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A REVIEW ON THE SEED SECTOR OF ETHIOPIA: PROSPECTS AND CHALLENGES OF FABA BEAN SEED SUPPLY

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ABSTRACT
This paper was aimed to review faba bean seed production, productivity and to identify the systemic bottlenecks that constrained the seed sector. The study is primarily based on secondary data reviewed from different sources. Pulses, which occupy approximately 13 per cent of cultivated land and account for approximately 10 per cent of the agricultural value addition next to cereal crops, are critical to smallholder livelihoods in Ethiopia. Faba bean is the most important pulse crop in both area coverage and volume of annual production in Ethiopia. To boost production and productivity, increased use of inputs crucially improved seeds is imperative. A seed is one in every of the foremost necessary sources of innovation, notably in resource-constrained small farm environments. In Ethiopia, the informal seed system is still the primary source of seed for smallholder farmers. Although the formal seed sector started about six decades ago, the commercial seed sector supplies less than 10% of the country's seed demand per year. Hence the majority of the farmers show a tendency of depending on the informal system. However, in Ethiopia, a successful seed program that supplies sufficient quantity of high-quality seed of adapted varieties on time and with reasonable cost remains to be a significant constraint.

1. Introduction

Endowed with varied agro-ecological zones and diversified natural resources, Ethiopia has been known as the homeland and domestication of several crops. Pulses, which occupy approximately 13 per cent of cultivated land and account for approximately 10 per cent of the agricultural value added next to cereal crops, are critical to smallholder livelihoods in Ethiopia (Shahidur *et al.*, 2010 and CSA, 2016). According to (FAO, 2015), Ethiopia is ranked thirteenth among pulse producing countries in the world. The major varieties of pulses grown in Ethiopia include faba beans, chickpeas, haricot beans, lentils, dry peas, mungbean and vetches. According to CSA (2016), faba bean (*Vicia faba* L.) is the most important pulse crop in both area coverage and volume of annual production in Ethiopia.

The productivity of pulses in general and faba bean in particular in Ethiopia is still, far below its potential. For example, current average faba bean yields are 2.1 tons per hectare (CSA, 2018) but the demonstrated potential in Ethiopia ranging from 2.8 to 6.2 tons under research field and 2.3 to 3.9 tons per hectare under farmers field with research recommended practices (MoARD, 2009). This shows that there is still a room to improve its productivity and to transform the sector. The low acreage and yield are attributed to different

biotic, abiotic and institutional factors. Lack of improved seeds and high use of local varieties on more than 95% of the total pulse cropped area (Shahidur *et al.*, 2010) was the significant production constraints. Therefore, the study was aimed to review the seed systems of Ethiopia and to identify systemic bottlenecks that constrained the sector.

2. Result and Discussion

2.1. Overview of Pulse Production in Ethiopia

Pulse crops are necessary elements of crop production in Ethiopia's smallholders' agriculture, providing an economic advantage to tiny farm holdings as another supply of protein, money-financial gain, and food security (MoARD and ATA, 2013; Joep *et al.*, 2014; USAID, 2014; Boere *et al.*, 2015; CSA, 2016). Pulses rank second among ingredients used in national dishes in Ethiopia and are an integral component of the cooking culture of Ethiopians (Alemneh *et al.*, 2017). Pulses contribute to farmer gain as a higher-value crop than cereals, and to diet, as a value effective supply of protein that accounts for about 15% of protein intake (Boere *et al.*, 2015). When utilised in crop rotation, pulse crops can increase soil fertility and improve soil health. Some of them have also played an essential role in the export sector generating foreign currency for the country. Pulses are the third-largest export crop of Ethiopia after coffee and sesame, contributing around USD 251 million to export earnings in 2013/14 (Boere *et al.*, 2015). The most important export pulses include haricot beans, chickpeas (Kabuli type), faba beans, lentils and field peas (Tadesse, 2019).

