CURRENT SITUATION, INVESTMENT OPPORTUNITIES, AND FUTURE OUTLOOKS OF MALT BARLEY PRODUCTION IN ETHIOPIA

(SECOND DRAFT)

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Abbreviations and acronym

AMF	Asella malt Factory
CSA	Central Statistical Agency
DAs	Development agents
EIAR	Ethiopian Institute of Agricultural Research
ERCA	The Ethiopian Revenues and Customs Authority
ESE	Ethiopian Seed Enterprises
ETB	Ethiopian Birr
EU	European Union
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GoE	Government of Ethiopia
HLW	Hectoliter Weight
ICARDA	International Center for Agricultural Research in the Dry Areas
PPP	Public Private partnership
SNNP	Southern Nations, Nationalities and Peoples Region
TKW	Thousand Kernel Weight
USD	United States Dollar
USA	United States of America
USDA	United States Department of Agriculture

Executive Summary

This study assesses the current situation and identifies opportunities and constraints along the malt barley value chain in Ethiopia. The future prospects of malt barley production, processing and marketing in line with the booming brewing industry and investment opportunities in the country are also explored. The paper also makes a thorough review of relevant literature and analysis of secondary data to address the major issues prevailing in the malt barley value chain and to make projections about the future.

Barley is the fifth most important cereal crop in Ethiopia produced on about 1 million hectares of land from which 1.78 million tons of grain is produced annually (CSA, 2013). However, the share of malt barley is small estimated at 7 % of the total annual production. Currently, the cultivation of malt barley is mainly concentrated in the highlands of Arsi, West Arsi and Bale administrative zones of the Oromia Regional State. Despite, its limited cultivation, malt barley represents an attractive market opportunity for smallholder farmers in the highlands where cold temperature limits the possibility of successfully growing alternative cash crops.

Malt barley is among the priority commodities that have attracted the attention of policy makers in Ethiopia. The government is keen to boost production of malt barley through appropriately supporting smallholder farmers and attracting commercial farming. Recently, through a public - private partnership involving the Ethiopian Institute of Agricultural Research (EIAR), Assela Malt Factory (AMF) and four breweries (BGI, Meta Abo, Harar and Bedele), a lot of effort is being exerted to boost malt barley production by strengthening malt barley research and scaling up of available malt barley technologies. As a result, notable progress has been made in raising production in the project areas of the Central Highlands, Bale and Arsi. Both area expansion and improvements in productivity have been the major drivers for the increase in production. Despite all efforts, however, malt barley production is still restricted to few areas and productivity is much below the potential. Even in the traditional malt producing areas of the country, much of

the malt grain produced is locally consumed mainly due to limited infrastructure and unattractive prices offered in the local market to the large amount of malt barley which is rejected by the AMF for failing to meet the high quality standards.

The malt barley sub-sector in Ethiopia is not yet well developed. The Assella Malt Factory (AMF) is the only institution engaged in the processing and marketing of malt grain in Ethiopia. Recently, investment on breweries has increased and consequently the demand for malt barley has also grown significantly reaching 65 thousand tons per year which is expected to increase further with the ongoing expansion of old breweries and the establishment of new ones.

Due to poor quality of locally produced malt barley, domestic production of malt grain covers only 38% of total national demand. Inadequate supply of malt by the local malt factory (AMF), therefore, has remained a major production constraint faced by almost all the breweries. Consequently, all the breweries import most, if not all, of the malt they need and spend a considerable amount of the much-needed foreign currency, which could have been used for other development programs in the country. The gap between domestic supply and demand indicates an opportunity to enhance local production and substitute import through huge untapped malt barley potential in the country. Therefore, given the expanding demand due to increased capacities of existing breweries and those under establishment, there is a need for intensified research and development efforts along the malt barley value chain for increasing productivity, production and quality of malt barley in Ethiopia, without which, the country's reliance on imports is likely to grow even further.

The key areas identified by this study that need major emphasis in malt barley research for development include: scaling up and out of productive varieties, managing acidic soils, developing and implementation of optimal agronomic practices for ensuring high malting quality,

pest management, seed production and distribution systems, linking farmers to the market and favorable policies to boost malt barley production. These measures are believed to enhance the diversification of livelihoods in the barley-livestock based production systems of the highlands of Ethiopia and make substantial contribution to national economy through import substitution and possibly through export of malting barley grain.

1. Introduction

Barley (*Hordeum vulgare* L.) is one of the oldest crops cultivated in the world. Archaeological evidence from the Fertile Crescent indicates that about 10000 years ago the crop was domesticated from its wild relative (*Hordeuum spontaneum* C.Koch) (Zohary and Hopf 1988; Harlan 1995). Ever since, owing to its high potential for adaptation to diverse agro-ecologies and its various uses, the cultivation and use of barley has expanded throughout the world.. In Ethiopia, barley is the earliest crop to be domesticated and has been grown since the beginning of cultivation (Berhane et al., 1996). This long history of barley cultivation and the large agro-ecological and cultural diversity in the country has resulted in a large number of barley landraces and rich traditional practices. Ethiopia is one of the few countries bestowed with desirable genetic variability of barley. The diversity in the Ethiopian barley landraces has got an international recognition for its useful traits such as resistance to diseases and high nutritional quality which is of great importance to the generation of improved varieties through provision of genetic materials for breeding (Berhane et al, 1996).

Barley has a broad ecological adaptation that sets it apart from other cereal crops. Barley is cultivated in almost all regions of Ethiopia starting from 1,400 meters above sea level (m.a.s.l.) to over 4,000 m.a.s.l. demonstrating wide ecological plasticity (Berhane et al., 1996). Barley is the fifth important cereal crop in the country after maize, wheat, *teff* and sorghum. It is produced on about 1 million hectares of land from which 1.78 million tons of grain is produced annually (CSA, 2013). The average national yield of barley is about 1.75 tons per hectare. Both food and malt barley are grown side by side sharing similar agro-ecologies. While food barley is produced mainly for subsistence consumption by the rural farm households, malt barley is largely a commercial crop produced for the market (both for industrial malt grain production and for cottage local beer and liquor production).

As of 2013, the share of malt barley in total barley production does not exceed 15 %. However, malt barley is of high priority in the national research and development interventions of the government owing its importance in the beer industry. Since the early 1920's Ethiopia has been totally dependent on imported malt for its breweries, spending millions of dollars every year.

From 1998 to 2012 about40.0 thousand tons of roasted and non-roasted malt were imported costing the country more than 27.8 million USD per year (ERCA, XXX) f).

In the barley-based farming systems of the highlands of Ethiopia, smallholder farmer have very few alternative crops. One source of income could be growing malting barley, which has dependable local buyers in the country (Bayeh and Berhane 2011) and possibly export market. Although there is a considerable potential for increased production of high quality malting barley, the production of malting barley in Ethiopia has not expanded enough to benefit most barley growers. Among others low productivity of land races, unavailability of improved barley technologies to farmers, biotic factors (mainly insect pests and foliar diseases), abiotic factors (low soil fertility, low soil pH, poor soil drainage, drought and poor agronomic practices) and weak technology transfer and poor access to markets are identified as the main constraints responsible for low productivity and limited expansion of malt barley (Chilot et al. 1998; Bayeh and Berhane, 2011). The poor quality of locally produced malting barley is also another major constraint which leads to rejection by the Assela malting factory (AMF) for which farmers are compelled to sell their produce in local markets for local consumption as food barley or for the production of local beer called "*tella*" or local liquor called "*areqae*" posing further disincentive effects on the producers.

In the last two years, the former Harar and Bedele breweries have been acquired by Heineken while Diageo acquired the former Meta Brewery. Following privatization of the breweries, the capacities of the breweries has increased further widening the domestic demand and supply of malt barley. As domestic malt grain production has always been targeting only the domestic demand, the expansion of malt barley grain production is intertwined with beer production in Ethiopia. Beer production in the country increased from 1million hectoliters in 2003 to roughly 4 million hectoliters in 2012 exhibiting a growth rate of nearly 20% annually. The growth in beer production has led to corresponding growth for malt barley demand, which is the key raw in-put for beer production. Currently, the four major breweries in Ethiopia (BGI, Dashen, Heineken and Diego) require about 65,000 tons of malt barley per year to produce to at their current full

capacity of 3.8 million hectoliters of beer (Dashen brewery, XX, AMF, YY) and this amount is expected to increase further with the ongoing expansion of old and completion of at least xx new breweries currently under construction.

Data compiled from AMF for various years indicates that malt barley production in the country has increased from 74.7 thousand tons in 1997 to 119 thousand tons in 2012 registering 59.3% increase. However, despite these notable achievements, domestic production covers only 38% of total annual demand (25 thousand tons out of 65,000 tons) while the major bulk (79%) of production (94,000 tons) was used for subsistence consumption or sold in local markets mainly due to its poor quality for commercial malt grain production. As a result, the county is still importing significant quantities of malt grain to augment local production. Malt imports has grown tremendously reaching 40.0 thousand tons in 2012 covering 62% of total annual demand and costing the country about 27.8 million USD. The AMF is currently producing 25 thousand tons of malt grain per year which is only JJ% of its capacity. Poor quality of locally produced malt barley is again the main reason for AMF to operate under capacity. The gap between current demand and supply levels and the under capacity operation of AMF show the potential for further expansion of domestic supply of malting barley.

However, only about 55% have been supplied by Assela Malt Factory. The balance has been fulfilled by importing malt..

Research on malt barley has been carried out in the country since the mid-1960s, with the introduction and evaluation of exotic varieties (Fekadu et a l, 1996). As a result, malt barley production started in 1975 in Arsi zone with varieties Beka and Proctor, which were identified through research during the previous years. Since then, malting barley production has shown

some level of increase in Arsi zone, and has expanded to other potential areas such as Bale, the central highlands of Shoa and Northwestern Ethiopia.

Based on review of the relevant literature and analysis of secondary data, this study assesses the current situation and outlook for malt barley production, marketing and utilization in Ethiopia. The study presents the key features of the malt barley sub-sector and makes projections about future demand and supply of malt barley in the country. Results of the study are expected to bridge the information gap through providing facts and figures about the key features concerning production and utilization, constraints stifling productivity and expansion of malt barley, intervention areas and opportunities for exploiting the malt barley sub-sector towards meeting malt barley needs of the breweries in the country as well as the possibility of entering the export market.

In its attempt to meet the above goals, the next section of this study presents the methodology employed for collection and analysis of data. Section 3 presents the global trends in malt barley production, marketing and utilization. Section 4 describes the malting barley sub-sector in Ethiopia with due emphasis on production, local demand and supply as well as import and export of malt barley. The 4th section describes available technologies, malt barley seed systems, efforts in malt barley technology diffusion and assessment of constraints along the value chain. Future outlooks of malt barley production and consumption are analyzed and presented in section 5. Using SWAT analysis, section 6 presents the opportunists and potential constraints in the future development of the sub-sector. Finally, section 7 concludes by summarizing the key findings and avenues for future research and development as well as discussion of their policy implications.

2 Data and Methodology

2.1Data

The information used in this study was collected from various sources. Data from the Central Statistical Authority (CSA) is the basis for estimating malt barley area and production. In Ethiopia, CSA collects data throughout the country using a network of 25 branch offices, 2,290 enumeration areas and about three thousand enumerators and field supervisors. Besides, the CSA data and other data from secondary sources, primary data are generated through focus group discussions with key informants and communities in major malt barley growing areas.

2.2 Methods

This study is based on review and synthesis of the relevant literature and analysis of secondary data. A broad range of issues are considered in the assessment including inventory of improved malt barley technologies, malt barley technology adoption and analysis of the adoption decision behavior of malt barley farmers. Furthermore, numerical analysis of the supply and demand of inputs and outputs as well as critical evaluation of major constraints and investment opportunities are made. Using time series data covering the period 1980 to 2012, trend analysis and projections of future malt barley production and consumption outlooks are conducted for the period 2014 to 2025. .

A number of statistical tools are used to analyze and synthesize the data. Descriptive statistics are largely used to summarize and present malt barley facts and figures while graphs are employed to project trends related to malt barley production and consumption. The analysis of the future malt barley outlook considered three scenarios. The first scenario considers historical trends of production and malt barley area based on historical average growth rates. The second scenario assumes malt barley production will be expanded to new high potential barley growing environments using available best-bet technologies. The third scenario is based on the

assumption that malt barley production further expands not only to high potential but also the low potential barley producing areas of the country.

3 Global barley production and trade

3.1 Global barley production

Barley is the fourth most important cereal crop in the world after maize, rice and wheat (FAO, 2012). Table 1 indicate that area planted to barley declined from 1996 until 2012 while yield per unit area experienced a continual increase from 1.6 t/ha to 2.7 t/ha during the same period. The production volume increased until it reached a peak of about 171 million tons in 1986-1990 and then declined following a significant decrease in area cultivated. Both the area planted to barley and the total production declined in 2012 in spite of increase in the yield per hectare (Table 1). A slight decline in barley area cultivated in 2012 is mainly due to unfavorable climatic conditions in the main producing countries (e.g. Australia) and increase in production of other crops in areas that have traditionally been major producers of barley, particularly in USA.

Table 1: Average global barley production (1961-2012)

Years	area harvested (million, ha)	Production (000' ton)	Yield (t/ha)
1961-70	61.4	99382.9	1.6
1971-80	77.8	150508.2	1.9
1981-85	79.3	162495.5	2.1
1986-90	76.0	171619.0	2.3
1991-95	72.9	161477.9	2.2
1996-00	58.8	141820.7	2.4
2001-05	56.4	143174.0	2.5
2006-11	53.0	139670.1	2.6
2012	49.0	132350.2	2.7

Source: FAO (2012)

Globally, the major producers of barley are Russia, Australia, Ukraine, Turkey, Spain, Canada, Morocco, France, Germany, USA, United Kingdom, Algeria and Ethiopia (Table 2). Russia produces the highest quantities of barley with an estimated production of approximately 13.90 million tons followed by Australia with a production of about 8.2 million tons in 2012. On the African continent, the top barley producers for the year 2012 were Algeria and Ethiopia having produced about 1.6 million tons each. The productivity of barley in Ethiopia was 41.7 % higher than the African average of 1.2 t/ha, but 37% lower than the world average of 2.7 t/ha. It is noteworthy that the productivity of barley in Ethiopia is comparable to Russian Federation and close to that of Ukraine and Australia.

