barley variety known in Ethiopia. It was also depicted that out of the improved varieties, 19% of them accounted for malt barley while 11% were improved food barley varieties.

According to varietal level adoption rates (Table 19), Miscal-21 accounted for relatively the largest proportion (13.8%) followed by Holker (11.7%) and Beka (3.9%), all of which are malt barley varieties. Among the food barley varieties, HB-3336-20 (locally named as *Shege*) is relatively better adopted (3.9%) followed by HB-1307 (3.8%), Ardu 1260-B (2.5%), HB-42 (1.9%) and Aruso-42 (1.9%). The adoption rates of all other improved varieties was very low, below 1%.

When regional comparision is observed, the largest proportion of local varieties are grown in Amhara region (87%) while the largest proportion of malt barley varieties are grown in Oromiya region (40%). The largest proportion of improved food varieties are grown in SNNPR (17%). On the other hand, improved barley varieties account for 54% in Oromiya region while it is 18% in SNNPR. In Amhara region, improved varieties grown are the least of all the regions accounting for only 13%.

More adoption status of malt barley varieties might be attributed to the fact that malt barley is mainly considered as a cash crop despite it can also be used as food crop. On the other hand, food barley is of largely a food crop. The other reason might also be that malt barley is especially promoted by Malt processing factories offering the farmers with price incentives,

stable market demands and guarantee as far as the requried quality is imaintained. For instance, Asela Malt Factory located in Oromiya region at the town of Assela, is highly engaged in the promotion and expasion of malt barley mainly in Oromiya and SNNPR regions.

On the other hand, food barley is believed to be of largely a food crop than cash crop. As a result, almost no private companies are also invovled in the introduction, promotion and dissemination processes as it is done for malt barley. Almost only government institutions, such as Research Institutes and Ministry of Agriculture, are engaged in the promotion and dissemiantion processes despite such efforts are still inadequate, scanty and it does not embrace most of the barley growing agro-ecologies of the country. The rorels played through international organizations, such as ICARDA, is worth to be acknowledged here which has its own contributions in the adoption of improved varley varieties. It is believed that ICARDA has been offering considerable assistance to Ethiopia in exchanges of germplasms, and rendering technical and financial supports.

The other factor that might have contributed for low adoption status of improved food barley varieties might be the belief of the farmers that there are also local varieties as productive as improved ones with similar input provision and management levels. If the recommeded rates of inputs are applied, farmers believe that, they can harvest almost comparable yeilds from local varieties as well. Farmers have also apparently asserted that local food barley varieties can even offer reasonable yields without provision of extra inputs as per research recommendations.

Table 18. Simple Average Adoption rates of Food and Malt barley varieties in the regions, 2010.

Category of barley variety	Type of barley variety	Amhara		Oromiya		SNNPR		Overall	
		n	%	n	%	n	%	n	%
Local varieties	Food barley	554	87	383	47	424	81	1361	69
Improved varieties	Food barley	24	4	105	13	90	17	219	11
	Malt barley	48	7	326	40	6	1	380	19
	Un-identified	11	2	8	1	1	0.2	20	1
Total		637	100	822	100	521	100	1980	100

8.2 Varietal Level Weighted Average Extents of Adoption

The extent of adoption of improved barley varieties was also exhibited through the proportion of area occupied relative to total area covered by barley varieties. In general, the simple average extent of adoption of improved barley varieties in three of the regions accounted for 36%. Out of this, the largest share of extent of adoption rate goes to malt barley varieties (23%) while improved food barley varieties accounted for 12% (Table 19). It was also noted that 64% of the total area under barley was occupied by local varieties.

According to regional comparison, the extent of adoption of malt barley varieties in Oromiya region was 40% while this proportion is 8% for Amhara region and 1% for SNNPR. On the other hand, the extent of adoption of improved food barley varieties is 17% in SNNPR while it is 15% in Oromiya and 3% in Amhara regions. The findings apparently reveal that improved malt barley varieties occupy the largest proportion of the barley area under improved varieties in Oromiya region while improved food barley varieties are dominant in SNNPR.

When the weighted average extent of adoption of improved barley varieties in three of the regions is concerned (Table 20), relatively the largest proportion is accounted for Miscal-21 (12.07%) followed by Holker (9.03%) and Beka (2.41%), all of which are malt barley varieties. Out of the improved varieties of food barley, the weighted extent of adoption was higher for Aruso-42 (3.53%) followed by HB-1307 (2.23%). The weighted extent of adoption of almost all of the other improved barley varieties was below 1%. Varietal level deviation of weighted extent of adoption rate from simple average was below 1% for almost all of the varieties, depicting closer estimates made by simple and weighted average extents of adoption.

Table 19. Simple Average Extents of adoption of Food and Malt barley varieties in the regions, 2010.

