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Review on The Impact of Plant Breeding in Crop Improvement in Ethiopia

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Abstract: **In earlier days the extent of plant breeding as an art and as a science was much disputed. Plant breeding was practiced first when people learned to look for superior plants to harvest for seed; thus selection became the earliest method of plant breeding. The results of those primitive efforts in plant selection contributed much to the evolutionary development of each of the cultivated crops. Before breeders possessed the scientific knowledge that is available today, they relied largely on their skill and judgment in selecting the superior types. The breeders should be good observers, quick to recognize variations among plants of the same species, which could be used as the basis for establishing new varieties. Among the scientific disciplines essential to addressing this challenge, plant breeding will play a unique role by developing the new crops, ornamentals, or forest trees that meet societal needs. Plant breeders will develop plants that are adapted to our changing environment and that can improve environmental quality. The objective of this paper is to review the impact plant breeding in agriculture in general and in crop improvement, food security & investment specifically. The achievements of plant breeders are numerous, and can be grouped into several major areas of impact – yield increase, enhancement of compositional traits, crop adaptation, and the impact on crop production systems. Plant breeding is not without negative side effects, the replacement of local landraces with improved and varieties of narrow genetic base results in genetic vulnerability and genetic erosion. The limitation of genetic diversity directly impact on the lack of input materials for new breeding programs.**

Keywords: **Plant breeding, Genetic diversity, Improved Varieties, food security.**

1. INTRODUCTION

Plant breeding is the art and the science of changing and improving the heredity of plants (Poehlman, 2013) Modern plant breeding is based on understanding and utilization of genetic principles. It presupposes knowledge of the botanical characteristics of the species, of plant diseases and their epidemiology, of insect pests that feed upon the different plant species, of physiological factors related to adaptation of plants, and of biochemical characteristics affecting utilization and nutritive value (Poehlman, 2013). Knowledge about the extent of genetic variability and patterns of agro-morphological variation in local germplasm from a target region is an important prerequisite for efficient crop improvement (Bashir *et al*., 2014). Global food security demands the development of new technologies to increase and secure cereal production on finite arable land without increasing water and fertilizer use. The use of heterosis through hybrid breeding has produced tremendous economic benefits in worldwide crop production (Kempe *et al*., 2014).

Simulated learning systems are now widely used to train special skills in complex environments. Clinical training of nurses and health care workers are time-consuming and resource-demanding, but can be well supplied by simulations in special virtual learning environments. It is possible through experimental studies to assess the effect on such simulated training of skills within health care (Tsai et al., 2008). Several more general software packages for simulation based training of complex skills are available on the internet. Several British law schools collaborate on a simulated virtual learning approach to train skills in legal transactions with the software SIMPLE (SIMPLE, 2011). ISLE Interactive Simulated Learning Environments gives as a service the construction of user defined training systems for complex and expensive equipment or environments (ISLE, 2011). The software SIMWRITER from NexLearn can be customized to users' needs for simulation to train complex social skills (Nexlearn, 2011). Virtual Property Manager is simulation software developed to teach students within residential property management, developed to generate more interest among students for the area (Carswell & James, 2007). The principles of efficient training with virtual learning environments have been outlined with the theory of problem spaces (Stefanutti & Albert, 2003).

Generally plant breeding has been a key science in improving crop production, with an estimated contribution to productivity increases of around 50% cited by (Raggi *et al*., 2017). The improvements made in field crops by plant breeding are numerous (Poehlman, 2013). The impact of plant breeding in crop improvement, food security and investment was cited throughout this text to illustrate the ways in which the important crop plants have been made more productive and safer to grow. Developing sustainable societies is the grand challenge of the coming century. More food, feed, fiber, fuel, and forest products necessary to meet basic human needs must be produced from less land, water, and nutrients. A growing population will require expanded landscaping and urban forests to moderate the environment and produce suitable living spaces. Among the scientific disciplines essential to addressing this challenge, plant breeding will play a unique role by developing the new crops, ornamentals, or forest trees that meet societal needs. Plant breeders will develop plants that are adapted to our changing environment and that can improve environmental quality (Brummer *et al*., 2011). The objective of this paper is to review the impact plant breeding in agriculture in general and in crop improvement, food security & investment specifically.