Faba bean is Ethiopia's primary legume which is cultivated in the highlands often in rotation with wheat, barley or teff. It is the most important pulse crop in both area coverage and volume of annual production in Ethiopia with average productivity of 1.9 tons per hectare (Hailu *et al*., 2014; CSA, 2016). Ethiopia is the second largest producer of faba bean in the world after China (FAOStat, 2017; Mussa and Gemechu, 2006) through its contribution was not more than 14.7 per cent of the amount that the top ten growing countries can contribute (FAOStat, 2017).

According to CSA (2016), faba beans, chickpeas and haricot beans are the significant pulses covered 3.56% (about 443,966.09 hectares), 2.07% (approximately 258,486.29 hectares) and 2.86% (about 357, 299.89 hectares) of the grain crop area, respectively. Accordingly, over 90% of the total crop land is cultivated by smallholder farmers using traditional practices. The report also revealed that the production obtained from faba beans, chickpeas and haricot beans was 3.18% (about 8,486,545.69 quintals), 1.77% (approximately 4,726,113.88 quintals) and 2.03% (5402389.37 quintals) of the grain production, in that order.

While faba bean was grownup throughout the country, production is targeted within the Amhara and Oromiya regions (Shahidur *et al*., 2010; Esther and Giller, 2013; Joep *et al*., 2014; Boere *et al*., 2015). Amhara region alone accounts for more than 34% of area coverage and about 31% total volume of production of the country (CSA, 2018). The primary producers are smallholders with small and dispersed plots under rain-fed conditions. More than 3,568,225 farmers were involved in growing faba bean. North Shewa (Amhara region), North Shewa and Arsi zones of Oromia region are identified as significant production areas of faba bean (Biruk, 2009; Joep et al., 2014; CSA, 2016). The growing importance of faba bean as an export crop in Ethiopia has crystal rectifier to a revived interest by farmers to extend the area under production (Samuel *et al*., 2008). Ethiopia exports around US$30 million per year of faba bean (Joep et al., 2014).

However, in Ethiopia the productivity of pulses in general and faba bean in particular is still, far below its potential. Major production constraints including lack of improved seeds and a high use of local varieties

(Shahidur *et al*., 2010; Boere *et al*., 2015), small farm management practices and land fragmentation. Low soil fertility in the high potential areas is another problem, while fertilizer use on legume crops is usually low (Asfaw and Shiferaw, 2009). Besides, the crop is threatening by new gall forming disease (Hailu *et al*., 2014). Very recently, it was found the most devastating and widely disseminated in the high land potential areas within a few years since its occurrence (Hailu *et al*., 2014).

To boost production and productivity, increased use of inputs crucially improved seeds is imperative (Abebe, 2010). The seed is one amongst the foremost necessary sources of innovation, particularly in resource-constrained small farm environments. Increasing the standard of seeds will increase the yield potential of the crop by significant folds and therefore, is one of the most economical and efficient inputs to agricultural development (FAO, 2006). The responses of all alternative inputs rely to an oversized extent upon the standard of seeds used. According to ATA (2011), the use of improved seeds increases productivity by 50 per cent.

To this end the pulse research program in Ethiopia has released a number of improved pulse varieties including 31 faba bean varieties (MoANR, 2016) to improve its productivity through developing and promoting enhanced cultivars with high and stable yield, and resistant/tolerant to significant biotic and abiotic stresses (Mussa and Gemechu, 2006). Despite the release of this large number of improved varieties, the use of certified improved seeds by farmers is shallow. Of the total annual arable land coverage by major food crops in 2010, only 3.5% is covered by improved seeds (Abebe, 2010). Only 2.9% of the farmers in Ethiopia reported using improved seed in 2011 (CSA, 2011). Low agricultural technology adoption rates can have many reasons; in Ethiopia, one important reason is the substantial lack of improved seed (MoA, 2013). For instance adoption rate of improved faba bean varieties based on the proportion of land allocated is estimated to be 22.38% at national level (Zewdie & Dawit, 2015). Enhanced seed availability through formal or informal or both sources will improve smallholder farmers' access to seed and enhance improved variety adoption.

