

Review on Adoption of Improved Soya Bean Technologies: Empirical Evidence from Ethiopia

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Abstract

Soybean is a legume crop grown in the tropical, subtropical, and temperate climates which are used for food and animal feed. However, the production and productivity of soybean are low and improvement in production and productivity depends on the extent to which a household has applied the recommended production technologies. The objectives of this review were: to identify the determinants of adoption and intensity of improved soybean varieties to generate information that helps to understand and evaluate the key challenges in Ethiopia. From the review, the reviewer understands different scholars' points of view. Sex of household, age of household head, education, farm experience, participation in training, and extension service affect the adoption of improved soya bean varieties positively and significantly while the distance to the nearest market affects adoption of improved soya bean varieties negatively and significantly. On the other hand, the intensity of adoption was affected by age, soya bean farm experience, participation in training, and size of livestock holding. Most of the studies reviewed in this paper indicated that sex has a significant positive impact on the adoption of improved soya bean varieties. However, the participation of female households in the adoption process indicated that 15% of female-headed households and dominated by 85% of male household heads. Therefore, to improve the like household heads. Therefore, to improve the likelihood of adopting modern agricultural technologies like improved soya beans by smallholder farmers, female-headed households should get emphasis in all activities of the promotion of new technologies. In the current scenario of our country; there is a flourishing of different huge oil factories like W.A and BK using Soya bean as a major input to their production. Those industries demand a higher amount of Soya bean as an input and create a backward linkage to Soya bean producer farmers. For instance, W.A's edible oil factory alone needs 20,000 hectares of land to run the business and 500,000 quintals of soya bean requires per year. Therefore, it can improve smallholder farmers' livelihood by creating market opportunities to supply their products directly to factories. Yet, the promotion of new Soya bean varieties and comprehensive studies on the adoption and impact of soya beans should get any attention from respective actors.

Keywords: Adoption; Determinate, improved soya bean; Ethiopia

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1. INTRODUCTION

Agriculture is a dominant sector of the Ethiopian economy which takes a lion share of contribution to the GDP, employment, and foreign exchange earnings. It is still believed to remain a sector that plays an important role in stimulating the overall economic development of the country in the years. However, Ethiopian agriculture is dominated by subsistence, low input-low output, rain-fed farming system. Low agricultural productivity can be attributed due to limited access to agricultural inputs by smallholder farmers, financial services, improved production technologies, irrigation and agricultural markets, and poor land management practices that have led to severe land degradation (CSA, 2016).

Following these facts, Ethiopian governments have focused on promoting technology-led initiatives on crop production to enhance productivity, particularly in smallholder agriculture (FDRE, 2010). Currently, the government is undertaking a strategy of improving agricultural productivity primarily through agricultural intensification, involving increased use of inputs, including seeds of improved crop varieties (Iticha 2020). Crop production is one of the agricultural sub-sectors that improve farmers' livelihood through the utilization of improved inputs like improved crop varieties, fertilizer, pesticides, etc., and also it is a common agricultural practice followed by worldwide farmers to grow and produce crops to use as food and fiber. This practice includes all the feed sources that are required to maintain and produce crops.

Soybean is included under the pulse crops and it is one of the emerging high values, profitable, and multipurpose crops used for the preparation of different kinds of soya bean foods, preparation of animal feeds, and raw material for the processing industry (FAO, 2015). It was introduced to Ethiopia in the early 1950s, becomes one of the most vital low land crops, and adapted to low to medium agroecology predominantly produced by smallholder farmers (Hagos & Bekele, 2018) Production of this crop is vital in Ethiopia to overcome food insecurity and malnutrition—the crop can substitute the relative expensive of animal protein.

Currently, the major soybean growing areas are the western and South-Western parts of the country; notably Benishangul-Gumuz, Gambela, and parts of the Oromia Region. Oromia and Benishangul-Gumuz

regions account for the highest production of Soya bean in the country, 51% and 40% respectively (Sopov, 2015). However, in some potential areas, willingness to produce soybean become decreased, its production growth becomes stagnant due to low or nil demand of soybean for direct consumption and marketing, monopolistic soybean trade, high transaction cost to sell at district market and poor infrastructure facilities and high transport cost. Furthermore, smallholder farmers were not fully adopted the newly released improved high-yielding soybean varieties and used local soybean varieties that decreases productivity and production.