2. LITERATURE REVIEW

IMPACTS OF PLANT BREEDING IN CROP IMPROVEMENT

The achievements of plant breeders are numerous, and can be grouped into several major areas of impact:- development of improved varieties, yield increase, enhancement of compositional traits, crop adaptation, stress and lodging resistance and the impact on crop production systems. The improvement of crop plants by alteration of traits using traditional plant breeding program is time consuming and labor intensive. The researchers are switching towards biotechnological approaches for crop improvement (Saurabh *et al*., 2014).

Development of Improved Varieties

The major characteristics sought for in the genetic improvement of cereals have been high yield, diseases and insect pest tolerance/resistance, wide adaptation, yield stability, adaptation to varied ago-ecologies and farming systems with suitability to optimum rainfall and drought-prone (especially terminal drought) areas, various types of maturity (early, intermediate and late), quality (mainly seed color and tolerance/resistance to major biotic and abiotic stresses). Crop research apart from the generation of improved technologies and information, it is also involved in the generation of basic knowledge. The generation of basic information on the biology, genetics, physiology, socio-economics, food technology and other aspects of the crops rests heavily upon the domestic research in Ethiopia.

The improvements made in field crops by plant breeding are numerous (Poehlman, 2013). A very good example is the provision of high-yielding varieties with adequate grain quality is the principal objective of the wheat breeder. However, to permit potential high yield to be fully realized and maintained, disease must be controlled (Lupton, 2014). The applications of transgenic technology for wheat hybrid seed production become successful through application of transgenic technology for hybrid seed production in wheat (Kempe *et al*., 2014). Induced mutation is used with great success by different breeding programs for developing new cultivars. The cultivar has resistance to lodging, high yield potential and long grains with superior quality 8,944 kg/ha (Schiocche *et al*., 2014). Morphological improvement and heterosis are the only two effective approaches to increase yield potential in rice breeding (Yuan, 2015). Increasing in yield potential is very limited without these two approaches. However, genetic engineering must be combined with favorable morphological characters and strong heterosis; otherwise, there will be no actual contributions to yield increase (Yuan, 2015). Through morphological improvement and the use of inter-sub specific (indica/japonica) heterosis, much progress in developing super hybrid rice varieties has been achieved (Yuan, 2017). In Ethiopia, until 2014, about 960 varieties were recommended or released for major agricultural crops (cereals (Wheat, barley, tef, maize and sorghum), legumes (haricot bean, chickpea, lentil and faba bean), oilseeds, industrial (cotton), tuber and roots) and horticultural (vegetables, fruit trees and aromatic-spices, medicinal) crops (Atilaw *et al*., 2016)

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Table1. Number of varieties released by public and private sector (selected crops)

Crop(s)	Total	Private sector	Private sector (%)	No of varieties under EGS production (2015)
Cereals (6)	319	29	9	99
Legumes (7)	186	2	1	51
Oilseeds (5)	85	17	20	13
Tuber crops (2)	61	6	10	-
Vegetables (17)	120	63	53	-
Fruit trees	41	4	10	-
Condiments and Medicinal plants	40	3	8	-
Cotton	26	7	27	-
Forage and pasture	33	1	3	-
Total	**911**	**132**	**14**	**163**

Source: MoANR, 2016

Yield and productivity

The increase in productivity per hectare is often the most frequent manifestation of the adoption of improved varieties in regions of higher and more assured production potential where farmers are using improved inputs such as chemical fertilizers and pesticides. Production of food crops by small farm households in SSA does not fit the above textbook expectation of finding large productivity effects attributed to varietal change. In SSA, production is rain fed and uninsured. Drought is a frequent visitor to farmer fields. The demand for shorter duration varieties that escape drought is high. All things being equal, shorter duration translates into lower yields in good rainfall years. The use of chemical inputs is low. Without accompanying changes in input use, farmers cannot leverage varietal change into abrupt gains in yields in favorable weather. Therefore, varietal change in and of itself is unlikely to result in substantial productivity change (Sanders *et al*., 1996; Bulte *et al*., 2014).

