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Status, Opportunities, Challenges and Emphases for Future Interventions of Malt Barley (*Hordeum distichum* L.) Production in Ethiopia

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ABSTRACT

Malt barley is a recently introduced malting crop in the highland of Ethiopia used for preparing alcoholic beverages, especially beer. It is the main source of income for smallholder farmers and is also important to meet the domestic malt demand of breweries. In Ethiopia, there are potential areas for malt barley production. The national malt production interest meets through expansion in different areas of the country. The malt barley productivity is limited due to the lack of high yield potential varieties, insects, diseases, weeds, waterlogging, low soil fertility, drought and soil acidity. In addition, there are also limited knowledge, skills and information that impede meeting the ever-increasing national demand. The objective of this paper is to review the status, opportunities, challenges and emphases for future interventions in malt barley production in Ethiopia. This review was done by gathering different published and unpublished materials and appropriate information from various literature sources like libraries, research reports, conferences, journals, books and internet centers. Initiatives and strategic plans, opportunities and the main limitations and obstacles encountered for malt barley production and productivity need attention for improvement adoption, production and productivity. It concludes many activities should be done to create a good linkage among farmers, seed producer cooperatives and unions, seed enterprises, agricultural extension offices, research institutions, NGOs and the Ministry of Agriculture to improve the supply of quality seed malt barley and to satisfy the increasing malt barley demand in Ethiopia.

Key words: Agricultural technology, Breweries, Malt barley, Productivity, Status, Sustainable.

Malt barley (*Hordeum distichum* L) is the prime cereal crop used in the production of malt and is economically valuable which belongs to the Gramineae family. Barley is one of the most beneficial cereal crops worldwide, which rank is four after rice, maize and wheat in terms of production (Lapitan *et al.,* 2009). Malt barley is a recent introduction malting crop in the highland of Ethiopia used for preparing alcoholic beverages, especially beer. The main growing altitudes of malt barley are between 2000 to 3000 m, but it can be farmed at elevations between 1500 and 3500 m (Berhane *et al.,*1996). It is the main source of income for smallholder farmers and is also important to meet the domestic malt demand of breweries (Mesay, 2020). However, the accurate statistical information on area coverage indicated that malt barley shares between 10 - 15% of the total land area covered by barley (Alemu, 2011) and the production is scarcely meeting the domestic demand.

Imports are the main source of malt barely to meet the demand, which accounts for 69 per cent of the total annual requirement due to the lack of domestic malt supply (ORDA, 2008). Similarly, Ethiopia introduced 60 per cent of the malt breweries principally from foreign growers in 2011 (Ethiopia-Barley-Business-Case Investor Presentation, 2012).

In recent years, as a result of the rising interest of breweries, producing of malt barely have enhanced meaningfully (Agegnehu *et al.,* 2014). In Ethiopia, the major raw material for beer production is malt barely which covers 90 per cent of the total costs of raw material (Tadesse, 2012). Various studies depicted that the existence of agroecology in Ethiopia is favorable for the production of malt barley that could bear the national interest of malt. Mohammed and Getachew (Mohammed and Getachew, 2003) reported that Ethiopia has produced a deficient amount of malt barley to stick out the demand of the homegrown breweries. According to the report of ICARDA (2016) in Ethiopia, there is a high lack of balance between malt barley production and demand. Brewing firms such as the Assela Malt Factory had to reduce output in late 2015 due to market malt barley shortages (ICARDA, 2016). In 2015 the total valued interest for malt barley is about 72,000 tons among this 35 per cent was provided from local barley farms and the remaining 65 per cent (63,526 tons) was received from abroad trade for a price of 38

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million dollars USD (ICARDA, 2016). Similarly, Rashid *et al.* (2015) reported that the net cost of imported malt barley raised from 240 thousand US dollars in 1997 to 40 million US dollars in 2014 and it is anticipated to get up to 420 million US dollars by 2025. On the contrary, the livelihoods of farmers could be significantly improved if farmers can cost-effectively grow malt barley to meet the rapidly growing domestic demand.

Nowadays, in Ethiopia, the main users of malt are domestic breweries. Because the local malt supply has not yet fulfilled the yearly demand, the brewers have long been reliant on considerable imports. In Ethiopia, there are huge capable areas for growing malt barley. However, its production is limited to the Arsi and Bale regions of the country. This had directed to a shortage of malt obtain for continuously growing national breweries throughout the year. Assela Malt Factory, Ethiopia's sole malt factory, has recently begun development and increased malt production capacity from 25,000 Metric tons to 36,000 Metric tons to meet the country's expanding malt demand from brewers. Malt barely produced solely in Arsi and West Arsi highlands is sufficiently large to meet Asela Malt Factory's malt barley interest if correctly formed and directed to the factory.