Different scholars have been researched the determinants of improved soybean varieties adoption and intensity. Therefore, this review aimed to identify the determinants of adoption and intensity of improved soybean varieties to generate information that helps to understand and evaluate the key challenges in Ethiopia.

2. LITERATURE REVIEW

2.1 Soybean Product and Its Application

Soybean is an important global crop providing oil and stable food of great nutritional value. The bulk of the crop is solvent extracted for vegetable oil and deflated soy meal. A small proportion of the crop is consumed directly by humans. Soybean flour made for Soya meal can be mixed with wheat flour. Moreover, it is also used in the making of candies and ice cream. The mature seeds can also be processed to give Soya milk, curds, and cheese. Soybean has several health-related advantages as well. It is regarded as equal in protein to animal foods. It is excellent for many different conditions such as high blood pressure, diabetes-related diseases, and many others. It is very useful in improving the menu of malnourished children and revitalizing heart and breast cancer patients and has no cholesterol (Dsa, 2008).

Soymeal accounts for over 60% of world meal production (vegetable and animal meal) and occupies a prominent position among protein feedstuffs used for the production of feed concentrates. Soybean oil is the second most important vegetable oil (after palm oil); it accounts for 25% of global vegetable/animal oils and fats consumption. The widespread use of soybean oil in particular as edible oil is due to its plentiful and dependable supplies, its competitive price, and its neutral flavor and stability in both unhydrogenated and partially hydrogenated forms. Moreover, the rapid rise in the demand for compound feed has contributed considerably to the rise in soya oil production. Soybean's role is expected to be secure because soya meal is in huge demand and oil is a very lucrative by-product (FAO, 2015).

2.2. Present Demand and Supply of Soya bean

According to CSA (2020), there are about 22,190.76 hectares of land covered by smallholders and produced 548,052.95 quintals of soybean. The average national productivity of the crop is 24.70 quintals per hectare. At present, the use of soybean in Ethiopia is limited to baby foods production. These baby food-processing plants such as the Faffa food factory mainly cover their demand totally from imports, as there is no ample and sustainable supply of soybean required by the factories.

According to the Faffa food plant, it produces faffa baby food with 18% deflated soy flour, Dube with 13% soy protein, and Meten containing soy flour with 14% protein. This implies that about 15% of the factory's whole product is soy flour and this percentage share can be used to estimate the present annual demand for soy flour by the baby food-producing plants. In this connection, the report of (CSA, 2007), pointed out that about 16,550 tons of Fafa, Dube, Edget, and Meten have been produced in 2006/07 alone which, therefore, implies that about 2,483 tons of soy flour have been imported into the country in 2006/07 alone. This by itself indicates the presence of huge demand for the product.

Additionally, given the wide range of health benefits of soybean stated earlier, flour mill factories are likely to blend their products with soy flour if it is available domestically at an affordable price. This will increase the nutritional value of the milled flour thereby increasing the demand in the market. According to (CSA, 2006) about 173,991 tons of wheat and other flour has been produced in 2005/06 alone. Since the minimum requirement of soy flour being blended by flour mill plants in many developing countries is 3%, the potential demand by the flour mill plants in the country is estimated at 5,220 tons.

In general, based on the foregoing analysis, the present annual potential demand for soy flour is estimated to be about 7,703 ton, where 2,483 ton (32%) emanates from the baby food-producing plants while the remaining 5220 ton (68%) is the demand of flour milling plants. In general, the above presentation divulges that there is substantial potential demand for the product. As indicated by (CSA, 2006) the average per hectare yield of soybean in commercial farming is about 1.5ton per hectare. The current annual potential demand for the soybean in Ethiopia is estimated to be 7,703 tons. The level of demand will increase in the future as more and more families become aware of the diet and health advantages of the grain.