2.2. Seed Systems of Ethiopia

The seed systems in Ethiopia can be divided into two broad but interacting seed delivery systems: the formal and the informal sector (Abebe, 2010 and ATA, 2011). There is also a system referred to as integrated seed system (Abebe & Lijalem, 2011). A farmer may have adopted an improved variety from the formal sector, but may decide to save seed from their own harvest or exchange through social networks for the next season's planting: the seed that's made informally (Zewdie *et al*., 2008).

The Ethiopian formal sector is made up of institutional operations associated with the development of improved varieties, multiplication, processing, storage and distribution to farmers (Zewdie *et al*., 2000). The formal seed system was established with the aim of a dynamic, efficient and well regulated formal sector that provides farmers with sufficient, affordable, timely and high quality certified seeds of improved varieties for key crops through multiple production and distribution channels while maintaining the genetic biodiversity of the country (Thijssen *et al*., 2008 and MoARD and ATA, 2013). The major actors who are involved in this system include research institutions, Ministry of agriculture, public seed enterprises, large private corporations, and small private seed enterprises. All actors have inter-dependent roles in the system and inefficiency of one actor will automatically affect negatively the performances of the rest of the actors.

Ethiopia's formal seed system begins with breeding programs at the Ethiopian Institute of Agricultural Research (EIAR), regional research institutes and universities. Germplasm acquisition is the first components of the functional seed system. The Ethiopian Institute of Bio-diversity Conservation is mandated to explore, collect, characterize, evaluate, document and conserve plant genetic resources (Getnet *et al*., 2001; ATA, 2015). The Consultative Group on International Agricultural Research (CGIAR)

centres are also important sources of germplasm for the national and regional crop breeding programs (Tilaye et *al*., 2014).

Variety development, releasing an adaptation primarily is the mandate and responsibility of Ethiopian Institute of Agricultural Research and Regional Agricultural research Institutes /RARIs (MoARD and ATA, 2013; Tilaye *et al*., 2014; ATA, 2015). The pulse variety releasing process was predominately owned by the national and the regional research institutes. So far, a total of 199 improved pulse varieties were released by the national research system, of which 31 faba bean varieties (MoANR, 2016). Variety adoption and development passes through a series of steps from germplasm acquisition through quarantine to variety trial and release.

Seed production is that the other key element of a functional seed system and is anticipated to supply adequate and quality seed within the national prescribed rules, laws and standards. Ethiopia has adopted four seed classes for seed production: breeder, pre-basic, basic, and certified seed (Zewdie *et al*., 2008; Abebe, 2010). EIAR and RARIs are primarily responsible for breeding, maintaining and providing breeder seed and pre-basic seed in sufficient quantity and quality for different crops and crop varieties to Ethiopian Seed Enterprise (ESE) or Regional Seed Enterprises (RSEs) and for private seed enterprises (Fikre *et al*., 2010 and Tilaye *et al*., 2014). It also produces basic seed on its farm in the center but the capacity is very low.

Seed production and multiplication involves a number of actors and passes through series of steps. It was predominated by the Public Seed Enterprises including the ESE and RSEs in Amhara, Oromia, SNNP, and most recently, Somali (ATA, 2015). The ESE is mandated for production, marketing and distribution of basic and C1 seed of improved crops varieties nationwide (Fikre *et al*., 2010). Now a day there are also seed producer and marketing cooperatives which are involved in production and multiplication of pre-basic and basic seed with a close supervision with research institutes and universities.

In the formal seed system, after seed production and processing there should be effective and efficient seed channel through which farmers can have access to improved seed. There are numerous factors to keep in mind when developing a robust marketing and distribution system for certified seed. Of which timeliness, quantity, quality, choice/competition, price, and channel reach are a few to list (MoARD & ATA, 2013). The seed marketing channel should provide timely access to sufficient and high-quality seeds of improved varieties with affordable price.