Category of barley variety	Type of barley variety	Amhara		Oromiya		SNNPR		Overall	
		ha	%	ha	%	ha	%	ha	%
Local varieties	Food barley	174.92	88	180.93	45	128.07	81.8	486.92	64
Improved varieties	Food barley	5.35	3	59.89	15	26.53	16.7	91.76	12
	Malt barley	15.65	8	160.35	40	1.5	1.0	177.50	23
	Un-identified	2.61	1	2.63	1	0.5	0.3	5.71	1
Total		198.53	100	403.79	100	156.60	100	758.92	100

Regional level simple and weighted average extents of adoption of improved barley varieties have also been summarized in Table 21. In Amhara Region, the weighted average extent of adoption was higher for Holker (3.94%), Sirinka (3.92%) and Miscal-21 (2%) varieties of improved barley. In Oromiya region, the weighted average extent of adoption was higher for Mical-21 (19.1%) followed by Holker (12.8%) and HB-42 (9.14%). The findings reveal that the dominantly adopted improved malt barley varieties are closely similar in both Amhara and Oromiya regions. On the other hand, Ardu 3336-20 (7.09%) and Ardu-1260 (3.05%) are relatively better adopted improved food barley varieties in SNNPR.

In general, adoption rates and extents seem to be very low at specific variety levels. Except some popular malt and food barley varieties, the adoption rates and extents of all other varieties was very low, mostly below 1%. This illustrates that the farmers have different preferences and accesses to the different barley varieties. Moreover, agro-ecological

adaptabilty might be different across the varieties. Even though availability of options of improved varieties is essential, the promotion and disseminaiton of these varieties seem to be very slow and inadequate in view of their low adoption rates.

Table 20. Varietal level simple and weighted average adoption rates and adoption extents, 2010.

Type of improved barley variety	Classification of the improved variety	Varietal adoption rate (%)		Extent of adoption			
		No. of variety grower HHs	Simple average adoption rate (% out of total HHs growing barley N=1198)	Area under specific improved variety (ha)	Simple average extent of adoption (% out of total area under barley) N=758.92 ha (A)	Weighted average extent of adoption (%) (B)	Deviation (B-A)
HB-42	FB*	23	1.9	7.08	0.9	0.83	-0.10
Ardu1260-B	FB	30	2.5	10.33	1.4	0.84	-0.52
Ardu 3336-20	FB	47	3.9	13.33	1.8	0.99	-0.77
HB-1307 (EH-1700/F7.B)	FB	46	3.8	19.58	2.6	2.23	-0.35
Kulumsa 1/88	FB	10	0.8	3.68	0.5	0.31	-0.17
Shasho # 22 GO-1	FB	2	0.2	0.09	0.01	0.02	0.01
Aruso (42) 4 (SN 99G)	FB	23	1.9	18.38	2.4	3.53	1.11
3371-03	FB	1	0.1	0.25	0.03	0.05	0.02
Sirinka	FB	7	0.6	1.00	0.1	1.35	1.22
Dimtu	FB	1	0.1	0.25	0.03	0.04	0.01
Improved	FB	26	2.2	1.28	0.2	0.23	0.06
Miscal-21 (M-21)	MB	165	13.8	85.26	11.2	12.07	0.84
Holker	MB	140	11.7	61.61	8.1	9.03	0.91
Beka	MB	47	3.9	17.38	2.3	2.41	0.12
HB-120	MB	9	0.8	3.50	0.5	0.62	0.16
Malt	MB	10	0.8	0.20	0.03	0.03	0
Savini	MB	9	0.8	5.88	0.8	1.28	0.51
Maruye	UID	1	0.1	0.13	0.02	0.01	-0.01
Basic	UID	1	0.1	0.25	0.03	0.08	0.05
Bithonge	UID	1	0.1	0.38	0.05	0.07	0.02
Abiot	UID	1	0.1	0.25	0.03	0.01	-0.02
Biloshi	UID	1	0.1	0.125	0.02		-0.02
Others	UID	15	1.3	4.61	0.6	1.02	0.41
Overall		**616**	**51.4**	**274.46**	**36.16**	**38.96**	**2.80**

*Note: FB=Food barley variety, MB=Malt barley variety UID=Un-identified barley variety

Table 21. Varietal level simple and weighted averge extent of adoption in the study regions, 2010.