In 2016/17 cropping season, the production of barley in Ethiopia covered a total area of 0.96 million hectares and obtained total annual production of about 2.0 million tons. The total area covered by barley in Amhara National Regional State is about 0.32 million hectares with a total production of 0.61 million tons and its productivity is 1.88 tons ha^{-1} still below the national productivity of 2.11 tons ha^{-1}. The world average productivity is 2.4 tons ha^{-1} (CSA, 2017).

To meet the national demand expanding the malt barley production is crucial since vast productive areas are existing for malt barley production. Thus, it is beneficial for the time-to-time growth of interest for raw materials by the brewery industry and to confirm reliable and better money earnings for the farmers. However, at the farm level, productivity has continued low. The malt barley productivity is limited due to the lack of high yield potential varieties, insects, diseases, weeds, waterlogging, low soil fertility, drought and soil acidity (ICARDA, 2016). In addition, there are also limited knowledge, skills and information that impede meeting the ever-increasing national demand. For example, as directed by many researchers there is a vast gap noticed between national average yield, achievable yield with recommended packages and potential yield for malt barley. Hence the objective of this paper is to review the status, opportunities, challenges and emphases for future interventions of malt barley production in Ethiopia.

Literature review

This review was written by the following literature thematic areas: (i) an overview of malt barley production and its importance in Ethiopia; (ii) identifying the need for farmers to adopt malt barley production and its adoption level in Ethiopia; (iii) the motivation of farmers to produce malt barley in Ethiopia; (iv) the occurrence of opportunities for malt barley production in Ethiopia; and (v) the main limitations and obstacles encountered, as well as what needs to be done to overcome.

Malt barley agroecology

Ethiopia has a huge potential for malt barley production, even if its current share of the market is quite tiny in comparison to food barley. To produce an attractive and plentiful crop, malting barley requires a suitable temperature. It can only be grown in the highlands of Oromia, Amhara and the Tigray Regional States, as well as a portion of the Southern Nation Nationality People (SNNP), between 1500 and 3500 meter above sea level (masl), however, it is primarily grown between 2000 and 3000 masl in Ethiopia (Berhane *et al.,* 1996). In Ethiopia's highlands, barely is the most reliable grain under extreme marginal circumstances such as drought, frost and low soil fertility and it thrives better than other cereal crops on highly damaged mountain slopes (Ceccarelli and Grando, 2006). It requires well-drained soil with a pH of 5.5-7.3 with an even rainfall distribution of 500-800 mm during the crop growing season. Agroecological-based land suitability map for growing malt barley in Ethiopia was done by CSA, (2017).

The key limitations for malt barley grain production are the adaptation capacity of the existing malt barley varieties to higher altitudes and particular agro-climatic zones. Poor crop management such as poor agricultural practices and fewer quality traits of varieties is a cause of less quality grain like high screen loss, low thousand-grain weight and high protein content even among the high potential areas of producing malting barley (Mohammed and Getachew, 2003). The national extension program had not been given attention until recently for barley as compared to wheat and maize. In addition, technology promotion, the linkage between industry and producers and market issues that have not been sufficiently addressed among stakeholders have also continued a problem until lately. Ethiopia can potentially substitute its import through domestic production of malt barley if the rising government interest and attention are given to the production of malting barley along with the suitable agro-ecological conditions in the country (ICARDA, 2016).

Production status of malt barley in ethiopia

In Ethiopia, the cultivation of food barley has been started 5000 years ago. The production of malting barley, on the other hand, has a very short history of about 40 years. It is connected with beer forming in Ethiopia which started with the establishment of the St. George Brewery in 1922 and specifically with the start of local malt production in 1974.

The research results of the Ethiopian Institute of Agricultural Research, Debre Zeit Agricultural Research Center 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, in 1974 the national malt production commenced by identifying and

recommending three presented malt barley varieties that is Kenya research, Proctor and Beka to minimize foreign currency (Fekadu *et al.,* 1996). In 1979, the Holker variety of malt barley was released through selection from a local cross in both Arsi and Bale as a result malt barley production expanded in those areas. Asela Malt Factory was established in 1985 with a capacity of 20,000 tons of malt which gives additional reinforcement to produce malt barley locally in Arsi and Bale. As Berhane *et al.* (1996) reported from 1987 to 1989 self-sufficiency in malt was attained as a result of a local supply of 250 thousand tons of malt grain and no import was made during this period. The production was taken up mainly in Arsi and Bale regions by state farms and some cooperatives. The momentum, however, due to the end of state farms and the failure of producer cooperatives, there was not sustained in the later years. Meanwhile, breweries have returned to importing malt to complement the local supply.