Seed quality control and certification is another component of the seed value chain system. Early Generation Seed is expected to fulfil the highest quality of varietal purity and seed quality attributes prescribed by the national seed laws (ESA, 2012). This includes field standards to maintain varietal purity and identity and seed standards in physical, physiological and health quality.

In Ethiopia, a successful seed program that supplies a sufficient quantity of high-quality seed of adapted varieties on time and with reasonable cost remains to be a major constraint. The situation is much worse in legumes, compared with cereals such as wheat and maize. Although the formal seed sector started about six decades ago, the commercial seed sector supplies less than 10% of the country's seed demand per year (Zewdie *et al*., 2008; CSA, 2010). For instance, the share of the formal seed sector was 2.8% in 2010 main growing season (CSA, 2010).

Since more than ninety percent of small-scale farmers' seed needs are met through local seed systems, there are good reasons to give due recognition to the informal seed system which is a low-cost option for farmers to access seed. The informal sector remains the primary supplier of the seed of improved and local varieties for many crops grown by small-scale farmers. With a properly designed integrated system, the local system could hence be used as a vehicle to provide small-scale subsistence farmers with modern

cultivars seed at an affordable price. The informal seed system covers methods of local seed selection, production and diffusion. The informal seed system in the Ethiopian context is defined as seed production and distribution practices where there is no legal seed certification (Dawit *et al*., 2010).

The seed value chain in the informal cluster is characterized by the dominant role of farmers themselves as the prevailing source, multiplier and disseminator of varieties and seed (Dawit *et al*., 2013). In the informal sector, farmers select their crops and local landraces/varieties, produce their own seeds, and/or locally exchange and purchase seeds. The informal seed system operates at local level and can relly upon indigenous knowledge of plant and seed alternatives, sourcing, retention, management and local diffusion mechanisms (Zewdie *et al*., 2008). Its thought of the foremost versatile system and it provides both native and improved crop varieties. The informal seed system encompasses farmers to farmer's exchange, farmers save seed, seed aid, NGOs support, community-based seed production, pre-scaling up and farmers demonstration (Tilaye *et al*., 2014).

According to Abebe (2010), the majority of Ethiopian farmers show a tendency of depending on the informal system due to, primarily, it is relatively cheaper and readily available in the farmer's villages simply at the time of seed is required. Secondly, it allows the use of seeds after testing on primary adopter farmers and it is more reliable and its sustainability is more guaranteed than the formal system. All these make small-scale farmers' demand for seed more complex and diverse, creating difficulties for the formal seed sector to address the total seed demand of such farms. It means alternative ways that enhance farmers' access to diverse seed sources be sought. One such approach is designing seed supply system that takes into account the complementarities between the formal and informal seed supply systems.

The line between the formal and informal seed sectors can become somewhat imprecise, as seeds of improved varieties may be saved by farmers and eventually thought-about as a local seed once some years of usage. Thus, the formal and local seed systems are not always as distinct or separated as the two labels may imply something to integrate and synergize both systems (Girma & Amanuel, 2017). A well-functioning seed system uses the appropriate combination of formal, informal, market and non-market channels with efficiency to meet farmers' demand for quality seed. Both the formal and the informal seed systems have their inherent strengths and weaknesses and in order to have an efficient seed system, they need to complement each other and focus on the area of their best specialization. It means the scientific knowledge of the formal seed system and the lifetime seed related knowledge of farmers should complement each other.

In recent years, the though of an integrated seed system has appeared within the Ethiopian seed sector. The integrated seed system combines attributes of each the formal and also the informal seed systems (Hassena & Dessalegn, 2011). The Ethiopian Agricultural Transformation Agency had noted the three seed systems in the Ethiopian seed sector: formal, informal, and an intermediary during the preparation of the seed system development strategy of the country (MoARD & ATA, 2013). Accordingly, the rationale for the recognition of the intermediate sector is to focus activities that identify and effectively address systemic challenges that hamper the growth of market-oriented yet limitedly regulated community-based seed enterprises and to strengthen a more decentralized seed production and dissemination system that complements the currently centralized formal seed system.