Plant breeding is vital to increase the genetic yield potential of all crops. Yields of major crops, for example, Chinese cereal production has increased steadily from 83.4 Mt in 1961 to 474.2 Mt in 2009, accounting for 9.5% of total global cereal production in 1961 and 21.8% in 2009. A yield breakthrough in super-rice varieties has been rapidly realized with the great efforts of Chinese rice breeders since 2011. The current landmark variety of super-hybrid rice, Super-1000, was developed, with yield reaching 16.0 t ha−1 in a 6.8-ha demonstration trial in Gejiu county, Yunnan province in 2015 (Yuan 2017). As summarized in the following (table 2) starting from 2004/05 to 2013/14 the yields increases in general. Yields in cereals averaged 21.4 quintals per hectare (q/ha) in 2013/14 and ranged from about 28 q/ha in maize to 13 q/ha in teff. Annual growth in yields averaged about 7 percent in all cereals, with specific average annual growth in barley, teff, wheat, sorghum, and maize yields standing at 4.8, 5.2, 5.9, 7.1, and 8.1 percent, respectively. Growth in cereal yields was faster relative to other crop groups. However, these yield increases are not totally due to the genetic potential of the new crop cultivars but also due to improved agronomic practices (e.g., application of fertilizer, irrigation). Crops have been armed with disease resistance to reduce yield loss. Lodging resistance also reduces yield loss resulting from harvest losses.

Table 2. Crop yields (in quintals per hectare)

Crop	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Cereals	11.8	12.7	14.4	15.3	16.7	16.9	17.8	20.0	21.6	21.4
Pulses	8.7	8.5	9.5	10.5	12.0	11.8	13.2	13.1	13.7	14.5
Oilseeds	5.4	4.8	5.5	8.2	8.2	7.8	8.6	8.1	8.4	8.7
Vegetables	57	47	43	50	51	54	58	68	64	63
Root crops	98	78	75	86	87	88	97	92	163	151
Fruits	47	86	83	67	67	73	68	79	70	60

Source: Authors' computation using CSA annual reports (CSA Volume I 2005-2014).

Enhancement of Compositional Traits

Breeding programs committed to improving agronomic, compositional, and nutritional qualities extend globally and include renowned organizations such as the International Maize and Wheat Improvement Center (CIMMYT) headquartered in Mexic (Venkatesh *et al*., 2015). Breeding for plant compositional traits to enhance nutritional quality or to meet an industrial need are major plant breeding goals. High protein crop varieties (e.g., high lysine or quality protein maize) have been produced for use in various parts of the world. For example, different kinds of wheat are needed for different kinds of products (e.g., bread, pasta, cookies, semolina). Breeders have identified the quality traits associated with these uses and have produced cultivars with enhanced expression of these traits. Genetic engineering technology has been used to produce high oleic sunflower for industrial use, while it is also being used to enhance the nutritional value of crops (e.g., pro-vitamin A "Golden Rice"). The shelf-life of fruits (e.g., tomato) has been extended through the use of genetic engineering techniques to reduce the expression of compounds associated with fruit deterioration.