In Ethiopia, Arsi is the main malt producing zone area under malting barley has significantly increased from 20 thousand ha in 2000 to more than 85 thousand hectares in 2012 with a mean annual growth rate of 5.4%. Correspondingly, the product obtained in the same period increased to about 120 thousand tons in 2012, with an average annual growth rate of 5.8% (FAO, 2014). Only the Arsi and West Arsi zones accounted for more than 85 percent of the entire malting barley acreage in the country. Malt barley cultivation has recently increased to the central highlands of North Shewa, South West Shewa, West Shewa, Bale zone of Oromia and North Shewa, South and North Gondar zones of Amhara. 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), despite malt barley could be grown in several highland areas of the country. The Ethiopian Institute of Agricultural Research has been introduced concreted efforts to increase malt barley production in 2009 for great potential for malt production in the country. Assela Malt Factory and four brewers (BGI, Meta Abo, Harar and Bedele) launched the scaling up of malt barley technologies and consolidation of malt barley research for five years (2009/10–2013/14). The project is coordinated by Kulumsa Research Center and is being implemented in the four federal and regional research centers, namely Kulumsa, Holetta, Sinana and Debre Berhan. As a result, in the capacity of malt barley cultivating areas of the central highlands, there is exciting improvement in encouraging malt barley technologies. Bale and Arsi with the intervention of the ongoing public-private partnership project.

Malt barley is currently one of the grain crops most commonly used for beer beverages or beer ingredients. So, farmers in high land areas of Ethiopia are mainly producing cash crops. Because of certain agronomical problems like space between plants, agroecological requirements of the crops and lack of improved varieties of the crops; the production of malt barley crops still does not fit the requirement of the malt factors. The production of barley in 2015/16 was about 21,708 tones and in 2020/21 the production was increased to 45,140 tones but due to the imbalance between demand and supply the factory was forced to import greater than 13,100 tones in 2020/21 by about $27,280,000. The production and supply of malt barley increased year after year within the past six years 25% increment recorded, in line with this the demand also increase about around 39%.

Opportunities for malt barley production

In Ethiopia, there are enormous possibilities that allow the growth of malt barley production and productivity. The obtainable chances supply to the future enhancement of malt barley production in Ethiopia are mentioned below.

The occurrence of conducive climatic conditions

The highland of Oromia, Amhara, Tigray Regional States and part of Southern Nation Nationality People (SNNP) have suitable climate and edaphic conditions for malt barley production. For instance, in the Oromia region, West Arsi zone out of 12 districts 10 are growing malt barley among which seven districts are capable growers (Mesay, 2020). Similarly, in Amhara, Tigray and SNNP regions malt barely is produced and there are also potential areas and producers. Analysis of grain samples collected from producers/farmers showed that the majority of these regions are not growing malt barley to their maximum capacity. Spreading malt barley production in all suitable areas is the chance at hand to avoid the malt barley shortage.

The current cropping methods

Crop rotation improves malt barley productivity in the area, for example, potato cultivation in the belg season in West Arsi aids in the cultivation of malt barley by rotation and the pulse and malt barley rotation system in the Chole area ensures the sustainability of malt barley production in the study area. In general, crop rotation is useful for soil restoration, which is vital for increasing production.

The availability of strongly committed farmers

Government's support to malt barley production and cluster-based farming for bulk production and aggregation to facilitate the collection, transportation and marketing. Some farmers produced from a hectare of land up to seven tons of malt barley. These farmers' yield shows by facilitating other farmers to provide model farmers could improve malt barley production of Arsi and Bale in Ethiopia and satisfy malt barley market demand.

Market opportunities

As various studies depict the expansion of urbanization; high population growth and the rise of individuals' income are the cause of the increment in beer consumption in the country. Many investors-initiated beer production in various areas of the country because of the high market demand for beer and wide expansion taking place in the previous breweries. Thus, the presence of increased market interest is an opportunity in the future for the production of malt barley.