The intermediate sector is specifically defined as business-oriented community-based groups (producer cooperatives or unions) that are engaged in the multiplication and distribution of noncertified seed of either modern or local varieties. The multiplication and distribution is generally within that local community and nearby areas (as opposed to farmer entrepreneurs that may scale beyond the local community). These groups are not formally registered, but have the option of applying for a newly introduced seed regulatory

scheme, Quality Declared Seed.

Innovative seed multiplication systems can include companies contracting with progressive farmers to ensure quality and access. A combination of formal (e.g. national programs) and informal (e.g. organized through villages or farmer groups) seed systems will be useful in many cases depending on their relative efficiency (i.e. in assessing varietal performance and controlling quality), responsiveness to seed buyers (e.g. small seed packs that allow smallholders to test new varieties), and existing local market knowledge — demand for explicit pulse varieties.) might incentivize the development of seed systems, whose growth can depend upon mechanisms for gathering market data.

When implemented effectively, community-based seed production schemes have several tangible advantages, including: better suited to provide farmers with a broad range of seed products that are less profitable for large-scale seed enterprises, specifically in the case of self-pollinating varieties; potentially reduce the costs of seed production and transportation; improve adoption of new crop varieties by potentially serving as demonstration sites; increase timeliness of seed delivery through alternative channels and models and provide more direct support for farmers to generate more income (Dawit, 2011; MoARD & ATA, 2013).

Though the formal seed sector is responsible for the production of seed for all crops (cereals, pulses, fruits, vegetables, and forages), their seed production is dominated by a few cereal crops, mainly hybrid maize and wheat (Zewdie & Louwaars 2012). Accordingly wheat and maize makeup nearly 64% and 23%, respectively, of the total certified seed supply from the formal sector. This indicates that very significant portion of the total pulses and faba bean area cultivated in particular is dependent on the seed source of informal system. Such informal/local seed system depends on local plant and/or seed selection, production and exchange system (Almekinders & Louwars, 1999), which may lack technical supervision for quality assurance. These constraints even seriously affect resource-poor farmers those who do not have alternative means to access improved technologies.

There are no sources which figure out the supply of improved seed of pulses through the formal seed system. However CSA (2011) shows that of the total land allocated for pulse production 12912ha (0.86%) was supplied through the formal seed sector. According to the data of the total arable land (553,381ha) covered by pulses in Amhara region only 0.29% (1617ha) was covered by improved seed. Markets for pulse seeds are comparatively small as a result of low-profit margins and its limitation to a spot agro-ecological production potential. The seed supply of faba bean production was mostly dependent on the informal seed system supplied through community-based seed production and pre-scaling up activities conducted by research institutes and other stakeholders.

2.3. Systemic Bottlenecks of the Seed Sector

Generally, Ethiopia's seed system has experienced tremendous growth. Farmers are more willing to invest in and adopt certified seeds as a result of large-scale popularisation and awareness campaigns conducted through the collaboration of the stakeholders along the seed value chain (MoARD & ATA, 2013). The establishment of Ethiopian Seed Enterprise's and regional seed enterprises led to advent of organised seed production and supply system in the country and remained the main supplier in the formal sector. However, in the country, the supply of improved seeds specially pulses never fulfilled the need of producers (Abebe & Lijalem, 2011). The amount of pulse seed produced by public and Private Seed Producers is insignificant, less than 1% of the total seed requirement (MoARD and ATA, 2013).