Table 2: Area cultivated, production and yield of barley in the main producing countries

Country	Area harvested M ha	Production quantity M tones	Yield tons/ha
Russian Federation	7.6	13.9	1.8
Australia	3.7	8.2	2.2
Ukraine	3.3	6.9	2.1
Turkey	2.7	7.1	2.6
Spain	2.7	5.8	2.2
Canada	2.1	8	3.9
Morocco	1.9	1.2	0.6
France	1.7	11.3	6.7
Germany	1.7	10.4	6.2
USA	1.3	4.8	3.7
United Kingdom	1.0	5.5	5.5
Algeria	1.0	1.6	1.5
Ethiopia	0.96	1.6	1.7
Africa total	4.9	5.8	

World total	49.3	132.4	
African average			1.2
World average			2.7

Source FAO Statistical Year Book 2013

Please provide some data and discussion of global production of malting barley here. Otherwise, the transition to the next section will be awkward.

3.2 Global barley trade

Barley is used commercially for animal feed and malt production where it is the most important ingredient in beer production. In some countries, the importance of malt barley for human consumption is also very high. The barley demand for the different uses is best met with specific varieties. Figure 1 shows the trend in production and marketing of barley over the period between 2007 and 2011.

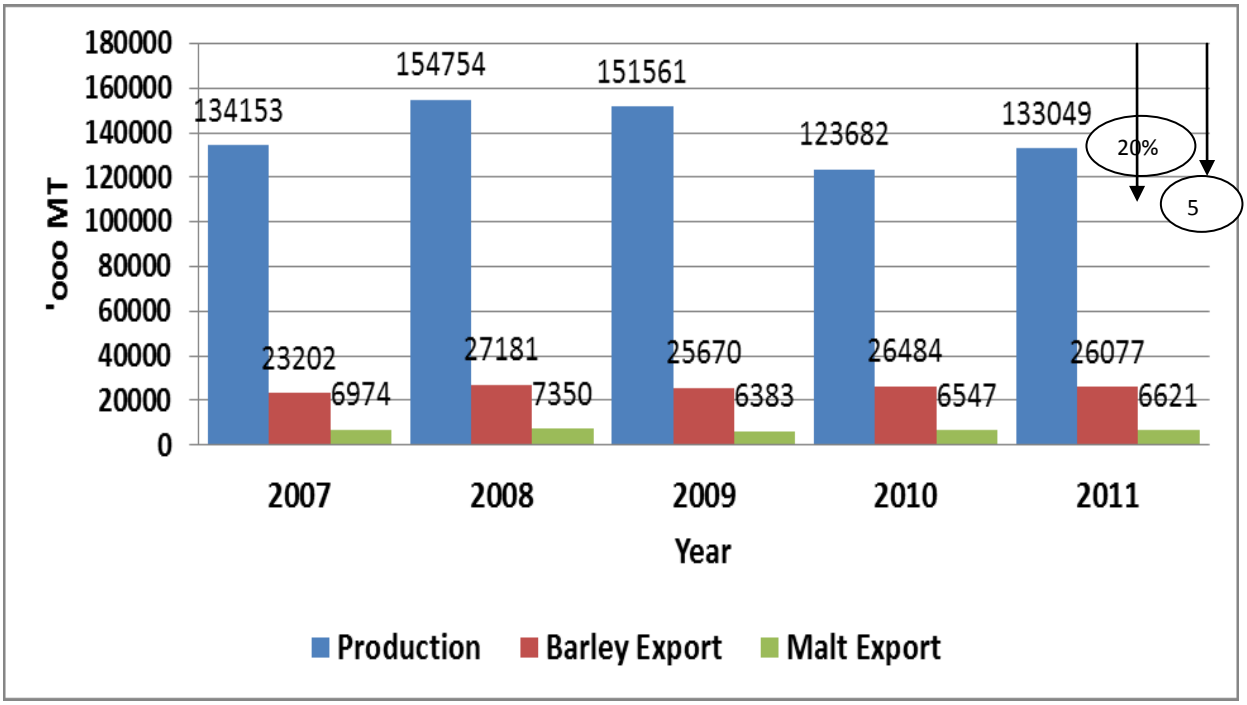

Figure 1: Global barley market trend
Source FAO Year book (2007-2012)

In general, the trend in world barley trade shows a slight increase over the five years period of 2007-2011. However, only an average of about 20% of total production is traded, as most barley produced is locally consumed in producing countries. During the same period, the proportion of malt barley exported was only 5% of total malt barley production and 26% of the total barley exports showing that feed and food barley trade dominate the world barley market. Among the main barley producing countries, EU (mainly France, Germany and Spain), Canada, Australia and Argentina are the largest malt exporters (Figure 2). Malt barley trade is expected to remain firmly in the hands of the three major exporters including the European Union (EU), Australia and Canada.

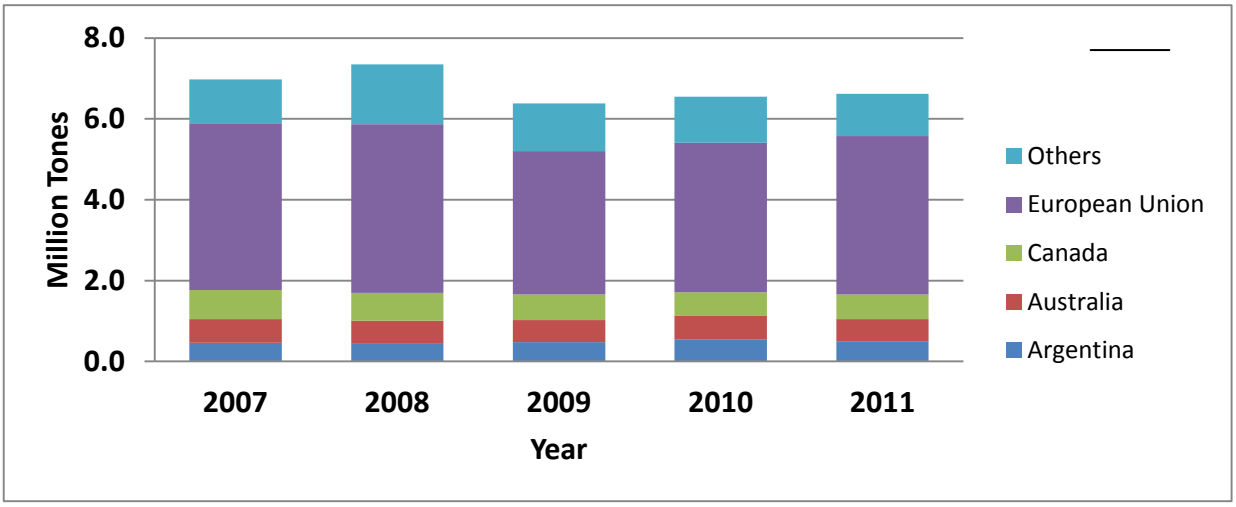

Figure 2: Major malt barley exporting countries in the world
Source: various CSA reports (2007- 2011)

4. Barley production in Ethiopia

Barley (*Hordeum vulgare* L) is an important staple food crop and has high potential in narrowing food deficit and the achievement of food security in Ethiopia. It sustains the livelihoods of millions of people residing in the highlands (Zemede, 2000) and fetches a substantial income for farmers. Particularly, barley is produced by about 4.5 million farm households supporting a

population of about 22 million[1] in the Ethiopian highlands. Moreover, millions of urban and rural dwellers drive their livelihoods from the processing of barley into local drinks called *tella* and *areqae*.

Barley is grown in diverse rain-fed agro-ecological zones of Ethiopia characterized with a wide range of climate. In terms of altitude, barley grows well from 1800 to 3000 m.a.s.l. At the highest elevations, it is often the only crop grown that provides food, beverages and other necessities to many millions of people. Barley grows well on well-drained soils with moderate acidity and neutral pH. It has good tolerance to frost and drought and also to saline and alkaline soil conditions, but is sensitive to high levels of aluminum usually associated with low pH. It requires an evenly distributed rainfall of over 500mm. Over 98% of total area and production of barley is concentrated in four regions namely: Oromia, Amhara, Tigray, and Southern Nations, Nationalities, and People's Region (SNPPR) while small amount of barley is also produced in the Harari and Benishangul Gumz regions.

The diverse traditional recipes that are prepared from barley and the strong barley consumption habit of the population signify the importance of the crop in Ethiopia (Birhanu et al., 2005). According to Stefania and Helena (2005), it accounts for over 60% of the total volume of food intake of the people in the highlands of Ethiopia. Furthermore, barley straw is a good source of animal feed especially during the dry season, and it is also a useful material for thatching roofs of houses and for use as bedding. Barley is ideally suited for malting for three main reasons: high enzymatic activity, a protective hull for the germinating seedling and use in filtration, and the firm texture of the steeped kernel (Burger and LaBerge, 1985). The share of malting barley production is however quite low (about 10%).

[1] This figure is generated using a conservative estimate of average household size of 5 in the Ethiopian highlands.

Barley is cultivated in different production systems. Chilot et.al. (1996) identified four major barley production systems, namely; early, late, *Belg* and residual moisture. The late-barley production is the dominant form of production system in the main rainy season (locally called meher season which normally extends between June and Mid-September) in the high altitude areas of the country. Early barley production system (usually between the months of XX and YY) is indispensable in both mid and high altitude areas during the main rainy season. Significant amount of the 'Belg' barley (barley produced during the short rainy season February to Mid-June) and the residual moisture barley production systems are practiced in some regions of the country (generally occurring during the months ZZ-LL) depending on topography and rainfall distribution of the area (Chilot *et al*., 1998; Fekadu and Hailu, 1998).

Barley is one of the major cereal crops with strategic importance in Ethiopia. It ranks 5th following teff, maize, wheat, and sorghum. During 1986-2012, the contribution of barley to total area under cereals averaged about 11% (Fig. 4).

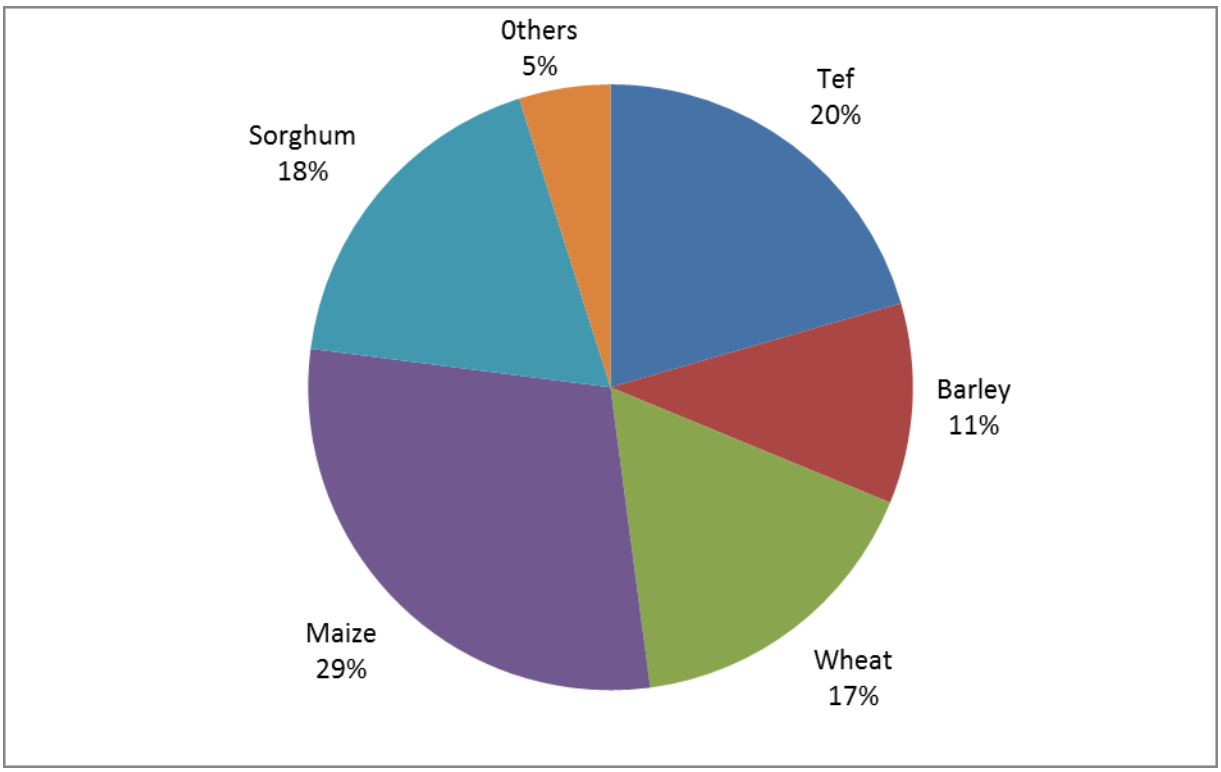

Figure 3: Average contribution of barley area to total area cultivated during 1986-2012

Source: various CSA reports (1986- 2012

In terms of production, barley accounted for 13% of the total volume of cereal production (Figure 5). As is true for all cereal crops, barley production has been on the increase with high inter-annual variability.