The presence of policy

The growth and transformation plan I and II working on supplying plenty amount of malt barley to malt factories by improving malt barley production in the country. The production of malt links agriculture and industry which is involved in government policy. Therefore, in near future, the government policy support to increase agricultural production is a good possibility to boost malt barley production and productivity.

Challenges for malt barley production

Low productivity

The farmers could not get varieties that have the capability to be grown on a variety of soil, this minimized the farmers' need to adopt the varieties. Misicale-21 is to be adopted by the farmers due to its better yielding and growing on a wide range of soils. In contrast to Misicale-21, farmers are discouraged from growing malt barley varieties that have good quality for malting as a result of incapability of cultivating on a variety of soils and less productivity.

In Ethiopia, use two-row types of malt barley varieties which has less yield than local six-row food barley varieties in farmers' perception. Subsequently, farmers are refusing to participate in malt barley production. Therefore, the absence of six-row malting barley varieties is a gap in malting barley research (Yirga *et al.,* 1998).

Inaccessibility of improved seeds

The improvement of production and productivity of malt barley can be maintained through the utilization of quality improved seeds among producers. Due to the inaccessibility of improved seeds on time as per required, farmers were forced to use their own saved seeds for longer periods. The inaccessibility of improved malt barley seeds can be expressed in three ways (not reaching on time, needed quantity and quality seeds). Malt barley was found not to be grown so widely as showed by the information made from a survey of 2,160 farm households within 36 kebeles of 9 purposively selected districts; only 7.49% of the sample households reported to have grown malt barley in 2014/15, almost all improved varieties. The significant yield gap in the smallholder farmers' field is partial adoption of the full package of improved technologies even if demonstration of improved varieties and integrated crop management technologies are vital for increasing crop production and productivity (Zewdie and Adamu, 2020). Barley is primarily used in the brewing industry for malting, with quality influenced by grain parameters like kernel shape, size, boldness and protein content. However, availability often results in poor quality, necessitating the identification of malt varieties with different parameters for improved production (Gebeyaw, 2021).

Price of inputs

Some inputs particularly fertilizers and herbicides are expensive and are not affordable to smallholder farmers and seed if it is purchased from centrally located seed enterprises. Timely availability and access to production inputs such as herbicides and fertilizer are major constraints.

In focus group discussions, farmers have knowhow about the benefit and use of fertilizer for the malt barley production. However, as a result of the high price of fertilizer farmers use less amount than recommended in many parts of Ethiopia. The partial budget analysis revealed that the farmers benefited from malt barley production, despite farmers protesting for fertilizer price. Farmers give less focus to the cost-benefit analysis rather high attention given to fertilizer price because its price increases from time to time (Yirga *et al.,* 1998).

Malt barley producing households earn about Birr 20,175 per year by taking into account costs of fertilizers, pesticides and seed purchased but without considering non-commercial inputs such as labor.

Poor crop management

Farmers are grown malt barely by rain fed. Most farmers are not applying full production packages for improving malt barley production and productivity. Biru *et al.* (2020) reported that poor crop management is the most important yield limiting factor of improved varieties across agro-ecologies in Ethiopia. Due to limited use of improved varieties and poor agronomic practices, malt barley production has not extended satisfactorily (Zewdie and Adamu, 2020). Long-term experiments show that inorganic fertilizers without organic manures can lead to soil degradation and micronutrient deficiency in Barley crops (Randhawa *et al.,* 2020). Crop pests (weeds, diseases and insects) not only reduce yield but also reduce seed quality in the field and the storage if not adequately controlled by farmers. Chemical composition significantly impacts beer quality and brewing efficiency, with grain protein and kernel plumpness being key parameters in malt barley, strongly linked to nitrogen application (Kaur *et al.,* 2024). Moreover, due to poor field management, negligent harvesting and threshing on less cleansed locations affect grain quality and raise the commodity's mixed percentages. Due to the lack of mechanization, the production of food and industrial crops in developing countries like Ethiopia is highly labor-intensive in smallholder agriculture (Houmy *et al.,* 2013).

Land suitability mapping

Crop level suitability mapping revealed that the country has around 1.9 million hectares of very appropriate land area for malt barley cultivation (Nigussie *et al.,* 2019). Thus, suitability maps for six malt barley varieties were developed to identify potential areas for further scaling up of improved technologies in non-project target areas. The primary elements evaluated in the land suitability study include climate factors (temperature and rainfall at the time of growth period and length of the growing period), topography (altitude and slope), soil types and soil qualities (pH, depth, texture and drainage).