Crop Adaptation

Selection of plant varieties specifically adapted to regional production and end-use is an important component of building a resilient food system (Brouwer, 2016). The integration of genetic engineering with conventional plant breeding, within an interdisciplinary approach, will likely accelerate the development and adoption of crop cultivars with enhanced adaptation to climate change related stresses (Varshney *et al*., 2011). Formal crop breeding using landrace resources has a key role to play in climate change-adaption strategies (Hellin, 2014). The development and dissemination of climate-responsive germplasm may take several years because the process consists of several steps, including breeding, on-farm testing, release of varieties, and germplasm dissemination crop plants are being produced in regions to which they are not native, because breeders have developed cultivars with modified physiology to cope with variations, for example, in the duration of day length (photoperiod) (Hellin, 2014). Early maturing cultivars can be used to produce a full season crop in areas where adverse conditions are prevalent towards the end of the normal growing season (Keleman *et al*., 2013). In crops such as barley and tomato, there are commercial cultivars in use, with drought, cold, and frost tolerance. Improved varieties that crop breeders identify as superior to landraces under experimental conditions may actually yield substantially less under farmers' conditions because of genotype-by-environment interactions (Keleman *et al*., 2013). Lodging is the bending or breaking over of grain before harvest. Lodging causes yield losses in small grains, soybeans, corn, sorghum, and other crops. In cereals, the reduction of plant height has been the main target for improving lodging resistance. A very good example is the shorter length of the lower internodes; smaller inner Culm diameter and higher thickness of mechanical tissue in japonica rice improved stem strength has reduced lodging risk (Bashir *et al*., 2014).

Drought Stress Threats

Crop production and productivity are intermittently and regularly suffering from drought, erratic rainfall and high heat intensity. Identification of genotypes (climatic resilience varieties) withstanding drought and tolerate high heat intensity is the area of focus is, thus, of paramount significance to mitigate the problem.

Next to productivity, improved environmental stress tolerance is essential to all breeding programs (Brummer *et al*., 2011). Crop varieties with increased tolerance to abiotic stresses, like heat, frost, soil acidity, aluminum-rich soils and drought stress, can play an important role in managing current climatic variability and adapting to climate change (Cairns *et al*., 2013; (Brummer *et al*., 2011). The development of climate-resilient germplasm is possible through a combination of conventional, molecular and, in some cases, transgenic breeding approaches (Cairns *et al*., 2013). The current findings coupled with technological developments in crop genomics and genetics set the stage for plant breeding in which herbivore induced defenses can be used to provide better crop resistance against insect attack (Tamiru *et al*., 2015) Wheat: Hybrids often display increased yield, enhanced yield stability, and improved abiotic and biotic stress resistance that result from heterosis (hybrid vigor) (Schnable and Springer, 2013). Recent large-scale phenotyping involving extensive collections of inbred lines and hybrids revealed that hybrids were superior to the mean of their parents for grain yield, susceptibility to frost, leaf rust, and Septoria tritici blotch (Gowda *et al*., 2012). Consistently higher grain yield stability for wheat hybrids compared with lines was observed in multiplication field trials (Muhleisen *et al*., 2014).

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Impact of Plant Breeding On Crop Genetic Diversity Variation in Genetic Diversity Measures

Crop genetic diversity has traditionally been analyzed using morphological traits, particularly those agro-morphological traits of interest to users. Currently, there are more than 30 types of molecular markers available for assessing genetic diversity (Mondini *et al*. 2009). These markers have been widely applied to measure genetic diversity in crop plants and have played an important role in the characterization of crop genetic variation. However, genome wide SNP markers with better sampling of plant genomes have not fully been applied to assess crop genetic diversity (Hyten *et al*. 2006). It is difficult to interpret and generalize the findings from estimation of different diversity parameters using different markers, even on a crop species (Rauf *et al*. 2010). Specifically, not all of the genetic diversity measures applied have been equally sensitive in detecting diversity changes from plant breeding practices, and different diversity measures may have different levels of accuracy and precision (Mohammadi and Prasanna 2003; Fu *et al*. 2005). Not all of the molecular markers applied have been equally informative for diversity assessments, as illustrated in oat using AFLP and SSR markers (Fu *et al*. 2003, 2004). Thus, discrepancies can be expected, even for the same assessment using different diversity parameters.