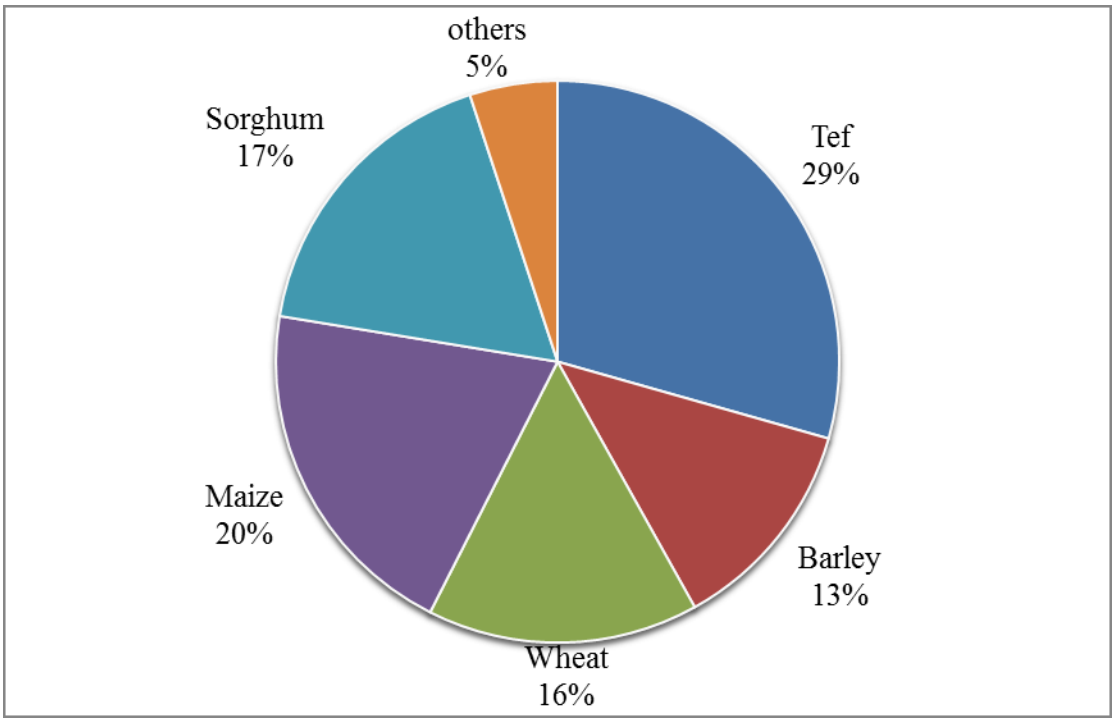

Figure 4: Average contribution of barley to total volume of cereal production during 1986-2012.

Source: various CSA reports (1986- 2012)

During the 2012/13 cropping season, the total area under barley cultivation was about 1.0 million hectare, while the production was estimated at 1.78 million tones. Barley cultivation is also widely distributed, with more than 4.5 million smallholder farmers in the four major regions (Table 3). Although barley is widely grown in Ethiopia, the major producing areas are concentrated in the two regional states - Amhara and Oromia. These two regions accounted more than 80% of the total barley production (see Table 3).

Table 3: Regional Estimates of Area, Production and Yield of barley in 2012/13 production year

Region	No. of Smallholder Farmers	Area (ha)	Production million tones	Productivity (t/ha)	% of total national production
Oromia	1,565,303	448545.3	0.89	2.0	50.4
Amhara	1,653,421	388113.2	0.59	1.5	33.2
Tigray	461,129	98165.5	0.16	1.6	8.9
SNNP	769,481	82040.2	0.13	1.6	7.4
National	4,461,619	1018752.9	1.78	1.7	

Source: CSA (2012)

In the period 1986-2012, total volume of barley production and cultivated area showed steady increase (Figs. 6 and 7). The average total cultivated area under barley increased from an average of 653 thousand hectares for the period 1986-90 to an average of 1 million hectares in 2012-13, with an average annual growth rate of 2.6 %. During the same period average barley production has increased from 0.70 million tons to 1.78 million tons, with an average annual growth rate of 5.5 %.

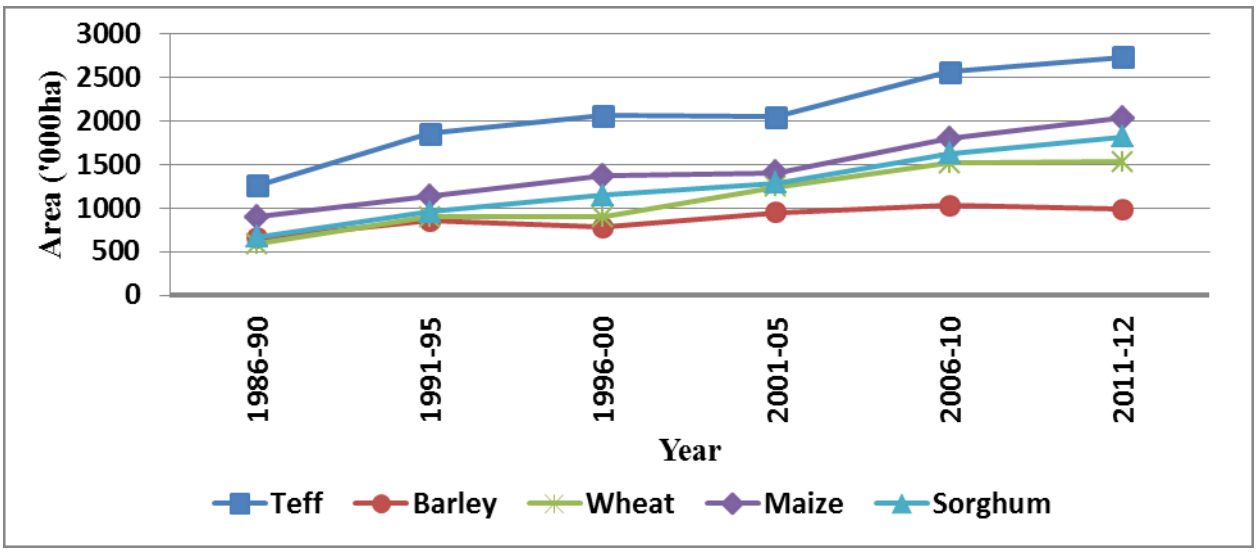

Figure 5: Cereals cultivated area trends in Ethiopia (1986-2012)
Source: various CSA reports (1986-2012)

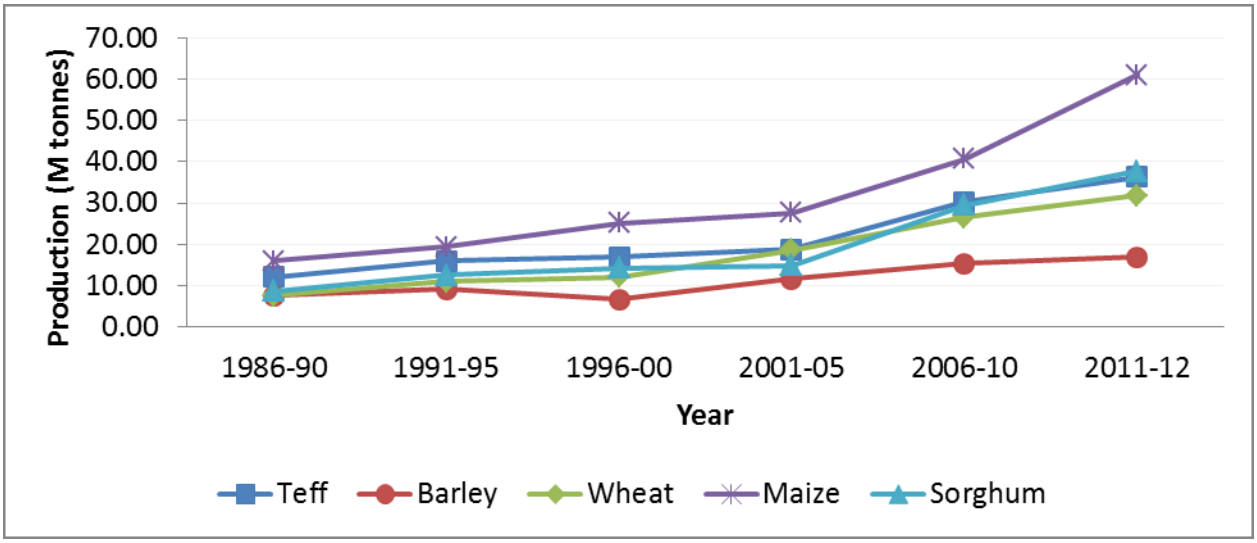

Figure 6: Cereals production trends in Ethiopia (1986-2012)
Source: various CSA reports (1986-2012)

Average Grain yield of barley has also showed an increasing trend, particularly starting from the years 2000-2005 barley yield exhibited an average annual growth rate of 3.6% (Fig. 8). The dramatic increase of yield levels starting 2000 is due to land intensification and productivity increments because of the increased adoption of improved varieties and farm management practices and certified or high quality seed use by farmers.

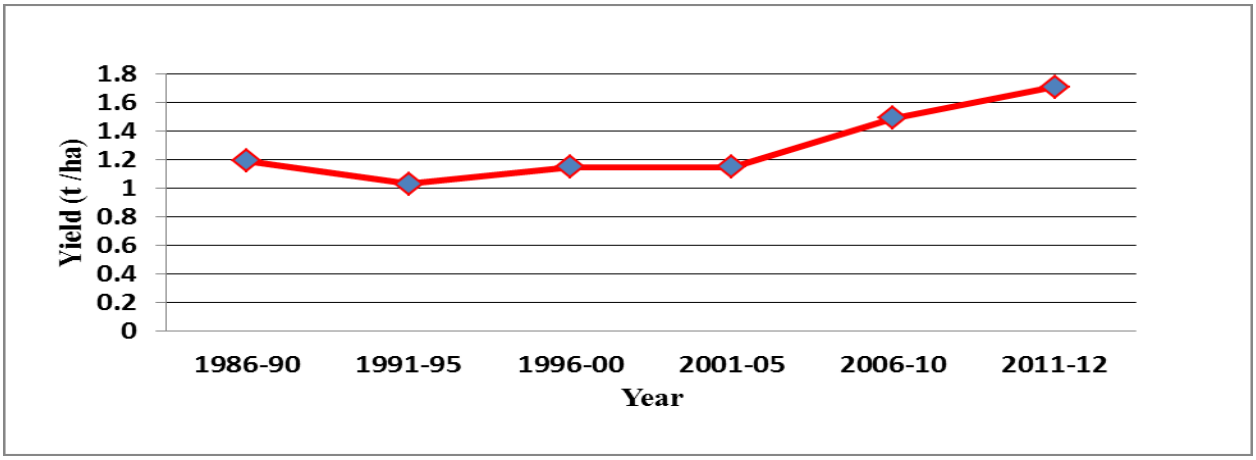

Figure 7: Barley yield trends in Ethiopia (1986-2012)

Source: various CSA reports (1986-2012)

5. Malt barley production

5.1 Malt barley agro-ecology

Ethiopia has enormous potential for malt barley production though its current share is very small as compared to food barley. Malting barley requires a favorable environment to produce a plump and mealy grain. It grows best at altitudes ranging from 2300 to 3000 m.a.s.l. with uniform rain fall distribution of 500-800 mm during the crop growing season. It requires a well-drained soil with pH of 5.5 – 7.3. Figure 8 provides an agro-ecological-based land suitability map for growing malt barley in Ethiopia. Currently malt barley grain is mainly produced in the South eastern part

of Ethiopia (Arsi and Bale), Central Highlands and North-Western part of the country (Gojjam and Gondar).

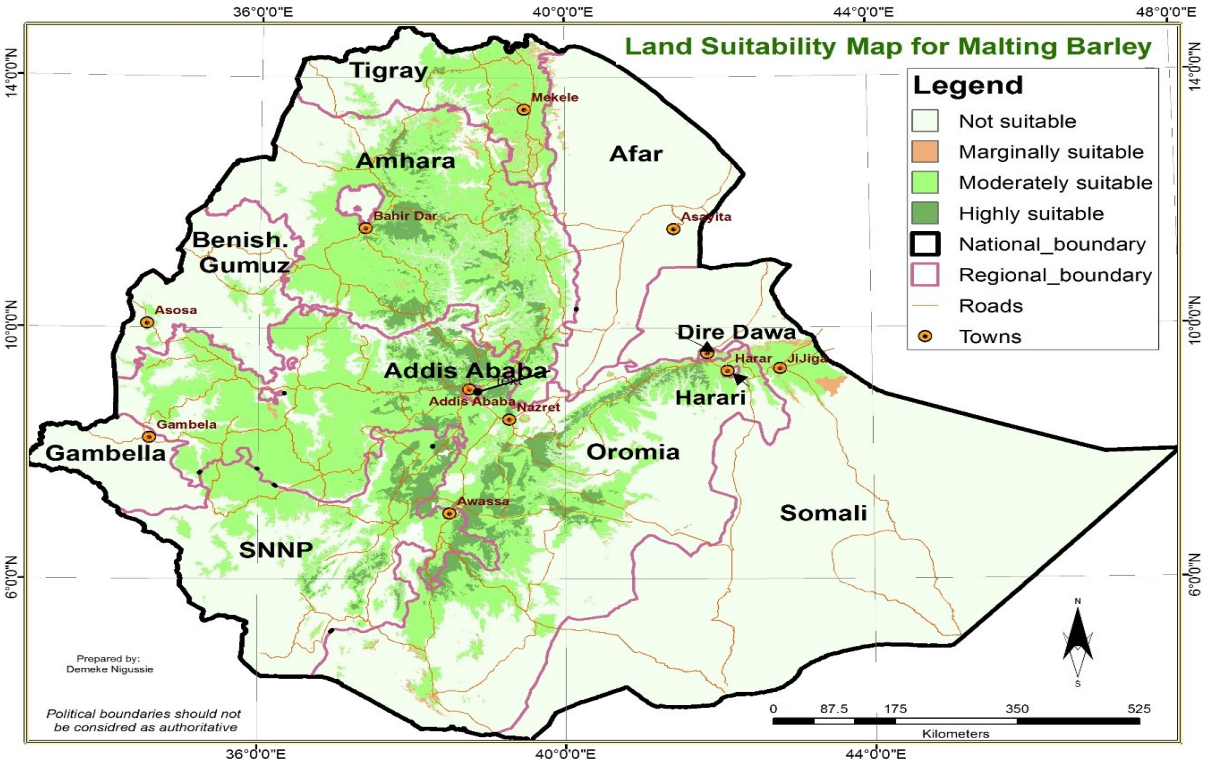

Figure 8: Land suitability map for malting barley production

The major constraints for malt barley grain production include adaptation of the current malt barley varieties to higher elevation and specific agro-climatic zones. Even among the high potential areas producing malting barley, poor crop management which are based on cultural practices and poor quality traits of varieties lead to poor quality grain such as high screen loss, low thousand kernel weight and high protein content (Mohammed and Getachew, 2003). Until recently barley had not been given due attention in the national extension program as compared to wheat and maize. In addition, technology promotion and linkage among stakeholders have not been sufficiently addressed and the issue of market and the linkage between industry and

producers has also remained a problem until recently. Given the rising government interest and attention given to the production of malting barley along with the suitable agro-ecological conditions in the country, Ethiopia can potentially substitute its import through domestic production of malt barley.