Types of improved varieties	Amhara (Area N=198.5 ha)			Oromiya (Area N=403.8 ha)			SNNPR (Area N=156.6 ha)		
	Sum of area under improved vareity (ha)	Simple extent of adoption (%)	Weighted extent of adoption (%)	Sum of area under improved vareity (ha)	Simple extent of adoption (%)	Weighted extent of adoption (%)	Sum of area under improved vareity (ha)	Simple extent of adoption (%)	Weighted extent of adoption (%)
Ardu 1260-B	0.13	0.07	0.03	7.31	1.81	1.02	1.81	1.16	3.05
Ardu 3336-20	0.54	0.27	0.05	2.13	0.53	0.05	10.67	6.81	7.09
HB-1307	0.44	0.22	0.20	11.08	2.74	3.55	8.06	5.15	1.92
Kulumsa-1/88	1.37	0.69	0.40	2.25	0.56	0.28	0.05	0.03	2.25
Others	2.49	1.25	1.51	1.63	0.40	0.76	0.50	0.32	0.49
Miscal-21	6.73	3.39	2.00	77.77	19.26	19.09	0.75	0.48	1.20
Holker	7.86	3.96	3.94	53.38	13.22	12.81	0.38	0.24	1.88
Beka	0.94	0.47	0.43	16.94	4.20	3.80	0	0	2.02
Improved	1.63	0.82	0.54	10.71	2.65	0	2.21	1.41	0.37
Malt	0.13	0.07	0	2.64	0.65	0.05	0.38	0.24	0.01
Maruye	0.13	0.07	0.03	0	0	0	0	0	0
Sirinka	1.00	0.50	3.92	0	0	0	0	0	0
HB-42	0	0	0	6.00	1.49	9.14	1.81	1.16	1.55
Biloshi	0	0	0	0.13	0.03	0.03	0	0	0
HB-120	0	0	0	3.75	0.93	1.03	0	0	0
Savini	0	0	0	5.88	1.46	2.15	0	0	0
Abiot	0	0	0	0.25	0.06	0.02	0	0	0
Basic	0	0	0	0.25	0.06	0.13	0	0	0
Dimtu	0	0	0	0.25	0.06	0.06	0	0	0
Bithonge	0	0	0	0.38	0.09	0.12	0	0	0

9. Adoption Status of Inorganic Fertilizer on Barley

The study has also assessed the adoption status of minimum tillage technology on barley plots and sub-plots. It was revealed that the average adoption rate of minimum tillage technology was only 1.7% (2.3% for SNNPR, 1.5% for Amhara and 1.3% for Oromiya regions). This is because, farmers perceived that minimum tillage requires a lot of human labor to dig pits for planting crops. As a result, the average adoption rate which used to be 8% at the beginning of introduction of the technology has declined to 1.7% at the time of this study (2010).

In the study regions, barley is mainly a rainfed crop. It was only 2% of the farmers who have claimed to have access to and use irrigation for barley produciton. Regional comparison reveals that 5.6% of the households in Amhara region have experiences of producing barley through irrigation while it is almost none in other regions (0.4% for Oromiya and 0.6% for SNNPR). Despite the productivity of barley is very high through irrigation, limited access of a large proportion of the farmers to irrigation facilities has forced them to prioritize crops to be produced with irrigation. Accordingly, focus is given to relatively high value cash crops, such as vegetables and fruits to produce with irrigation.

Barley is also reported to be highly productive when it is produced in short season, locally known as "*Belg* season". *Belg* used to be a common season in earlier days and barley was the major crop to be produced in this season. However, shifts in trends of rainfall distribution has effected to shrinking of the reason from time to time and in some areas complete loss of the season. This is believed to be one of the typical indicators for the effects of climate change in Ethiopia.

Barley research program has recommeded that fertilizer need to be applied to exploit the potential yeilds of barley. A blanket recommendation of 100 kg/ha DAP and 50 Kg/ha UREA has also been recommeded for barley. Accordingly, the average adoption rate of DAP on barley was figured out to be 64% (Table 22). Adoption rate of DAP was high in Oromiya region (87.5%) followed by SNNPR (54%) and Amhara (35.9%). However, the proportion of adopters who applied the recommended rate of DAP was only 11%. The findings have also revealed that the average adoption rate of UREA on barley was 22.6%. However, the proportion of adopters who applied the recommended rate of UREA was only 4.2%.

However, a large proportion of barley growers (40%) did not apply inorganic fertilizers at all. Regional disparity was also evident in fertilizer use in that the proportion of farmers who did not use fertilizer was higher for Amhara region (59%) than other regoins (28% for SNNPR and 17% for Oromiya). Moreover, 73% of the overall sample households (69% for Amhara, 86% for Oromiya and 62% for SNNPR) did not applly UREA on their barley fields.

Farmers who applied the recommeded rate of DAP and UREA accounted for only 11% and 4%, respectively (Table 23). This implies that a large proportion of the farmers (46% for DAP and

17% for UREA) are partial adopters of inorganic fertilizers. The reason might be attributed to high cost of inorganic fertilizers which is alarmingly increasing from year to year. The other reason can also be that farmers often give priority of fertilizer application for other cereals, such as tef and wheat. Farmers have also the belief that barley can give reasonable yields even without application of inorganic fertilizer better than tef and wheat does.