Plant breeding is not without negative side effects, the replacement of local landraces with improved and varieties of narrow genetic base results in genetic vulnerability and genetic erosion. Genetic diversity may be expected to be low due to natural populations have become fragmented, resulting in small population sizes and consequent genetic drift (Weeks *et al*., 2011). For out crossing species that display inbreeding depression, rather than adhering to a strictly local protocol that may reflect the low genetic diversity common in small fragmented populations, adaptive potential may be better achieved with high-quality and genetically diverse seed (Breed *et al*., 2013).

More recently, the spread of modern, commercial agriculture and the introduction of new varieties of crops has been the main cause of the loss of genetic diversity (Allender 2011; Lopes *et al*., 2015). Genetic uniformity leaves a species vulnerable to new environmental and biotic challenges and causes heavy damage to the society.

The intensive selection in the process of hybrid rye breeding program narrowed genetic diversity in rye (Dopierała *et al*., 2015; Targońska *et al*., 2016). The search for new genetic variability and enrichment of the existing variability are important approaches in modern cereal breeding (Liu *et al*., 2014). Traditional breeding methods were based on strong selection pressure and improved the diversity and caused genetic uni-formity of cultivars (Broda *et al*., 2016). The limitation of diversity directly impact on the lack of input materials for new breeding programs. The low variability within S. cereal ssp. cereal causes considerable difficulties in the achievement of the breeding goals (Broda *et al*., 2016). Therefore, the breeding of new cultivars for better yield, resistant to diseases and pests or with the increased tolerance of environmental pressures is very difficult.

IMPACT OF PLANT BREEDING IN FOOD SECURITY

Increased yields from improved varieties may enhance food security directly by stretching household consumption over more months in the same cropping year. Some of those months may occur in the hotter and drier hunger season. Improved varieties may also have the potential to capitalize on good rainfall years conducive to heavier production that opens up opportunities for inter year storage of staple food crops. Indirectly, and just as importantly, higher yields will result in lower prices that reduce food insecurity. Given that much semi-subsistence, small-producing households are net consumers in that they buy more than they sell, the indirect price effect of increased production on food security should figure prominently in traded staple commodities, such as maize.

The majority of Ethiopian population relies on cereals to meet its nutritional requirements particularly with regard to calories. However, most cereals are deficient in major micro nutrients and on the other side animal products rich in the essential nutrients for human being are unaffordable to low income.

Increasing the production and productivity of the crop sub sector is one of the measures taken in Ethiopia to assure food security of more than 80 million people and escape from long-lived poverty persisted in the country. This improvement can only be realized if modern technologies are utilized from which seed take the first priority due to its nature. However, in order as seed to be a key factor in agricultural productivity, it must be channeled into a system. Positive impacts on poverty reduction and lower food prices were driven in large part by crop germplasm improvements in CGIAR centers that were then transferred to national agricultural programs for adaptation and dissemination (Pingali, 2012). Improved crop varieties are a key output of agricultural research and have contributed to significant increases in agricultural

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production and productivity (Pingali, 2012). The richness of national per capita food supplies in regard to the 52 measured crop commodities increased consistently over the past 50 year for all variables (Khoury *et al*., 2014). This increase in similarity brought national food supplies around the planet closer to a global standard composition. Between 1961 and 2009, homogeneity increased by 16.7%, as measured by the mean change in similarity between each country and the global standard composition, with a maximum (single-country) change of 59.7%. Likewise, mean among-country similarity increased by 35.7%. In Ethiopia, the seed demand is increasing rapidly due to the agricultural development. Thus, securing the supply of quality seed and planting material of the most important food crops is the most effective way to sustain food security (Atilaw, 2010). Based upon a limited number of global crop commodities and processed products has been associated with the rise in no communicable diseases, such as adult-onset diabetes, heart disease, and certain forms of cancer (Kearney, 2010). The problem of food security is larger than it has ever been, with more than 800 million people chronically hungry and millions more at risk (FAO, 2013). Despite progress in some parts of the world to reduce hunger, in other areas, particularly in Africa and the Middle East, the hungry population is growing. Even among plant scientists, there is a well-ingrained perception that there is enough food in the world, but that the problem is distribution. The broadest and most widely accepted definition of food security is that provided by the FAO, that is, as a “situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2013). Neither the status of food security nor its achievability is uniform throughout the world, within individual countries, or over time.