5.2 Historical trend

Cultivation of food barley in Ethiopia is believed to have been started some 5000 years back. The production of malting barley, on the other hand, has a very short history of about 40 years. It is associated with beer making in Ethiopia which started with the establishment of the St. George Brewery in 1922 (Tadesse, 2011) and particularly with the start of local malt production in 1974. The research results of the Debrezeit Agricultural research Center, Ethiopian Institute of Agricultural research and Arsi Development Unit (with its extension and marketing structure) as well as the readiness of St. George Brewery with its new malt plant (capacity of 5000 tons malt) enhanced the local production. Formally, local malt production started with the identification in 1974 and recommendation of three introduced malt barley varieties, namely Kenya research, Proctor and Beka to reduce foreign exchange (Fekadu et al, 1996). Malt barley production expanded in both Arsi and Bale with the release of Holker, a selection from a local cross in 1979. The establishment of the Asela Malt Factory with a capacity of 20,000 tons of malt in 1985 further strengthened the local malt barley production in Arsi and Bale. Self-sufficiency in malt was attained from 1987 to 1989 through local supply of 250 thousand tons of malt grain and no import was made during this period (Berhane et al., 1996). Production was met largely by state farms and some cooperatives in Arsi and Bale regions. The momentum, however, was not maintained in the latter years due to closure of state farms and breakdown of producer cooperatives. Ever since, breweries have reverted back to importing malt to supplement local supply.

Malt barley production in Ethiopia has shown a significant increase both in area and production (Figs. 8 & 9) but has still been predominantly restricted to Arsi, West Arsi and Bale administrative zones of the Oromia region. Out of the total barley area of 1 million hectares in Ethiopia, expert estimates in 2010 showed that malting barley constituted about 8-9% (80 -90 thousand ha). In Arsi, which is the major malt producing zone in the country, area under malting barley has significantly increased from 20 thousand ha in 2000 to more than 85 thousand hectare in 2012 with an average annual growth rate of 5.4%. Correspondingly, the production obtained in the same period increased to about 120 thousand tones in 2012, with average annual growth rate of 5.8% % (Figs. 9 &10). The Arsi and West Arsi zones alone constitute over 85% of the total malting barley area in the country.

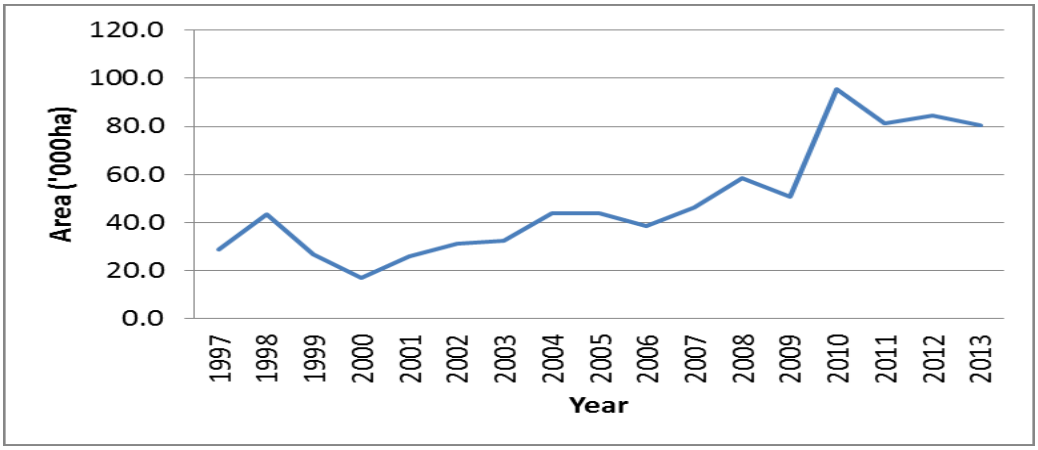

Figure 9: Malt barley Area in Arsi
Source: AMF and CSA reports (1997-2012)

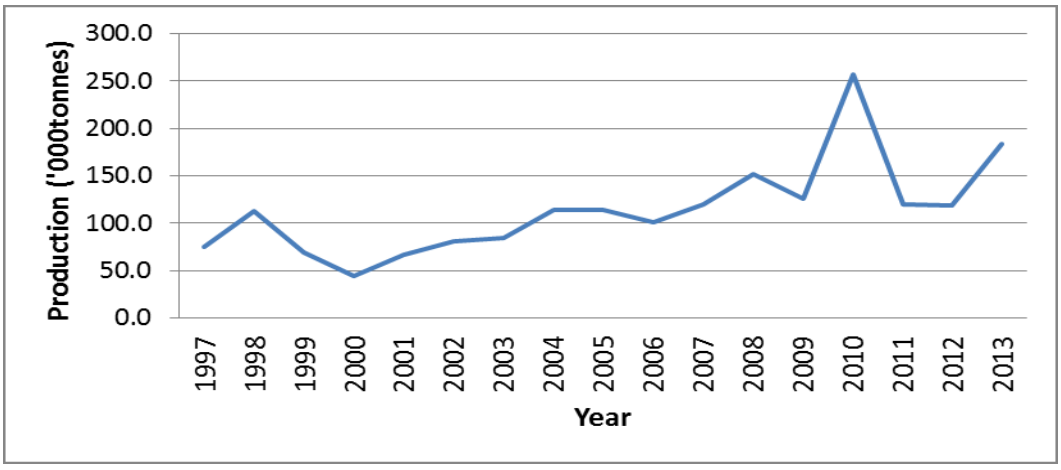

Figure 10: Malt barley production in Arsi
Source: AMF and CSA reports (1997-2012)

Recently, malt barley production has expanded to the central highlands of North Shewa, South West Shewa, West Shewa, Bale zone of the Oromiya region and North Shewa and South and North Gondar zones of the Amhara region. Even though malt barley could be grown in many highland regions of the country, only a few malt barley varieties are adopted in the Arsi and Bale regions where farmers can sell their produce to the Asela Malt Factory (AMF). Given the tremendous potential for malt production in the country, concerted efforts to boost malt barley production have been initiated in 2009 by the Ethiopian Institute of Agricultural Research (EIAR), Assela Malt Factory (AMF) and four breweries (BGI, Meta Abo, Harar and Bedele) to strengthening malt barley research and scaling up of malt barley technologies for a period of five years (2009/10– 2013/14). The project is coordinated from Kulumsa Reserach center and being implemented in the four federal and regional research centers, namely Kulumsa, Holetta, Sinana and Debrebirhan. As a result, there is an encouraging progress in promoting malt barley technologies in the potential malt barley growing areas of the central highlands, Bale and Arsi with the intervention of the on-going public private partnership project.

5.3 Malting barley production requirements and quality traits

Malt is produced from barely, which is the most important raw material for beer production. Other materials such as wheat, rye, sorghum, or millet can also be used to produce malt. Of all the possible raw materials, barely has proved to be the most suitable source of malt for beer production (Poehlman, 1994). Malting barley is a type of barley, which is malted for the preparation of lager and pilsner beer. Good malt is one which during controlled germination has its endosperm completely modified to a smooth mealy consistency so that when kilned (dried) it becomes friable. When ground and mashed, it will allow water to permeate completely and allow the residual enzymes to convert and make soluble the starch and part of the protein (Cook, 1962). Good malting barley should have the specific qualities listed in Table 3. Various studies showed that malting quality involves physical, chemical and biochemical properties that contribute to desirable malt processing and product properties. Some quality parameters such as increased malt extract, adequate levels of amylases and relatively low protein have been incorporated into cultivars for they are basic requirements of the maltery or breweries (Rasmusson, 1985).

Malt barley grain should be round and plump that have more endosperm and fewer husks, thus giving more extract. The grain should be stored at 15% or less moisture content and have high (100%) germination energy during malting. It should have low nitrogen content since the more the protein content the less is the starch and have less malt extract. Generally, the grain should be fresh and have creamy yellow color with fine wrinkled husk with no damage during threshing.

Malt barley is one of the principal ingredients in the manufacture of beer. Accepted malting barley varieties must allow malt production within parameters that meet brewers' specifications. The malting characteristics of barley also depend on growing conditions, harvesting conditions, and storage. To be used in the brewing industry, barley must fulfill the following main criteria:

- high germination capacity
- purity (in the variety)
- graded grain

- low protein content

5.4 Malting barley production technologies in Ethiopia

Research on malt barley started in the 1960's by the Holetta Agricultural Research Center of the then Institute of Agricultural Research (IAR) with the major objective of developing appropriate malt barley technologies in view of saving the foreign exchange incurred for the import of malt. The research largely focused on producing high yielding and disease resistance malt barley varieties suitable for the diverse agro-ecologies of the country. In particular, research on malt barley emphasised on:

- evaluating the local collection for suitability for malting purposes and screening of introductions from Europe abroad;
- hybridization of locally adapted elite lines with introduced cultivars for enhanced agronomic performance, disease resistance and acceptable malting quality;
- studying crop management practices and fertilizer requirements and demonstration and
- pre-scaling up of improved technologies to potential malt barley growing areas.

Useful results have been obtained from the research program. Most notable findings include:

1. Varieties. About 15 varieties are released or registered mainly from introductions and local crosses (Table 4). Most of the varieties are demonstrated and disseminated to farmers particularly in Arsi and Bale Zones.
2. Production environment. Research on suitability of barley growing environments for malt grain production indicates not all barley-growing areas are suitable for malt barley production. The best locations are those lying above 2200 m and having an annual rainfall over 500 mm, spread over at least four and half months during the growing season. Frost-prone and waterlogged areas are not suitable for malting barley production. Well-drained fertile reddish brown soils with a pH of 5.5 - 7.3 are generally suitable for good malt barley production. The malting barley varieties adapted to Ethiopian conditions require a longer

period of ripening.

3. Production technology. Optimum cultural practices, fertilizer requirement and crop pest management options were recommended for malt barley especially for potential barley producing areas. Agronomy trials on malt barley have focused on the development of fertilizer rates for specific domains, the utilization of alternative sources of fertilizer (such as use of farmyard manure as organic fertilizer), establishment of location-specific barley planting dates, and determination of specific seed rates for released varieties. Some of the major recommendations include:
   - Seed rate: broad cast 100kg/ha; drill, 75kg/ha
   - Planting date: June 15-23
   - Fertilizer rate: 40 kg/ha N and 26 kg/ha P, depending on the fertility status of the area.
   - One hand weeding at 30–35 days after crop emergence is required to prevent economic yield reduction. Post-emergence application of 2,4-D 72% a.i. at 1 lt/ha controls some broad-leaf weeds
   - Fungicide tests showed that two sprays of Bayleton and Tilt at 0.5 lt/ha are effective against scald and net blotch, respectively.

Despite the considerable success on the research front, sufficient efforts have not been made to demonstrate the varieties to farmers in other parts of the country.

Table 4: List of malt barley varieties released by the national agricultural research system in Ethiopia from 1973 to 2012

No.	Variety Name	Year Release	Protein %	TKW (gm)	HLW (kg/hl)	Sieve test >2.5mm	yield Potential (t/ha)	Suitable agro ecology:	
								altitude (masl)	rainfall (mm/yr)
1	IBON 174/03*	2012	10.0	46.5	61.9	93.7	3.0-5.7	2300-2801	500-800
2	Sabini*	2001	8.5	45.0	59.5	89.7	2.5-3.0	2300-2800	500-800

3	Bahati*	2011	8.7	47.1	69.1	92.3	2.5-3.0	2300-2800	500-800
4	EH1847*	2011	10.6	46.0	60-64	87-93	3.5-4.0	2300-2800	500-800
5	Friegebs	2010	9-10.5	38-50	51-65	-	4.0	2300-3000	500-800
6	Bekoji-1*	2010	10.5	46.6	66.0	97.3	3.5-4.0	2300-2800	500-800
7	Misccal-21*	2006	11.5	46.0	68.2	94.1	2.5-4.6	1550-2850	500-800
8	Haruna Nijo	2006	11.6	42.8	63.6	45.3	4.8	2300-2800	500-800
9	CDC Select	2006	11.8	44.2	69.7	52.4	3.6	2400-2900	500-8002
10	HB – 1533	2004	12.8	38.7	68.6	44.6	2.6-3.0	2300-2800	500-800
11	HB-52	2001	11.1	40.5	70.7	41.8	2.4-4.7	2300-2800	500-800
12	HB-120	1994	11.9	40.0	70.7	87.0	2.4-3.5	2300-2800	500-800
13	Holker*	1979	10.4	41.1	67.4	89.8	2.4-3.1	2500-3000	500-800
14	Beka*	1976	9-11.5	33.1	69.9	89.9	2.5-3.8	2300-3000	500-800
15	Proctor	1973	8.5	24.4	61.7	-	2.1-4.4	2300-3001	500-801

*= Under production

TKW=Thousand kernel weight, HLW= Hectolitre weight

5.5. Scaling up of malt barley technologies through a public private partnership project

The Institute of Agricultural Research, Asela malt factory and the four breweries (Bedele, Meta, Harar and BGI) have initiated a project on strengthening malt barley research and technology transfer in 2009. The project focuses to ensure the dissemination of new malt barley varieties and availability of pure seed of the varieties to the farmers through informal seed system and thereby enhancing the malt barley grain supply to Assela Malt Factory. The scaling up activity is being done in collaboration with Zonal/Woreda Bureaus of Agriculture. Intensive trainings on malt barley production technologies, seed quality and management have been given to malt barely growing farmers, development agents (DAs) and experts in the project areas. Training and experience-sharing forums were delivered to more than 2000 farmers, 400 experts from the woreda bureaus of agriculture and development agents.