Extension services

In many sections of the nation, notably in malt barley production, the usage of farmer training facilities for

demonstration and farmer training is uncommon. Moreover, there is a limitation and less regularly using readable extension materials about malt barley production such as manuals of production, leaflets, brochures and magazines (Mesay, 2020).

Unavailability of inputs credit

There are no practice inputs (better seeds) credit through down payments in Ethiopia, where farmers pay 50% of the input price while planting and the remaining 50% of the seeds price after output, plus the interest rate (Mesay, 2020). On the other side, it may reduce the use of loans by farmers.

Lack of sustainable cropping system

Shifting cultivation and crop rotation are essential for a long-term cropping system, yet only a small percentage of farmers practice them. The majority of farmers' practice of continuous cultivation and monocropping creates ideal conditions for the development of grass weeds, which contributes to malt barley's low production. Organic fertilizer significantly enhances soil fertility and crop production, yet local farmers often neglect its application. Low barley productivity is primarily due to traditional methods and poor soil fertility, with soil erosion and lack of proper conservation practices causing low fertility and pH (Arebu, 2022).

Lack of good marketing system

There are several issues with the marketing system, including delays in malt barley price-fixing, the involvement of numerous players in malt barley marketing and a market information gap are the major ones. The seed marketing system is not well established yet. Low seed price of malt barley compared with grain market as per farmers' perception and capacity and financial constraints to strengthen seed producer cooperative with seed cleaning machines and mini-seed testing laboratories.

As a result of the engagement of a lot of market actors stretching the market channels and increasing transaction costs, the price of the items is elevated when they reach end customers. While passing through many chains, the malt market may become increasingly complex. A variety of cheating practices have been seen in malt barley marketing, with the most prevalent being balance adjustment cheating of 5-10 kg per 100 kg (Mesay, 2020). Furthermore, the producers' margins were compressed due to the engagement of various players in marketing. Because of the existing gap, merchants, particularly tiny dealers, benefit from the farmers' labor and can profit illegally. Farmers, on the other side, were furious when the manufacturer announced its pricing. Farmers started selling malt barley in early January, but the Asella malting factories and others established the price in late January and farmers sold their malt barley to dealers at a reduced price at this time.

Unions and farmers' weak coordination

The poor coordination of unions and farmers make the condition conducive for traders to be beneficiaries in an illegal way. In line with this, the situation is discomforting farmers to restrict malt barley production which could amplify the shortage (Mesay, 2020). Lack of information and access to technologies are factors that affect technology adoption and achievement of farmers in addition to weak extension services (Zewdie and Adamu, 2020). A Few years ago, a smaller number of unions and farmers 'cooperatives deployed in malt barley marketing to a deficient level. However, due to limitations in marketing know-how, less assurance and a shortage of tactics and experience to gather quality grain, they removed malt barley marketing during the study.

CONCLUSION

Malt barley has lately emerged as an important agricultural commodity in Ethiopia, where it is being used to improve food security and create more sustainable and climate-resilient production systems. Malt barley acceptance and increased output are seen as opportunities to reverse the country's poor productivity, poverty and food insecurity patterns. The status, acceptance level, potential and problems of malt barley production for drinks were all highlighted in this review article. Weak policy attention, restricted utilization of production inputs, insufficient management practices, weak research and extension services, poor infrastructures, market challenges and other obstacles to malt production have all been noted. Erana (2020) found a similar evaluation finding on grain legume production in Ethiopia. Various agro-ecologies, malt barley diversity, population and urbanization trends and rising demand in the brewing sectors all provide prospects and chances for improving output and productivity. Additionally, improving production techniques, packaging and promotion of malt barley, improving technologies and market access, creating awareness and integrating indigenous knowledge and developing facilities all require more attention and focus to improve barley adoption, production and productivity.

RECOMMENDATIONS

Based on the review process the following points are recommended:

- The farmers/producer's knowledge, skill and attitude should be increased through scaling up training initiatives to improve malt barley technologies and to assure the quality of malt barley grain production.
- Seed producer and marketing cooperatives should have capacity-building training and experience sharing on technical aspects of malt barley seed and grain production, such as field inspection, harvesting, storage, postharvest handling, marketing and business management.
- The concerned body/ government should supply effective herbicides and other inputs with affordable full package production inputs on time.
- Farmers, seed producer cooperatives and unions, seed firms, agricultural extension offices, research

institutions, NGOs and the Ministry of Agriculture should also collaborate to boost the availability of quality malt barley seed and meet Ethiopia's growing malt barley demand.

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