The Impact of Seed production in Ethiopia

In Ethiopia, various actors and stakeholders are involved in seed production activities. All these actors and stakeholders, in one way or another, contribute to production, promotion, supply and marketing of improved seed in the country. Studies show that only a small area of land is covered by improved seed, however.

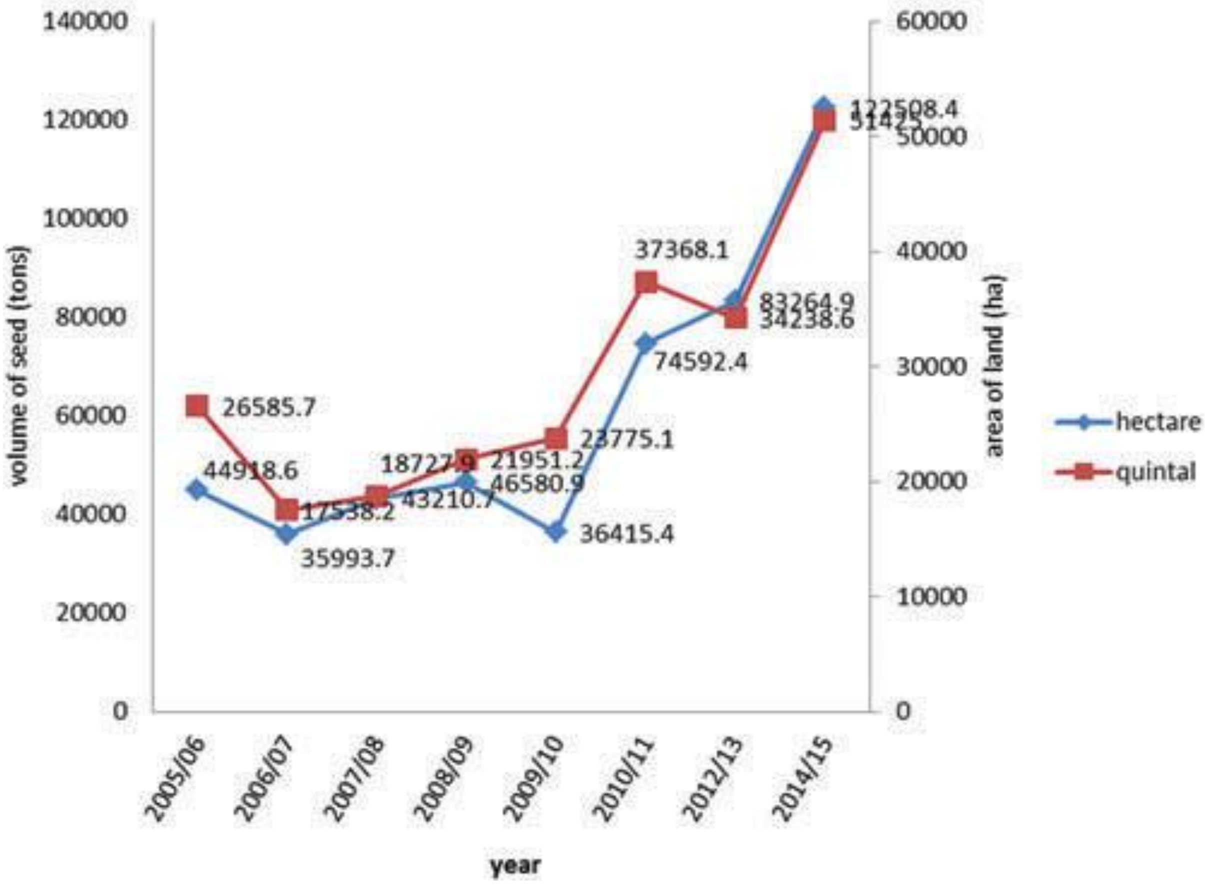

Figure 1. Areas covered by improved seed and amount of seed used across years by smallholder farmers.