The scaling up activity in the last three years covered 28 woredas in Arsi, Bale and Central highlands. Summary of malt barley scaling up activities during the last three years are presented in Table 5. Currently, more and more individual farmers are involved in the production of malt barley in the new potential areas of the Central highlands and Bale.

Table 5: Area covered (Ha) and seeds distributed through the private-public partnership (PPP) malt barley project, Ethiopia

Zone	Woreda	participant farmers	Seed dist (t)
Arsi	Tena, Dixis, Chole, Lode Hitosa, Hitosa, Tio, Guna, Kore, , Shashemene, Seltana	1996	47.22
Bale	Gasara, Dinsho, Goba Zuria, Sinana	890	20.38
West Arsi	Adaba, Dodola		
SW Shoa	Tole, SedenSodo, Sodo Dache, Kersa-Malima, Wonchi, Woliso	1250	32.02
W Shoa	Ejere, Wolmera, Jeldu		
N Shoa	Degem		
Debrebirhan	Ankober	457	8.49
Total	28	4593	10.83

Average yield obtained = 2.10- 4.1 t/ha

5.6 Malt barley seed system

Availability of quality seed of the preferred varieties at the right time in sufficient quantity is a prerequisite for widespread adoption of improved varieties. Despite the availability of preferred improved varieties generated by research, seed supply remains a bottleneck in barley production in general and malt barley production in particular. During the past four decades more than 15 barley varieties have been released, of which the seed of only 3 are currently produced by the Ethiopian Seed Enterprise (ESE) (Table 6). Ensuring the supply of sufficient quality seed at the

right place, time and at affordable price, therefore, would be crucial in the development of the malt sub-sector. The availability of pure seed undoubtedly helps farmers to produce high grain quality and improve productivity, which in turn help them to get premium price from the market. This is especially true in case of malt barley. High quality malt barley produced also help the malt factory in producing high quality malt for the breweries and save great amount of foreign currency which is being currently spent for the import of malt from abroad.

Table 6: Demand and supply of improved seeds by major malt barley varieties during the 2012 cropping year

Variety	Demand tones	Supply tones	Supply as % of demand
Holker	5458.5	1883.0	34.5
Beka	1652.8	843.1	51.0
Misccal 21	2239.5	220.4	9.8
HB52	2149	-	-
HB 120	932	-	-
HB1533	102		

Source: National seed committee, 2013

The seed system in Ethiopia is largely based on informal mechanisms such as farmer selection and farmer-to-farmer exchanges, which account for over 90 percent of the seed trade (Belay, 2004). The dominance of the informal sector is not only because of the limited capacity of the formal system, but primarily by the country's diverse nature and structure of agriculture. The national research system led by the Ethiopian Institute of Agricultural Research and a number of regional research centers and higher learning institutes provides improved varieties in the form of breeder and pre basic seeds. The Ethiopian Seed Enterprise (ESE) then multiplies seed in response to official demand projections articulated by regional bureaus of agriculture. During the period 2000–2007, the ESE's seed sales have been dominated by wheat and maize, which

account for more than 90 % of sales (Bishaw et al., 2008). As a result, the informal seed system remains the major supplier of seed of improved and local varieties for many crops, including barley, grown by smallholder farmers. There have been some efforts by XXX to disseminate improved barley seeds to farmers in the different agro-ecologies and production systems in Ethiopia. Yet, the availability of timely and high quality seed for improved barley varieties in sufficient quantity to farmers is a major bottleneck for barely production in general and the adoption of improved varieties in particular.

The role of the private sector in the production and marketing of seeds is low and confined to hybrid maize seed (Alemu and Tripp, 2010). Recently, in addition to the ESE, four new public seed enterprises are established by Oromiya, Amhara, SNNPR and Tigray Regional State tasked with the multiplication of basic and certified seeds. Table 6 presents the supply of improved barley seeds from the formal sector from 2007 to 2012. The supply of improved barley seed has shown an increasing trend where it has increased from 636 tons in 2007 to 10, 731 tons in 2012 (Table 7).

Table 7: Trends in the barley seed supply in tons from the formal sector (2007-2012)

Crop	Year					
	2007	2008	2009	2010	2011	2012
Wheat	9276	13678	14053	23909	59810	76683
Maize	8795	8388	9869	28101	35310	41633
Barley	636	650	905	2011	3705	10731
Teff	652	647	787	1955	4351	8122
Sorghum	28	80	150	349	182	142

Source: National seed committee, 2013

6. Barley import and export

Malt is a major raw material for beer production. The product has an increasing demand with increasing beer production. Currently, the Asela Malt Factory (AMF) is the only malt factory engaged in the production and marketing of malt in the country. The AMF, however, does not satisfy the malt demands of the local breweries. As a result, almost all of the breweries import part or all of their malt requirements from abroad. Import of malt (roasted and not roasted) in the past fifteen years was about 285,334.59 tons (Table 8). Import of malt has risen tremendously from about 3.5 thousand tons in 1996 to over 40 thousand tons in 2012 registering 11 fold increases. A substantial increase of import is registered during the year 2010, 2011 and 2012 (Table 8). In terms of value, the country spent 189.1 USD million for importing a total of 285,334.9 tons of malt barley during the period 1998 to 2012. The main reason for such huge increase of import is due to the increased demand of malt because of the continuous expansion of breweries and the limited capacity of the existing factory to satisfy the demand.

Table 8: Malt barley (roasted and non-roasted) import from 1998 to 2012

Year	Quantity (t)	Value (ETB)	Value (USD)
1998	3,501.8	10,675,244.4	1,500,217.0
1999	19,856.7	24,257,906.9	3,054,498.0
2000	3,042.3	13,117,368.1	1,596,311.2
2001	9,623.9	36,749,084.8	4,344,633.8
2002	5,509.0	21,557,400.2	2,516,095.2
2003	5,428.2	24,143,453.4	2,807,411.0
2004	6,200.4	30,872,703.5	3,574,719.0
2005	10,913.2	52,942,054.0	6,048,584.9
2006	26,967.3	126,448,933.5	14,394,223.3
2007	32,194.8	216,128,904.2	23,887,717.8
2008	30,826.4	303,090,752.0	31,287,756.2

2009	22,541.4	238,059,857.0	20,050,691.7
2010	34,182.4	306,204,532.9	21,024,033.3
2011	34,522.0	429,207,628.8	25,151,782.9
2012	40,024.9	497,486,101.7	27,846,033.8

Source: Ethiopian Revenue & Customs Authority

A significant amount of row malt barley was also imported since1999. As clearly shown in Table 9, a total of 29 thousand ton of row malt barley was imported with a value of 9.6 million USD from 1999 to 2012 with no major import from 2002 to 2011 (see Table 9). During 2012 alone, AMF imported 13, 2002 tons of raw barley at a cost of 6.4 million . USD to compliment the short supply from the domestic market.

Table 9: Raw malt barley import from 1999 to 2012

Year	Quantity(t)	Value (ETB)	Value (USD)
1999	5000.0	7860113.6	989726.8
2000	4983.8	8199522.2	997836.5
2001	5775.0	10502871.8	1241694.4
2007	0.2	2678.1	296.0
2008	0.1	3309.5	341.6
2009	0.5	3394.7	285.9
2010	41.1	267416.0	18360.8
2011	7.4	75440.7	4420.9
2012	13200.2	113782141.2	6368783.7
Total	29008.3	140,696,887.8	9,621,746.6

Source: Ethiopian Revenue & Customs Authority

Although Ethiopia is a net importer of barley, the country exported a limited amount of barley during the last fifteen years from 1997 to 2012 (ERCA, XXX).During the indicated period a total of 9943.1 tons of barley was exported to various countries including Djibouti, Saudi Arabia, Europe, USA and Canada earning 465,696.5 USD.

7. Malt barley outlook

7.1 Outlook for malt barley production

The malt barley sub-sector in Ethiopia is in its infant stage. So far the major concentration of malt barley production is in the highlands of Arsi, West Arsi and Bale. Marketing and processing of malt grain is dominated by the Assella Malt Factory (AMF). Malt barley production in these areas has been transformed from low input food barley production to high input market oriented malt production. Smallholder malt barley producers in these areas have responded reasonably well to the intensified agricultural research and extension efforts. Data compiled from AMF for various years indicate that malt barley production has increased from 74.7 thousand tons in 1997 to 119 thousand tons in 2012 registering 59.3% increase. Both area expansion and improvements in productivity have been the major drivers for the notable achievements registered so far. Despite these remarkable achievements, however, the county is still importing significant quantities of malt grain to augment local production. The volume of malt importation has grown tremendously reaching 40.0 thousand tons in 2012 costing the country 27.8 million USD. Malt imports are likely to grow to satisfy the expanded capacities of existing breweries and those under establishment. Hence, the establishment of new breweries and increased scale of operation of existing ones have called for increasing production and productivity of malt grain production in Ethiopia.

As has been discussed in the various sections of the report, variations in malt barley production potential are evident in Ethiopia. The factors, which contribute to these variations among other things, are rainfall amount and distribution, altitude, soil type and fertility status, topography and

presence of pests and diseases. Differential access to market and other supporting services have also believed to have contributed to the observed variations. Based on these biophysical parameters and access to market (mainly in terms of proximity to the AMF), potential malt barley-producing areas in Ethiopia could be categorized into three malt barley growing groups (Table 10).

Table 10: Average malt barley area and production in 2010 and 2011 for the three groups of malt barley growing environments

Malt barley growing environment	Area	% share	Production	% share	Yield
High potential high market	230.13	21.21	499.53	28.97	2.08
High potential low market	662.17	61.04	1008.26	58.48	1.53
Low potential low market	192.47	17.74	216.44	12.55	2.13
Total	1084.77		1724.23		

Source : CSA 2011 and 2012

1. High potential and high market access: Currently, malt barley production for commercial purpose is restricted to the highlands of Arsi, West Arsi and Bale. Farmers in these areas have the experience and motivation for producing quality malt grain provided appropriate technical support and the right economic incentives are provided. Hence, malt barley production could be further intensified using best-bet available improved production technologies. According to CSA (2011 and 2012), on the average about 230.13 thousand ha of land area is devoted for the production of both malt and food barley in this category (Table 10).

2. High potential with poor market access: Barley growing areas in 27 zones registering above average barley productivity are included in this category. In 2011 and 2012, on the average, about 662.172 thousand ha of land was covered by barley and barley production will continue

to be a viable option to farmers in these zones (Table 10). However, as a result of poor access to market due mainly to the absence of nearby malt processing factories, opportunities for producing and selling malt grain until recently is limited.

3. Medium to low potential with low market access: Fifteen barley producing areas registering below average barley yields are included in this category. Average area covered by barley in 2011 and 2013 was about 192 47 thousand ha (Table 10). Barley production in these areas, though, limited, much of what could be produced can reach the market with improvements in road and marketing facilities. Hence, these areas should also be given emphasis, as the proportion of the produce reaching the market could be significant.

Smallholder farmers have a menu of malt barley production technologies to choose from. Among others, availability of improved malt barley technologies compared to competing crops, relative profitability, the policy environment and biophysical setting are likely to influence the choice of malt barley production technologies by smallholder farmers. Malt barley growers have got three malt barley production technological alternatives to choose from.

The first technological alternative involves the use of best bet malt barley production package including recently released and registered improved malting barley varieties, recommended soil fertility management and other agronomic and crop protection practices such as weed and pest control. This best bet malting barley production package are more likely to be adopted in the traditional malt producing areas of Arsi, West Arsi and Bale where farmers have already gained experience in the production and marketing of the crop. Using this technology malt barley yields could be raised from the current average level of 1.8 ton/ha to 2.5 ton/ha.

The second alternative, sometimes referred to as intermediate technology as in option one involves the use of improved malt barley varieties but some elements of the package such as fertilizer and

weeding regimes may be used at sub-optimal levels. This scenario is likely to be important in the high potential malt barley producing areas which have not yet started producing malt barley. Malt barley yields under the second alternative are estimated at 2.0 ton/ha which is lower than the yield levels in option one, but higher than what could be obtained under the use of traditional production practices.

The third option involves the use of improved malt barley varieties as in option one and two but with traditional agronomic and fertility management practices. Barley yields under this option are estimated at 1.5 ton/ha. This yield level, though, low are stable and less risky. Smallholder farmers in the low potential barley producing areas are assumed to use this alternative.

Analysis of the future production outlook of malt barley, therefore, needs to take into account the historical production trends, potential productivity of malt barley technologies, the technology adoption behavior of smallholder barley producers, current investment opportunities, and price incentives. Therefore, taking into account the three categories of malt barley production areas discussed above and relating with the three alternative malt barley production technologies available for smallholder farmers, the future development of malt barley is projected under three scenarios (Table 11).

Scenario 1. The first scenario assumes that historical trends are likely to continue to the future with more participation of the private beer companies. Malt barley production will be restricted to the traditional malt barley producing areas. Farmers in the traditional areas, however, will be using available best-bet technologies attaining average productivity of 2.5 tons/ha. A productivity level is then assumed to increase at 2% annually during the 2014-2030 projection period. Besides, in the traditional malt barley growing areas, malt barley area is expected to grow by 10% per annum at the expense of food barley as more and more farmers will be attracted to the production of malt barley. This could be attained through increased provision of new and better

technologies, intensified extension efforts and improvements in the delivery of complementary inputs. Improvements in the input and output marketing system would be vital to meet the envisaged productivity and adoption levels. It is also assumed that the proportion of malt grain traded would increase by 10% annually as a result of improvements in the marketing system (Table 11).

Scenario 2. In the second scenario, all stakeholders including research (the national and regional agricultural research institutes the extension system, the AMF, private beer companies and policy makers are assumed to work hand-in-hand to avail improved malt barley packages in the rainfall assured high potential barley growing environments where the marginal gains due to use of the improved malt barley technologies is the highest. It is therefore assumed that malt barley production will be expanded into new but high potential barley growing areas such as the Central and Northern barley growing areas. Accordingly, it is assumed that area share of malt barley technologies in the traditional and high potential but new areas would increase by 2% and 10% per year throughout the projection period. While framers in the traditional areas are expected to be producing using the best-bet technologies, farmers in the new but high potential areas are assumed to use sub optimal technologies (option 2). It is also assumed that the volume of malt grain traded would increase by 10% annually from the 2013 (Table 11).