Seed insecurity is one of the prominent features of the agriculture sector in Ethiopia. Smallholder farmers lack both availability and access to varieties of improved seed (Girma & Amanuel, 2017). Farmers are not certain, year after year, to obtain on time the quality and quantity of seed necessary to fulfill their

production plans. Seed security could be a requirement for increasing food production, rising farmers' financial gain, alleviating poverty and making certain food security (Zewdie *et al*., 2008; Girma & Amanuel, 2017). Securing the supply of quality seed of the most critical food crops helps the country to sustain food security (Abebe & Lijalem, 2011). To strengthen food and seed security over the longer term, efforts might need to focus on seed value chain development.

The seed industry in Ethiopia was not efficient and effective, lacks availability of quality seeds at the right place and time, which further contributing for low agricultural productivity of crops (Abebe, 2010). Producing sufficient seed of all varieties needed, and deliver it to farmers promptly is the most important problem of the formal seed system (Girma & Amanuel, 2017). Seeds of improved varieties are not yet sufficiently produced and made available to the needy farmers.

The other systemic bottlenecks that affect pulse production in Ethiopia is inadequate availability of varieties meeting export market requirement, high yielding, and resistant to biotic and abiotic stresses (MoARD & ATA, 2013; ATA, 2015). Pulses being grown in a wide range of agro-ecologies have specific growing conditions and production constraints such as diseases, moisture stress, erratic and low rainfall, short or extended rainfall season, water logging, acidic soil, frost, high temperature etc.

The country's formal seed system; Which is highly dominated by the public sector; devotes much attention and money-to-money-spinning hybrid producing crops (Abebe, 2010; Tilaye *et al*. 2014). This has shown little or no interest in seed multiplication for crops with high seeding rates and low multiplication rates like faba bean. Despite the importance of faba bean and the release of several improved varieties for the last three decades, the adoption of improved faba bean varieties is constrained by poor and inadequate seed systems and lack of timely delivery.

The Ethiopia seed system also suffers from weak linkage and integration among the stakeholders and especially poor marketing system, seed multiplication schemes may fail to give the intended service to the farmers (Abebe, 2010; Abebe & Lijalem, 2011; Dawit, 2011). The pulses seed value chain in Ethiopia is far from efficient and fraught with challenges (Boere *et al.*, 2015). It is not well integrated and does not function as a unified system in a way that maximizes the welfare of all actors involved, from production up to consumption. Furthermore, it is filled with informal actors and multiple traders and middle–men.

The existing seed systems of the country also confronted with inadequate provision of excellent quality seed at reasonable prices; specialize in few crops (maize & wheat) within the formal system and different useful crops (such as pulses & oilseeds) stay orphans; low level of private sector involvement in the formal system; inefficient seed promotion, distribution and marketing mechanisms and seed quality assurance system (Abebe, 2010; Tilaye *et al*., 2014).

Supply chains that effectively deliver high-quality pulse seeds to producers are essential to increasing pulse production and consumption. A good seed system can make sure that top quality seeds of a wide range of crop varieties are produced and absolutely out there on the market in the required time and with reasonable price to farmers and other stakeholders (Kumlachew, 2015). Hence, farmers were forced to continue to use local varieties due to shortages of the seed of improved varieties, and therefore, the productivity of pulses will remains low.

3. Conclusion and Recommendation

Faba bean is the most important pulse crop in both area coverage and volume of annual production in Ethiopia. The productivity of pulses in general and faba bean in particular in Ethiopia is still, far below its potential due to lack of improved seed. Seed is one amongst the foremost necessary sources of innovation, notably in resource-constrained small farm environments. However, the use of improved seed remains

very low (6% in Amhara region). In Ethiopia three seed sectors have been recognized; the formal, informal and integrated seed sector. Though the legal seed sector was responsible for the production of seed for all crops, their seed production is dominated by a few cereal crops, mainly hybrid maize and wheat. Therefore the informal seed sector remains the major source of seed for the farming community. A successful seed program that supplies a sufficient quantity of high quality seed of adapted varieties on time and with reasonable cost remains to be a major constraint. As a result, the seed supply of faba bean production mostly dependent on the informal seed system supplied through community based seed production and pre-scaling up activities conducted by research institutes and other stakeholders.

Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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