Source: Central Statistics Agency (CSA) farm management practice survey(2005/6–2014/15)

NB: The figures represent only the main cropping season and area of coverage by improved seeds for the decade (2005/06 to 2014/15) by smallholder farmers. It also displays the amount of improved seed used to cover the area of land. The total area covered by improved seed, during main cropping season, increased from 44,918.6 ha in 2006 to 122,508.4 ha in 2015. Similarly, the total amount of seed used increased from 26,585.7 tons in 2006 to 51,425 tons in 2015. In this section, we highlight the specific role of seed producers (public seed enterprises, private seed companies/producers, and other producer organizations) in seed production.

Public seed enterprises

The role of public seed enterprises is significant in Ethiopia. Before 1991, the enterprise sold most of its seed directly to state farms, to farmers through NGOs, and to the Agricultural Inputs Supply Corporation (AISCO). Because of the policy reform toward market liberalization in the country, the role of state farms gradually declined in the agricultural sector. Hence, ESE has distributed a major share of its seed to farmers, NGOs and emergency relief programs of the MoA (Gebeyehu, Dabi, and Shaka 2001). Regional seed enterprises (RSEs) have been established to decentralize the agricultural and rural development efforts to regional states (Alemu 2011). The RSEs include Amhara seed enterprise (ASE), Oromia seed enterprise (OSE), and South seed enterprise (SSE). The RSEs started gradually replacing ESE as the sole public seed enterprise (Alemu 2011). The main objective of RSEs is to multiply and distribute improved seed of major crops to satisfy the regional seed demand. These public seed enterprises produce and supply large volumes of improved seed to the country. However, they focus only on a few crops (hybrid maize, bread wheat, teff, and barley) and do not have much interest and capacity (technical, facility and finance) in investing in crops/varieties demanded by niche markets. The Federal Ministry of Agriculture and Regional Bureaus of Agriculture coordinate the public seed sector with an impact on both the research institutions and public seed enterprises A complex of organizations and institutions operate, each responsible for parts of the above mentioned components of the public seed value chain (Alemu, 2015) Variety development has long been the sole responsibility of the EIAR. Since research decentralization, RARIs have increasingly been commissioned to develop varieties suitable for their regions. Moreover, agricultural universities and colleges are contributing to variety research and development. The variety release mechanism is still controlled at a federal level. The role of private seed companies is still limited to the production of hybrid maize seed, while the ESE is the main public sector seed producer and supplier of other crops and varieties. At Federal MoARD level there is one seed testing laboratory with a capacity of 5000 samples per year. There are no full pledge quality laboratories with required equipment and furniture in EIAR. The availability of these facilities varies from one center to the other. Some centers may have some of these facilities, but none has a complete set of facilities indicated above (Atilaw, 2010). In addition three RSA and 33 private seed growers have storage facilities with different amount of storage capacities. Most of the facilities are owned by the ESE but are not located strategically for serving small farmers throughout the country

Private seed producers (Companies)

Private seed companies (both domestic and international) are primarily concerned with the production, processing and marketing of hybrid maize seed. An increasing number of international seed companies are now entering the Ethiopian seed sector, introducing commercial varieties of potato, vegetables and hybrid maize. Most domestic companies are small or medium in size, and are locally oriented, but the production and marketing programs of international companies target the areas of high productivity, such as Oromia, Amhara and the Southern Nations, Nationalities and People's Region (SNNPR). Partnerships with public organizations, such as research institutes, Bureaus of Agriculture and some cooperatives, plays a significant role in variety demonstration, scaling-out farmer-based quality seed production and out-grower schemes. The scale of use of quality seed of improved varieties has increased over the last ten years (Alemu, 2015).