Scenario 3. In the third scenario, research, extension, policy makers and the private sector are assumed to aggressively and systematically involve in the promotion of malt barley production packages not only in the traditional malt barley producing areas but also in the high and low potential barley production areas. Consequently, malt barley production is expected to be further expanded to low potential areas. It is assumed that as a result of concerted multi-institution research and development efforts, area devoted to malt barley is expected to grow by 2%, 10% and 10% in the traditional, high potential and low potential areas, respectively. Accordingly, the share of malt barley in total barley area is expected to reach about 51 %, 46% and 11% in the old

(traditional), high and low potential barley growing areas of the country by the year 2030. In terms of the use of technological choice, however, while farmers in the traditional malt barley producing areas use best-bet technologies, farmers in the high and low potential areas where malt barley will be introduced to use intermediate production practices. In line with the production alternatives to be adopted and given the biophysical environments average malt barley productivity is estimated at 2.5 ton/ha, 2.0 ton/ha and 1.5 ton/ha in the traditional, high and low potential areas, respectively. Productivity, however, is assumed to be increasing at annual rate of 1% in traditional malt growing areas where the baseline productivity is already high and at the rates of 2% and 1% in the new high and low potential areas, respectively. Furthermore, owning to the expected improvements in the marketing system, the proportion of malt grain produce is assumed to grow at 10% annually reaching 81% and 46% of the produce from the traditional and new areas, respectively.

Table 11: Baseline values and annual growth rates of malt barley area, productivity and grain used in production and demand forecast, Ethiopia

	Productivity		Area		Malt grain traded	
Scenarios	(ton/ha) in 2013	Annual growth rate (%)	('thousand ha) in 2013	Annual growth rate (%)	(,000 ton) in 2013	Annual growth rate (%)
I	2.5	1.0	43.4	2.0	16.9	10
II	2.0	2.0	0.0	10.0	0.0	10.0
III	1.5	1.0	0.0	5.0	0.0	10.0

The production projections for selected years are presented in Table 12. The projected area and production indicate malt barley area and production in Ethiopia will exhibit substantial growth in the years to come. In the second scenario where malt barley production is expected to expand into new and yet high potential areas, malt grain production is expected to raise by about 24% in 2015, 35% in the year 2025 and 42% in the year 2030 compared to the first scenario. Nevertheless, a pronounced improvement in malt barley production will be achieved in the third

scenario where malt barley production is expected to expand to both high and low potential barley producing environments throughout the country. Malt grain is expected to increase by about 83%, 127% and 195% in the years 2020, 2025 and 2030, respectively, compared to the baseline scenario. The implication is that raising malt grain production in Ethiopia requires not only intensifying extension efforts attempting to reach more growers to adopt available and proven malt barley technologies in the traditional malt production areas of Arsi, West Arsi and Bale but also creating conducive environments and persuading barley farmers in non-traditional malt barley growing areas to grow malt barley. A comparison of scenario III with scenario I reveal a similar trend further suggesting the need for a concerted effort to introduce malt barley production beyond the traditional growing areas to other barely producing areas throughout the country.

Table 12: Forecast of malt grain production under three scenarios, Ethiopia

Year	Scenario I		Scenario II			Scenario III		
	Area ('000 ha)	Production ('000 ton)	Area ('000 ha)	Production ('000 ton)	% change over scenario I	Area ('000 ha)	Production ('000 ton)	% change over scenario I
2012	84.5	190.2	84.5	190.2	0.0	84.5	190.2	0.0
2015	100.9	262.4	111.9	404.7	54.2	180.2	419.2	59.8
2020	106.0	304.5	123.8	557.6	83.1	230.6	577.0	89.5
2025	111.4	353.3	140.0	803.3	127.3	308.0	829.4	134.7
2030	117.1	410.0	163.1	1210.1	195.1	428.5	1245.1	203.7

7.2 Demand projection and outlook of the malt barley value chain

In Ethiopia, malt barley is a smallholder crop produced both for food and cash. In the year 2012, about 190 thousand tons were produced and consumed in Ethiopia. Of these only 14.6% of the malt grain were formally traded and used for malting. The balance is consumed by farm

households and urban consumers revealing the crops significance not only for malting but also as a food crop. Several local dishes such as injera (the most preferred food type for the majority of Ethiopians), kitta (unleavened bread), bread, porridge, besso and local alcoholic beverage like 'tella'and 'katikala' are produced and consumed mainly in rural areas. Recently, consumption for malt barley based food products is on the increase for it is considered a healthy diet in urban centers. Malt barley, therefore, has a large demand sink involving a wide array of stakeholders. The major stakeholders, however, are the Assella Malt Factory and by through their derived demand for malt grain, the five breweries operating in the country.

The demand for malt barley is a derived demand for beer. Consequently, the analysis of the market potential of malt barley should take into consideration not only the malt processing factories but also the brewery industry.

Beer consumption in Ethiopia, although, low compared to many African countries is on the increase (Figure 11). Beer production increased from 1 million hectoliters in XX to roughly 4 million hectoliters in YY registering an annual growth rate of 20%. The observed increase in beer demand is motivated by rapid urbanization, high population growth, and rising incomes. Consequently, per capita beer consumption is projected to grow by 15% to 20% annually pushing the per capita consumption levels to 8 to 10 liters in the next five years (XXX, YY).

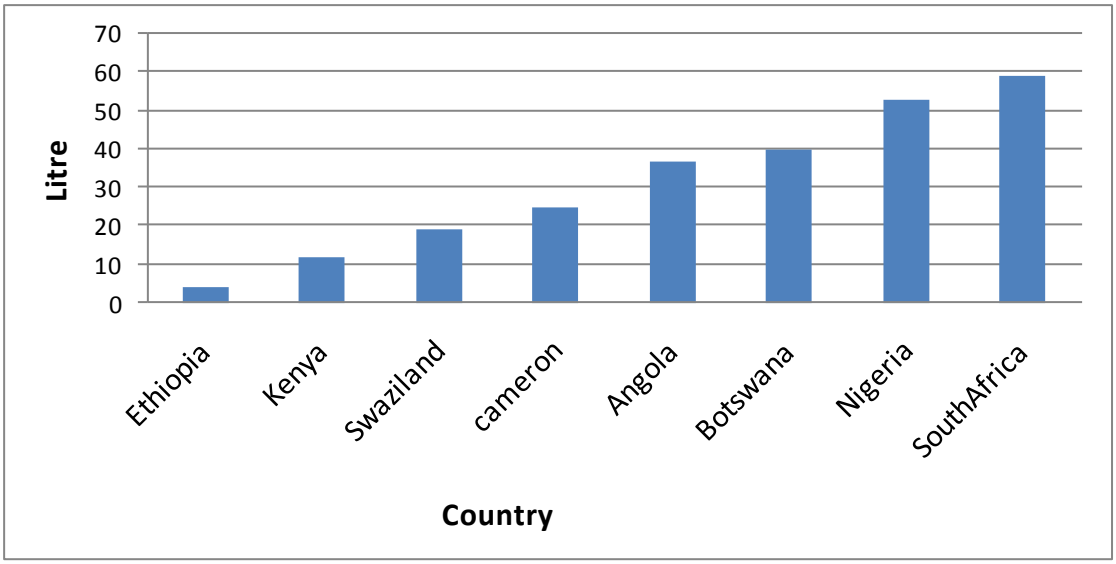

Figure 11: Per capita Beer Consumption in Selected African Countries

Currently, the bulk of the country's beer demand is supplied by four big brewing companies namely: the BGI Group, Dashen, Heinken (formerly Harar and beadle), and Diegeo (formerly Meta) Factories (Table 13). Of the four companies currently operating in Ethiopia, BGI is the largest brewery with a market share of 52.5% followed by Dashen, which is based in the north of the country. Recently, some of the local breweries have been acquired by international breweries. Heineken acquired the former Harar and Bedele breweries in August 2011 whereas Diageo acquired former Meta Brewery in 2012. Both Heineken and Diageo are carrying expansion projects. Besides the already existing breweries, three breweries namely Habesha, Raya, and Heniken- Kaliti are in the process of establishment and will be entering production in the next two to three years. Hence, this study makes demand projection for malt barley taking into account the expected increases in capacities of existing breweries and the establishment of new breweries.

Table 13: Current Breweries capacity and Malt Demand in Ethiopia

Factory	Capacity (HL/Year)	Total Capacity Share (%)	Malt Grain Requirement (ton)	Malt Barley Requirement (ton)
St. George (BGI)	2,000,000	52.5	34,000	49,300
Dashen	709,000	18.6	12,053	16,633
Meta (Diageo)	500,000	13.1	8,500	11,730
Harrar (Heniken)	300,000	7.9	5,100	7,038
Bedele (Heniken)	300,000	7.9	5,100	7,038
Total	3,809,000	100.0	64,753	91,739

At the moment the government owned Assela Malt Factory, a is the only malt producer in the country with an annual capacity of 36,000 metric tons. The annual malt demand in the country, however, is much higher, estimated at about 91,739 tons. Consequently, the county imports the balance to close the unmet demand. Meanwhile, a second malting plant with a capacity of 16,200 metric tons of malt per year is beginning production in the northern region, Gonder. Although, this new malt factory will undoubtedly contribute towards easing demand, there will still remain unmet demand that should be catered for through imports.

In this study, the demand for malt barley grain is projected assuming an annual increase of 15.8% until the year 2015 and then after demand is assumed to grow at conservative rate of 2% per annum. It is also assumes that not all malt barley grain produced is commercially traded. Table 14 compares the projected malt barley grain demand with the three malt grain production scenarios for selected years. A comparison of the baseline production scenario with the projected demand indicates that supply would not be able to meet demand requirements in the foreseeable future suggesting that the county will continue to import substantial amounts of malt grain to meet local demand. The second scenario which assumes expansion of malt barley production to major high potential barley producing areas narrows the gap between demand and supply. By the year 2025 however, local supply will not only meet local demand but also the country would be

able to export if it wishes to do so. A comparison of the third production scenario which assumes expansion of malt barley production to major barley growing areas in the country including low potential barley growing environments with the projected demand suggests that local production could satisfy local demand much earlier than in Scenario II.

Table 14: Comparison of projections of malt barley demand and supply, Ethiopia

Year	Actual/Projected Demand ('000 ton)	Scenario I		Scenario II		Scenario III	
		Marketed Surplus ('000 ton)	% change over demand	Marketed Surplus('000 ton)	% change over demand	Marketed Surplus('000 ton)	% change over demand
2012	80.54	27.82	34.54	27.82	34.54	27.82	34.54
2015	125.04	40.80	32.62	47.44	37.94	50.29	40.22
2020	138.06	60.42	43.76	79.45	57.55	87.23	63.18
2025	152.43	89.48	58.70	143.97	94.45	165.18	108.37
2030	168.29	132.52	78.74	288.57	171.47	346.39	205.82

Note: **Scenario I**: The proportion of malt grain commercially traded is assumed to increase at the rate of 10% from the 2013 level of 15.78% to 81% by the year 2030

Scenarios II and Scenario III: The proportion of malt grain commercially traded from the new high potential areas is assumed to increase at the rate of 10% from the 2013 level of zero to 46% by the year 2030

7.3 Malt barley investment oopportunities

7.3.1 Opportunities in malt barley sub-sector

Malt barley is among the priority commodities that have attracted the attention of policy makers in Ethiopia. The government is keen to boost production of malt barley by appropriately supporting smallholder farmers and encouraging commercial farming. Recently, through a public and private partnership involving the Ethiopian Institute of Agricultural Research (EIAR), Assela Malt Factory (AMF) and four breweries (BGI, Meta Abo, Harar and Bedele), efforts has are being made to boost malt barley production by strengthening malt barley research and scaling up

of available and new malt barley technologies. The project is coordinated from Kulumsa Reserach Center and being implemented in the four federal and regional research centers, namely Kulumsa, Holetta, Sinana and Debrebirhan. As a result, there is an encouraging progress in promoting malt barley technologies in the high potential malt barley growing areas of the central highlands, Bale and Arsi. Besides such government initiatives the following macroeconomic drivers can be taken as key opportunities that drive the malt barley sub-sector in Ethiopia.

Economic growth: For the past five years ending 2012, Ethiopian economy registered an average real GDP growth of 10%. The economic growth is increasing the standard of living and purchasing capabilities of the people.

Population growth: Coupled with economic growth, population growth has a tremendous impact on the growth of demand for beer and consequently for malt barley grain. The Ethiopian population is growing at a rate of 2.6%, which along with the prevailing economic growth, induces additional demand for beer and other barley based products.

Urbanization and changes in culture, tastes and preferences: Rapid growth of many cities and the cultural changes where many households are moving away from brewing the local beer called "*tela*" at home in favor of purchasing commercial beer for regular home consumption and functions, parties and more other occasions plays an important role. Moreover, there are clear changes in the tastes and preferences of the urban population where they are moving away from "tela" towards commercial beer which further increase the demand for commercial beer and hence the demand for malt grain and malt barley.

Conducive Business Environment: Given the relative peace and serenity in the country as well as some incentives from the government, the private sector's involvement in the national

economy is gradually increasing and as a result many private companies are now investing in beer production.

Increased foreign Community: The number of international organizations operating in Ethiopia is growing. As a result, the size of international community in the country is also increasing which spurs more demand for beer.

Foreign Investment: Investment policies and other supports attract foreign investors into the sector. Beer production and marketing is among the most lucrative areas of investment for foreign investors.

A Strength, Weakness, Opportunities and Threats (SWAT) analysis reveal that a lot of opportunities are available, which if appropriately tapped, would spur further development of the sub-sector. Among the opportunities that enhance the development of the malt barley sector include supportive agricultural development strategies and policies, availability of high yielding varieties suitable for the diverse agro-ecologies, and undeveloped but potential malt barley producing areas and high demand for the malt barley grain based products (Table 15). And yet, a wide array of constraints pose serious challenges to the development of the sector.