Weeding is also one of the packages of improved barley technologies. For optimum yield, twice weeding has been recommeded for the farmers. Accordingly, the average adoption rate of weeding in the three regions was 47%. Out of this, only 36% of them have adopted twice recommeded weeding.

Table 22. Adoption rates of DAP and Urea fertilizers on barley, 2010.

Types of improved varieties	DAP			UREA		
	No. of farmers applying DAP (N=1198)	% of DAP adopters	Average rate applied (kg/ha)	No. of farmers using UREA (N=1198)	% of adopters	Average rate applied (kg/ha)
Amhara	147	35.6	64.9	110	26.8	43.8
Oromiya	391	87.5	69.3	64	14.3	37.2
SNNPR	184	54.0	78.8	97	28.4	49.0
Overall	722	64.4	71.0	271	22.6	43.33

Table 23. Extent of Adoption of DAP and UREA fertilizers on barley, 2010.

Type of fertilizer	Rates used	Amhara N=		Oromiya		SNNPR		Overall	
		n	%	n	%	n	%	n	%
DAP	100 kg/ha	22	5.4	70	15.7	39	11.4	131	10.9
	90 – 110 kg/ha	28	6.8	91	20.4	50	14.7	169	14.1
UREA	40 – 60 Kg/ha	15	3.7	10	2.2	24	7.0	49	4.1
	50 kg/ha	22	5.4	9	2.0	19	5.6	50	4.2

10. Conclusion

Since three of the study regions account for more than 90% of barley produciton in the country, the findings of this study can also be attributed to national picutre. Decades of barley reseach endeavors has effected to a weighted average adoption rate of 41%. Out of this, 19% of the adopters can be described as complete adopters who planted improved varieties in all of their barley plots. On the other hand, 21% of them can be recognized as partial adopters in that they planted both improved and local varieties in parts of their barley sub-plots. The largest proportion of weighted average adoption rate was accounted for Oromiya region (71%) followed by SNNPR (27%) and Amhara (17%) regions.

Comparison of the three approaches in estimation of simple average adoption rates reveals a divergence to considerable scales. For instance, simple average adoption rate as per household survey was 40% while this figure is 27% for community perception and 24% for expert estimation. Therefore, community perception and expert estimation seem to have underestimated the adoption rate of improved barley varieties. Since household survey employs rigorous scientific tools and techniques in stratification, sample selection and data management, its findings are believed to be more credible and dependable than the other two approaches.

The weighted average extent of adoption of improved barley varieties has been estimated to be 38%. The largest proportion was accounted for Oromiya region (60%) followed by SNNPR (17%) and Amhara (11%) regions. In general, the area occupied by improved varieties of barley can be recognized as relatively high as compared to improved varieties of other cereals. Availability of sustainable demand sink, such as processing industries is believed to have largely contributed for the expansion of improved barley varieties, especially in Oromiya region. Moreover, malt barley varieties are characterized with their double benefits, such as for consumption as food and for industrial purposes. Therefore, they are both food and cash crops for the farmers and this merit is believed to have encouraged farmers to adopt and utilize the technologies.

Among the three approaches employed in this study to estimate adoption rates, community perception was apparently observed to reveal closer estimate to household survey as compared to expert estimates. Even though community perception and expert estimation approaches are less costly and require less time to process data, the information generated might not be substantially dependable for policy formulation and design of strategies. This is because, there is more of subjectivity in sample selection and identification of respondents. The expert estimates, especailly, were far apart from household survey estimates. This might be

because, the study embraced almost only breeders from Agricultural Research Institutes. However, other experts from Ministry of Agriculture, who are believed to have more information about their respective zones and regions, should have also been included in the expert panel.

The comparison between simple average and weighted average adoption rates and extents of adoption have also revealed convergence and close similarity with insiginficant deviation between them. Despite the variatoins seem to deviate apart at lower district levels, the divergence has eventually started to converge at higher regional and national levels.

Varietal level adoption illustrates that out of more than 200 barley varieties grown by farmers, 69% of them were perceived to be local varieties and these account for 64% of the area under barley. On the other hand, the extent of adoption of improved barley varieties was 31%, of which 19% of them were malt varieties while 11% were food barley varieties. Most widely adopted malt barley varieties included Miscal-21, Holker and Beka. Among the food barley varieties, HB-1307, Ardu-3336-20 and Ardu 1260-B were observed to have been adopted relatively better than others. In general, malt barley varieties, all of which are improved ones, were recognized to be largely adopted as compared to food barley varieties.

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