The volume of seed production by private producers increased from 4994.1 tons in 2012/13 to 9819.2 tons in 2014/15. More specifically, the contribution of private producers is high for hybrid maize seed production and distribution. For instance, in Amhara region alone, from the total amount of hybrid maize seed produced and distributed in 2014 (4803.7 tons), private producers' share was 38% (1832.2 tons) of the total (ISSD/BDU 2015). The share of private seed production in seed supply is even higher than this under direct seed marketing to end-users.

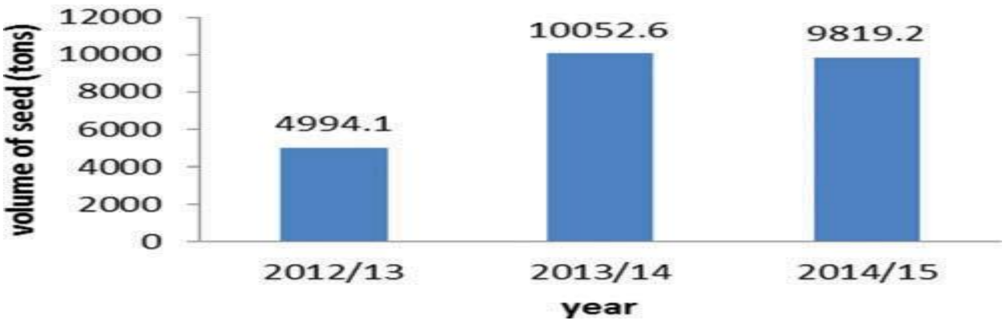

Figure 2. Amount of seed produced (tons) by private producers (2012/13–2014/15).

Source: Integrated Seed Sector Development (ISSD)/Ethiopia 2015 national workshop *Presentation.*

3. CONCLUSION

Plant breeding is the art and the science of changing and improving the heredity of plants. It was practiced first when people learned to look for superior plants to harvest for seed; thus selection became the earliest method of plant breeding. The results of those primitive efforts in plant selection no doubt contributed much to the evolutionary development of each of the cultivated crops. Plant breeding is key science in improving crop production, with an estimated contribution to productivity increases of around 50%. The improvements made in field crops by plant breeding are numerous. Among the scientific disciplines essential to addressing food insecurity, plant breeding will play a unique role by developing the new crops, ornamentals, or forest trees that meet societal needs. Plant breeders will develop plants that are adapted to our changing environment and that can improve environmental quality. In Ethiopia, major achievements were made for major agricultural cereals (Wheat, barley, tef, maize and sorghum), legumes (haricot bean, chickpea, lentil, faba bean, and etc), oilseeds(Noug, Linseed Sunflower , Safflower ,and etc), industrial (cotton), tuber and roots) and horticultural (vegetables, fruit trees and aromatic-spices, medicinal) crops. Plant breeding is not without negative side effects, the replacement of local landraces with improved and varieties of narrow genetic base results in genetic vulnerability and genetic erosion. The limitation of genetic diversity directly impact on the lack of input materials for new breeding programs. Plant breeding also had a significant impact in investment and in addressing food security, which should be matched with the current large population of the world in general and Ethiopia in particular. The Seed productions in Ethiopia are public and private in our country and dependent on government fund, but private company is lower as compared to public system. The capacity of quality seed distribution is lower, the farmers are forcing themselves to use in formal seed distribution among them. More the budget allocated over time in Ethiopia to handle important operation is lower.

4. RECOMMENDATION

The limitation of genetic diversity directly impact on the lack of input materials for new breeding programs. Plant breeding also had a significant impact in investment and in addressing food security, which should be matched with the current large population of the world in general and Ethiopia in particular. The investment on seed system in our country and dependent on government fund is lower in private company as compared to public system. Because of this reason the capacity of quality seed distribution is lower, the farmers are forcing themselves to use in formal seed distribution among them. More the budget allocated over time in Ethiopia to handle important operation is lower. The plant breeding strategies to overcome important challenges in the country is or less affected. At the finally higher institute is better to give training for public and private company by helping budget to develop the breeding program for the future and also technology of crops is very important in maximizing productivity of the crops in the future.

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