Table 15: Malt Barley Value Chain Development: Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis

Strengths	Weaknesses

Strengths	Weaknesses
• High yielding pipeline and released malt barley varieties that could be produced under various climatic conditions are available • Increasing private sector capacity and involvement in the production of malt barley seeds • Supportive government policy and commitment to boost production of malt barley • Establishment of new breweries	• Available malt barley varieties hardly meet European quality standards; • Limited use of available varieties due to poor performance of the formal seed system • Small scale and fragmented nature of farms leading to heterogeneity of harvested malting barley making sourcing and aggregation challenging; • The regulatory framework for the production of certified seed is weak leading to inefficiency in the Ethiopian Seed Enterprise (ESE), which is a public enterprise covering more than 90% of the seed market in the country. Due to the limited capacity, ESE is using community seed multiplication approach which does not seem to be functioning well. • Lack of transparent market interventions to build and support farmers' trust in the market • Lack of postharvest technologies among smallholder farmers instigating high post-harvest losses • Limited value addition and product development

Strengths	Weaknesses
• Conducive biophysical environment for the production of malt barley • Increased public and private partnership in research and development of malt barley • High current and increasing demand for locally produced malt • Potential opportunities for international trade to Africa, Europe, etc. due to large, sustainable and even organic production of malt barley • Cross-border trade mainly with Kenya with possible expansion to other neighboring countries • Growing demand for malting barley as a healthy diet • Improving rural-urban access roads	• Land degradation • Small and fragmented land holdings • excessive government involvement in input and output markets such as the dominance of publicly owned Ethiopian Grain Trade Enterprise, export bans and price controls may inhibit private sector involvement • Adoption by neighboring countries of self-sufficiency policies thereby limiting cross border trade

7.3.2 Constraints in malt barley sub-sector

Key constraints that stifle the malt barley sector include land degradation, small and declining land holdings, limited availability of quality malt barley seeds, low profitability of the crop mainly arising from low productivity and unattractive prices, the use of poor agronomic practices; and lack of irrigation system. The following provides, more discussion of the major constraints.

1. Lack of high quality seeds of improved varieties is among the most important constraints inhibiting expansion of malt barley production to non-traditional malt growing areas. Currently the Ethiopian Seed Enterprise (ESE) does not give much emphasis to malt barley seed production. Hence, adequate supply of quality malt barley seed would remain to be a major problem for the foreseeable future. In addition, lack of access to favorable seed-credit is likely to restrict resource poor farmers' chances of adopting improved malt barley production practices. The limited involvement of the AMF in procuring malt grain outside its traditional areas also poses serious challenge to the development of the malt barley sub-sector.
2. Traditional systems of land management and soil conservation are rather highly unsustainable. Consequently, land degradation and loss of soil fertility particularly due to soil erosion and continuous mining of the soil for arable crop production may undermine the promotion of malt barley production in the region.
3. The land holdings of most farmers in the major barley growing areas of the country are less than a hectare. As is the case with most farming systems in the tropics, the immediate goal of the farmers under such circumstances is to meet the food needs of the family rather than to produce cash crops for the market. Hence, farmers may prefer using their land for food crop production to venturing malt barley production. Moreover, malting barley harvested from different small farms if likely to have high variation in quality making it difficult for aggregation and more importantly for maintaining product quality for the malt factories. The

absence of substantial land in the highlands that can potentially be brought under large-scale commercial farms also makes input sourcing difficult for the factories.

4. Animal draft power is the major sources of traction for crop production in crop-livestock mixed farming systems that farmers have in their disposal. However, the proportion of farmers without oxen or having one ox is very high (about 67%). Lack of oxen negatively affects timely land preparation and plating thereby consequently affecting malt barley yields and possibly quality.
5. Farmers and some agricultural officers believe that two-rowed barley is less yielding than six-rowed barley varieties. Malt barley being two rowed type may be considered as low yielding, although there are malt barley varieties that can yield as much or better with appropriate practices than six rowed barley varieties.
6. Other more competitive crops such as wheat (which usually yields more than barley) and potato (regarded as a security food crop in many highland regions) may appear more attractive to the farmers than malt barley. Moreover, there is a claim that more bread wheat varieties have been released over a similar reference period than malt and food barley varieties combined together providing more choices and luring the farmer to the former than the latter.
7. Farmers' experiences with the use of inputs such as fertilizers and herbicides and their assimilation into the farming system are not adequate. Farmers seem less attracted by the bumper harvests accruing from the use of these inputs under favorable conditions than a guaranteed but modest level of subsistence production that they are accustomed with and that entails minimum risk. Farmers may be reluctant to take loans for the purchase of such inputs either because the technologies may not be economical or there may be a risk if crop fails.
8. There exists very little potential for irrigated crop production in the highlands where barley is the major crop in the region. Topography is the major hindrance to utilizing the big rivers for irrigating the highlands with the current level of economic development. However, small stream based irrigation systems that are within the reach of the small-scale farmers have in

most cases developed to provide supplementary irrigation for *belg* season or residual moisture barley or other crops production.

9. Although farmers have been producing barley as a major crop for years, they lack the knowledge of specific management practices required for malt barley production. The current extension program emphasizes more on other crops, with very little attention given to food barley and none to malt barley.
10. Stresses such as unreliable rainfall, low temperature and hail damage in major barley producing areas may sometimes pose threat to malt barley production.
11. Barley diseases particularly scald net blotch, leaf rust and smuts; insect pests such as chaffer grab, cut worms; and weeds mainly grass weeds are major problems for the production of the crop.
12. Analysis of household income and expenditure of the farmers shows that there is an acute shortage of cash for the purchase of inputs, consumption goods and services required.

7.4 Research and development priorities in malt barley

Analysis of current and future malt barley production and consumption projections suggest the need for continuous investment in malt barley research and development. The priority investment research and development areas are summarized in Table16 and 17, respectively. The expected investment in the area of malt barley research are related with development of malt barley technologies (varieties and associated agronomic practices) suitable for and acceptable by the small holder farmers and end users (maltery and breweries) for potential malt barley production environments and also for emerging production areas and agro-industries. Investment on socioeconomics research for understanding the prevailing conditions, timely identification of emerging challenges and opportunities in the malt barley value chain is needed. The research priorities in developing acceptable malt barley technologies are listed in Table 16.

Table 16: Research priorities in malt barley research in Ethiopia

no	Investment areas	Relevant actors
1)	Strengthening the development and adoption of suitable and acceptable varieties for emerging agro-industries (maltery and Breweries)	Public and partly private
2)	Strengthening the development of suitable varieties for new agro-ecologies and production systems (highland, Belg and irrigated)	Public and partly private
3)	Strengthening the development and/or adaptation of suitable malt barley technologies (pre- harvest, harvest, and post-harvest technologies)	Public and private
4)	Strengthening research on location specific malt barley agronomic and crop protection practices	Public and private
5)	Strengthening the multiplication and distribution of quality breeder and pre- basic seeds with sufficient quantity to public seed enterprises and timely supply of quality seeds to the farmers;	Public and private
6)	Strengthening timely identification of challenges and opportunities in malt barley value chain through socioeconomics research	Public and private
7)	Strengthening the malt barley research-extension linkages (technology delivery, adoption, impact, etc.)	Public and private

The investment in malt barley research and development are related with strengthening the seed system, technology packaging and delivery, reduction of post-harvest losses, improving the malt barley marketing system, and strengthening the linkages among all malt barley value chain actors including research, extension, seed actors, producers, traders, agro industries, and policy makers (Table 17).

Table 17: Development priorities in malt barley sub-sector in Ethiopia

No	Strengthening the national malt barley seed system including promotion of the engagement of private sector	Public and private
1)	Strengthening the delivery and access mechanism of non-seed inputs (fertilizer, chemicals etc)	Public and private
2)	Strengthening malt barley extension system including agro-ecology specific malt barley technological packaging	Public, private, ad NGOs
3)	Promotion of post-harvest technologies for reduced post-harvest losses	Public, private and NGOs
4)	Strengthening the technical and policy support for malt barley production and marketing	Public and private
5)	Strengthening the national malt barley grain marketing system	Public and private
6)	Strengthening the development of malt barley based agro-industries for increased value addition and import substitution of malt barley	Private and public
7)	Strengthening the linkage among stakeholders along the value chain through the establishment of stakeholders platform)	Public and private
8)	Strengthening the national malt barley research capacity though PPP.	Private, public and NGOs

8. Conclusions and recommendations

With more than 1.7 million metric tons produced on about 1 million hectares in 2012 by more than 4.5 million smallholder farmers across the country in a wide range of environments, barley is the fourth most important cultivated crops in Ethiopia. Two barley types namely food barley and malt barley are produced in Ethiopia. Malt barley constitutes, roughly 15% of the barley production. Currently, malt barley production is concentrated in the highlands of Arsi, West Arsi and Bale areas of the Oromia Regional State. While food barley is grown primarily for human consumption, malt barley is produced both for malt and home consumption as food. Malt barley represents an attractive market opportunity for smallholder farmers in the highlands where cold temperature limits the possibility of successfully growing other alternative cash crops.

Malt barley is among the priority commodities that have attracted the attention of policy makers in Ethiopia. The government is keen to boost production of malt barley through appropriately supporting smallholder farmers and attracting commercial farming. Recently, through a public and private partnership involving the Ethiopian Institute of Agricultural Research (EIAR), Assela Malt Factory (AMF) and four breweries (BGI, Meta Abo, Harar and Bedele), effort has started to boost malt barley production by strengthening malt barley research and scaling up of available malt barley technologies. As a result, notable progresses have been achieved in raising production and productivity in the project areas of the central highlands, Bale and Arsi. Despite all these efforts, however, malt barley production is still restricted to few areas and productivity is much below the potential. Even in the traditional malt producing areas of the country, much of the malt grain produced is locally consumed mainly due to limited infrastructure and unattractive market prices.

The malt barley sub-sector in Ethiopia is in its infant stage. Marketing and processing of malt grain is being single handedly conducted by the Assella Malt Factory (AMF). Data compiled from AMF for various years indicate that malt barley production has increased from 74.7

thousand tons in 1997 to 119 thousand tons in 2012 registering 59.3% increase. Both area expansion and improvements in productivity have been the major drivers for the notable achievements registered so far. Despite these notable achievements, however, the county is still importing significant quantities of malt grain to augment the local production. Malt imports has grown tremendously reaching 40.0 thousand tons in 2012 costing the country 27.8 million USD. Unless major changes in the areas of research, development, extension and policy and institutional support are introduced to increase productivity and production and also to enhance the marketing of malt barley and malt grain in the country to reverse the current trend, malt imports are likely to grow to satisfy the expanding capacities of existing breweries and those under establishment.

Recently, investment on breweries has increased and consequently the demand for malt barley has also increased significantly. In the last two years, the former Harar and Bedele breweries have been acquired by Heineken while Diageo acquired the former Meta Brewery. Following privatization of the breweries, the capacities of the breweries has increased further widening the domestic demand and supply of malt barley. For instance barley grain demand for the year 2012/13 is estimated to be over 65,000 tones and expected to increase further with the completion of the breweries under construction. The local malt supply, on the other hand, is much lower than demand estimated at 36,000 tones covering 55% of the total demand.

The mismatch between domestic supply and demand on one hand and the favorable biophysical environment on the other indicate that a huge opportunity exists to enhance local production and substitute import. There is a relatively huge domestic market for malt of reasonable quality, where large number of farmers in the highlands of Ethiopia can, therefore, potentially commit part of their barley area to malt barley production if the economic advantages of growing the crop to them are made apparent and effective extension and support services are in place. The on-going public-private initiative involving public research institutions, the AMF, the Breweries and

the Extension system in malt barley research and pre-scaling up of improved malt barley technologies to new areas, revealed that smallholder farmers are willing and able to adopt recommended malt barley technologies thereby raise production and productivity. It also suggests that farmers may not take long to learn the art of malt barley production to meet the quality standards. Providing appropriate technical support through trainings and advices is crucial to make use of the country's untapped potential of malt barely production.

Analysis of the malt value chain indicates that the production and distribution of malt barley of reasonable quality remains a major problem stifling the expansion of malt production to new but potential production areas. The recent public private initiative suggests that the problem could be resolved through concerted efforts of stakeholders. And yet a lot remains to be done to resolve the seed problem at a national level. A wider production of quality malting barley in the country will therefore save substantial amounts of foreign currency, replacing imports and meeting other local consumption needs. Moreover, given the very low unit price of food barley, the production of high quality malting barley, which fetches relatively higher prices, would benefit small holder farmers in Arsi, Bale, and other barley-producing highland regions. Production of malting barley could therefore serve as a source of cash income and would help to significantly improve the livelihoods of highland farm households in Ethiopia (Mulatu and Grando, 2011).

The production of malting barley, however, requires the use of quality inputs and agronomic practices. Therefore, if the ordinary barley producers are to take advantage of this niche market, they need to be provided with sufficient training, extension services, and the adequate (in quantity and quality) and timely delivery of productive inputs, including certified seeds of high yielding varieties, fertilizers, pesticides and herbicides. One way of effectively addressing this issue is the establishment of innovation platforms comprising stakeholders (farm input suppliers, farmers, small and large traders, existing malt factories, potential investors on malt factories,

existing and potential breweries and consumers) to enhance the efficacy of the malting barley value chain in the country.

Considering the high potential impacts of malt barley, key reasearch and development areas that deserve special emphasis are scaling up/out of productive varitieties, managing acidic soils, agronomic practices for the prodution of high quality malt, pest mangement, seed systems, and favorbale policies to boost malt barley production. These measures could diversify the livilihoods of barley-livestock based farming sytsems of the highlands and the economy of the country. The major recommendations are therefore summarized as follows:

1. In addition to the traditional malt barley producing areas of Arsi, West Arsi and Bale, the highlands in other regions could produce substantial amount of malt barley. Farmers in non-traditional production areas, therefore, could potentially commit part of their barley area to malt barley production if the economic advantages of growing the crop to them are made apparent. Therefore, research is needed to demonstrate the biophysical, social and economic feasibility of the production of malting barley in new but favorable agro-ecologies.
2. Farmers have already had the experiences and traditions of barley production. Therefore, if farmers perceive the benefits of growing malt barley, then they are bound to use their skills and also adopt improved management practices for malt barley production with minimum extension intervention to meet the anticipated malt barley requirement. Moreover, farmers can further exploit the experiences already gained from the informal seed production schemes to produce malt barley.
3. Malt barley varieties currently under production (Beka, Holker,& Misccal 21) and the newly released and registered ones (Bekoji-1, Sabini, Bahati, EH1847, IBON 174/03, Grace and Traveller) from the national program are the most likely candidate varieties to be used in potential areas.

4. Appropriate crop management practices are important to increase malt barley production through enhancing malt quality. Thus, due emphasis should be given in developing new crop management practices and fine tuning the existing ones
5. Malt barley research targeted at identifying varieties specifically adapted to high potential areas should also be strengthened. Cultural practices appropriate for these locations should be developed and verified. Efforts should be made to strengthen the research ability and capability of both the federal and regional research centers.
6. In the current extension program, malt barley should get a "special crop status" particularly in high potential and accessible weredas since malt barley production requires some specific attention and training. Currently there are malt barley production technologies (see section 7) that can be taken to farmers. These technologies are expected to boost malt barley production in these areas at least for the initial period.
7. Soil conservation is another important issue that should effectively be addressed by the extension program since soil degradation is the most important factor that limits production of malt barley in all the weredas.
8. The seed supply should be strengthened through secondary seed multiplication program, which is being practiced by farmers for other crops such as wheat. Strengthening the farmer-based seed multiplication by promoting them to seed producing cooperatives is important. Moreover, the Ethiopian Seed Enterprise should also be encouraged to fulfill its national responsibility by producing quality seeds of malt barley varieties.
9. Special attention should be given to the provision of credit for the purchase of inputs to the participating farmers in malt barley production.
10. Cash crops in barley-based farming systems of the highlands are scarce. Malt barley is a likely candidate that could fetch cash to the farmers provided that farmers are paid competitive or better price for the malt barley they produce.
11. In the recent past, the national malt barley grain demand was estimated at 91,739 tons a year. Considering the breweries under establishment, malt barley grain demand is projected to be

over 190,000 tons per year. Hence, there is a relatively huge domestic market for malt of reasonable quality. The malt factory established in Gonder should provide a readily available market for malt barley producing farmers in the region. This in turn enhances the adoption of improved malt barley production practices by farmers thereby leading to an increase in malt barley production in the two zones.

12. At least for the initial period, the malt factory and the brewery industry should continue in supporting the research, extension, seed production and marketing of malt barley. This may be further strengthened though setting up stakeholder platforms involving all stakeholders, which will link the companies to the different operational groups.
13. In order to facilitate the extension, production (of both seed and grains) and marketing of malt barley, potential farmers may be conveniently grouped into some kind of associations. This will enable the extension and the companies to assist farmers as groups and to carry out activities such as soil conservation and seed multiplication that need group effort.

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10. Annexes

Annex 1: Malt Quality Measurements of Assela Malt Factory

Parameters	Standards Ranges of EBC
Sieving test:	
>2.8mm	35-45%
>2.5mm	40-50%
>2.2mm	5-10%
<2.2mm	0.1%
Rejects	%
1000KWt	23-35g
Germination energy/capacity	96%
Extracts on dry malt fine	79-82%
Extract on dry malt coarse	77-80%
Extract difference	2-2.6
Physical appearance	Yellowish
Saccharification time	10-15
Odor of mash	Normal
Speed of filtration	Normal
Color of wort	2.5-4 EBC unit
pH of wort	5.6-5.9
Diastatic power	200-300wk
Protein content on dry malt	9-11.5%
Soluble protein content on dry malt	2.5-3.5%
Kolbach index	35-45%
Friability	78-81%
Acrospires length	
0—1/4	5 Corns
1/4-1/2	7 Corns
1/2-3/4	35 Corns
3/4-1	50 Corns
Over 1	Rejects

Source: Asela Malt Factory

Annex 2: Total malt barley production, consumption and import, 1997-2012, Ethiopia

Year	Total barley production **	Malt barley production*	Share of malt barley (%)	Malt barley Consumption (AMF)	% Domestic Consumption to production	Malt Barely imports	Value of imports USD
1997	786395.0	74674.6	9.5	16645.1	22.29	-	-
1998	768585.0	112863.4	14.7	17423.4	15.44	3501.8	1500217.0
1999	741928.0	69144.4	9.3	3867.2	5.59	19856.7	3054498.0
2000	945425.0	43680.0	4.6	6520.2	14.93	3042.3	1596311.2
001	931906.3	67228.2	7.2	18436.2	27.42	9623.9	4344633.8
2002	690000.0	80997.8	11.7	21924.1	27.07	5509.0	2516095.2
2003	1079686.1	84617.0	7.8	18170.8	21.47	5428.2	2807411.0
2004	1328052.0	113492.6	8.5	23294.1	20.52	6200.4	3574719.0
2005	1270679.8	113503.0	8.9	20525.9	18.08	10913.2	6048584.9
2006	1352148.0	100516.0	7.4	13836.1	13.77	26967.3	14394223.3
2007	1354807.1	119867.8	8.8	16345.1	13.64	32194.8	23887717.8
2008	1519404.2	151959.6	10.0	21704.7	14.28	30826.4	31287756.2
2009	1750443.6	126070.1	7.2	23718.7	18.81	22541.4	20050691.7

2010	1703346.5	256531.8	15.1	34861.5	13.59	34182.4	21024033.3
2011	1585286.9	119224.3	7.5	20244.3	16.98	34522.0	25151782.9
2012	1781652.2	119094.9	6.7	27820.7	23.36	40024.9	27846033.8
Total	19589746	1753466		305338.1		285334.7	189084709

* malt barley produced in Arsi and Bale; **= total barley production estimates from CSA sample survey data (1997-2012)

Annex 3: Malt barley area and productions in the high potential, high market malt barley producing areas, Ethiopia

		Year						Average		
Region	Zone	2010			2011					
		Area ('00hahaha)	Production ('000 tonnes)	Yield (t/ha)	Area ('000ha)	Production ('000 tonnes)	Yield (t/ha)	Area ('00ha)	Production ('000 tonnes)	Yield (t/ha)
Oromia	Arsi Zone	94.58	177.29	1.87	103.14	245	2.37	98.86	211.15	2.14
Oromia	Bale Zone	16.2	33.33	2.06	47.25	78.7	1.67	31.72	56.01	1.77
Oromia	West Arsi Zone	121.74	274.45	2.25	77.36	190.29	2.46	99.55	232.37	2.33
Total		232.52	485.07		227.75	513.99		230.13	499.53	

Annex 4: Malt barley area and productions in the high potential but low market access malt barley producing areas, Ethiopia

Region	Zone	Year						Average		
		2010			2011					
		Area '000ha	Production '000tonnes	Yield t/ha	Area '000ha	Production '000tonnes	Yield t/ha	Area '000ha	Production '000tonnes	Yield t/ha
S.N.N.P.R	Dawro Zone	15.24	2.12	1.39	0.88	1.04	1.61	1.20	1.58	1.32
S.N.N.P.R	Gamo Gofa Zone	157.13	19.31	1.23	21.73	44.17	1.61	18.72	31.74	1.70
S.N.N.P.R	Gurage Zone	171.35	36.57	2.13	18.25	48.05	1.61	17.69	42.31	2.39
S.N.N.P.R	Hadiya Zone	34.29	5.83	1.70	5.60	8.09	1.61	4.51	6.96	1.54
S.N.N.P.R	Kembata Tembaro Zone	13.30	2.24	1.69	1.63	2.36	1.61	1.48	2.30	1.55
S.N.N.P.R	Seltie Zone	86.08	14.15	1.64	10.67	16.51	1.61	9.64	15.33	1.59
S.N.N.P.R	Sidama Zone	134.54	21.20	1.58	26.22	40.22	1.61	19.84	30.71	1.55
S.N.N.P.R	South Omo Zone	25.13	3.32	1.32	6.08	12.44	1.61	4.30	7.88	1.83
Amhara	East Gojam Zone	757.52	108.02	1.43	49.48	57.70	1.61	62.62	82.86	1.32
Amhara	North Gonder Zone	473.19	79.47	1.68	44.67	77.42	1.61	46.00	78.45	1.71
Amhara	North Wolo Zone	545.81	94.14	1.73	41.99	44.82	1.61	48.28	69.48	1.44
Amhara	South Wolo Zone	425.57	59.66	1.40	41.35	54.06	1.61	41.95	56.86	1.36
Oromia	East Harerge Zone	95.67	11.62	1.22	4.57	7.35	1.61	7.07	9.49	1.34
Oromia	East Shewa Zone	140.41	19.84	1.41	10.66	13.29	1.61	12.35	16.56	1.34
Oromia	East Welega Zone	114.40	15.85	1.39	6.43	9.00	1.61	8.93	12.43	1.39
Oromia	Guji Zone	355.15	77.14	2.17	34.15	47.24	1.61	34.83	62.19	1.79
Oromia	Horo Guduru Wollega Zone	84.88	9.70	1.14	12.21	17.87	1.61	10.35	13.79	1.33

Oromia	Jimma Zone	270.96	42.03	1.55	21.08	26.85	1.61	24.09	34.44	1.43
Oromia	Kelem Wollega Zone	46.69	7.36	1.58	3.35	3.93	1.61	4.01	5.65	1.41
Oromia	North Shewa(Oromia) Zone	1045.72	163.86	1.57	86.98	108.53	1.61	95.78	136.20	1.42
Oromia	South West Shewa Zone	171.53	22.63	1.32	20.44	31.37	1.61	18.80	27.00	1.44
Oromia	West Harerge Zone	43.30	5.95	1.38	4.95	6.95	1.61	4.64	6.45	1.39
Oromia	West Shewa Zone	628.00	97.04	1.55	70.44	111.24	1.61	66.62	104.14	1.56
Tigray	Central Tigray Zone	224.68	25.83	1.15	18.38	31.71	1.61	20.43	28.77	1.41
Tigray	East Tigray Zone	304.88	48.00	1.57	32.28	59.38	1.61	31.39	53.69	1.71
Tigray	South Tigray Zone	528.69	69.04	1.31	38.52	69.88	1.61	45.69	69.46	1.52
Tigray	Western Tigray Zone	7.38	1.05	1.43	1.21	2.08	1.61	0.97	1.56	1.61
Total		6901.48	1062.98		634.20	953.55		662.17	1008.26	

Annex 5: Malt barley area and productions in the low potential and low market access malt barley producing areas, Ethiopia

Region	Zone	Year						Average		
		2010			2011					
		Area '000ha	Production '000 tonnes	Yield (t/ha)	Area '000ha	Production '000 tonnes	Yield (t/ha)	Area '000ha	Production '000 tonnes	Yield (t/ha)
S.N.N.P.R	Alaba Special Zone	0.59	0.43	0.73	0.26	0.53	2.04	0.43	0.48	1.13
S.N.N.P.R	Amaro Special Zone	1.10	0.75	0.68	0.95	1.29	1.36	1.02	1.02	1.00
S.N.N.P.R	Basketo Special Zone	0.70	0.78	1.12	0.12	0.16	1.34	0.41	0.47	1.15
S.N.N.P.R	Bench-Maji Zone	2.99	2.91	0.97	3.63	5.59	1.54	3.31	4.25	1.29
S.N.N.P.R	Burji Special Zone	0.04	0.03	0.79	0.15	0.11	0.77	0.10	0.07	0.77
S.N.N.P.R	Derashe Special Zone	1.50	1.39	0.93	1.19	1.16	0.98	1.34	1.28	0.95
S.N.N.P.R	Gedio Zone	3.21	2.94	0.92	4.44	4.73	1.07	3.82	3.83	1.00
S.N.N.P.R	Kaffa Zone	9.10	9.83	1.08	7.48	9.24	1.24	8.29	9.54	1.15
S.N.N.P.R	Konso Special Zone	0.81	0.39	0.48	0.04	0.04	0.97	0.43	0.21	0.50
S.N.N.P.R	Konta Special Zone	0.14	0.16	1.12	0.54	0.61	1.13	0.34	0.38	1.13
S.N.N.P.R	Shaka Zone	0.25	0.16	0.63	0.24	0.24	0.98	0.25	0.20	0.80
S.N.N.P.R	Wolayita Zone	2.09	1.90	0.91	0.43	0.46	1.05	1.26	1.18	0.93
S.N.N.P.R	Yem Special Zone	1.80	1.81	1.00	1.25	1.18	0.95	1.53	1.49	0.98
Amhara	Agewawie Zone	9.80	11.36	1.16	10.65	8.19	0.77	10.23	9.77	0.96
Amhara	Argoba Special Zone	0.31	0.31	0.99	0.03	0.02	0.80	0.17	0.17	0.97
Amhara	North Shewa(Amhara) Zone	49.31	44.57	0.90	63.00	90.86	1.44	56.16	67.72	1.21
Amhara	Oromia Zone	0.76	0.86	1.13	0.68	0.71	1.04	0.72	0.79	1.09
Amhara	South Gonder Zone	53.64	45.07	0.84	35.86	47.44	1.32	44.75	46.25	1.03

Amhara	Waghamera Zone	18.39	17.53	0.95	15.90	21.79	1.37	17.15	19.66	1.15
Amhara	West Gojam Zone	35.43	45.78	1.29	24.65	27.74	1.13	30.04	36.76	1.22
Oromia	Borena Zone	1.56	1.24	0.80	1.04	0.87	0.84	1.30	1.06	0.81
Oromia	Illibabor Zone	6.69	7.61	1.14	7.49	8.29	1.11	7.09	7.95	1.12
Oromia	West Welega Zone	2.03	1.61	0.79	2.16	1.75	0.81	2.10	1.68	0.80
Tigray	North Western Tigray Zone	0.22	0.12	0.55	0.26	0.34	1.34	0.24	0.23	0.97
Total		202.50	199.55		182.43	233.34		192.47	216.44	