2.3. Production and Productivity Gaps of Soybean in Ethiopia

There are favorable climatic and soil conditions for soybean production in South and Western Ethiopia, which is essential both for subsistence farming as well as for commercial purposes. The problems of producing soybean

are not only limited to market access but also low productivity and production, lack of processing facilities, lack of capital to increase production, and no market information system for effective agricultural marketing.

Soybean is a high-value and profitable crop. The economic viability of soy production is determined by the commercial utilization of its sub-products meal and oil respectively, which account for about two-thirds and one-third of the crop's economic value. Soy oil and meal are consumed worldwide as food and animal feedstuff respectively.

Figure 1: Advantage of soya bean



Source: own source from field day

Soybean varieties selected for drought tolerance have the potential of improving agricultural productivity and hence livelihoods if adopted by farmers. Soybean grows in areas where maize and common beans are grown. It is drought tolerant and grows to a height of 60–120 cm, maturing in 3 to 6 months depending on variety, climate, and location. Depending on the variety, the crop can be grown from 0-2200m altitude and under rainfall ranging from 300 to 1200mm. Altitude influences temperature that in turn affects the initiation of flowering and maturity. At very high altitudes, flowering may not occur and the crop remains vegetative. Therefore a crop that requires warm climates and is suitable for low to medium altitudes. It grows best when planted in pure stands.

Table 1: Soybean production, productivity, and area coverage of Ethiopia (2012/13-2019/20)

| <i>Production Year</i> | <i>Area coverage (Hectare)</i> | <i>Total Production (Ton)</i> | <i>Productivity (Qt/ha)</i> |
|------------------------|--------------------------------|-------------------------------|-----------------------------|
| 2012/13 | 31,854.75 | 636,53.101 | 19.90 |
| 2013/14 | 30,517.38 | 61024.916 | 19.90 |
| 2014/15 | 35,259.76 | 72183.745 | 20.50 |
| 2015/16 | 38,166.04 | 81241.833 | 21.30 |
| 2016/17 | 36,635.79 | 81234.659 | 22.20 |
| 2017/18 | 37,078.70 | 864,678.69 | 22.71 |
| 2018/19 | 64,720.12 | 1,494,546.13 | 23.09 |
| 2019/20 | 54,543.26 | 1,256,232.03 | 23.03 |

Source: CSA of Ethiopia

2.4. Empirical Studies on Soya bean Technology Adoption

The study was performed by (Mideksa, 2020) on Factors Affecting Adoption of Soybean Production Technologies in Tiro Afeta District, Ethiopia. The study was based on cross-sectional data of 188 smallholder farmers (97 non-adopter and 91 adopters of soybean production technology) who were randomly selected from total households. The data were collected using the schedule, focus group discussion, and key informant interview and analyzed using descriptive statistics and Heckman selection model for the factors affecting household's soybean production technology. The result from Heckman's two-step model indicated that education level of household, total livestock holding, improved seed availability, frequency of extension contact, credit use, and farm income were positively and significantly influenced whereas market distance negatively and significantly affected the adoption of soybean production technologies. In addition, the result indicated that age, landholding size, and farm income determine the intensity of soybean technologies adoption positively and significantly whereas distance from the market affects negatively and significantly.

(Musba, 2019) undertaken the study on the Impact of Improved Soybean (Belessa-95) Variety on Income among Smallholder Farmers in Bambasi Woreda, Benishangul Gumuz Regional State. The response of the farmers to the demonstration of improved soybean varieties was collected from 18 randomly selected farmers. In this study, a multi-stage sampling technique was employed to select rural kebeles and households. A structured interview schedule was developed, pre-tested, and used for collecting the essential quantitative data for the study from 134 randomly selected households. Descriptive statistics and propensity score matching (PSM) models were employed to analyze data. The estimation of the impact of improved soybean variety on farm income showed that the sex of household head, the religion of household head, distance to the nearest market, and cooperative membership of household head have been the major factors of group difference.

The study undertaken by (Galmesa, 2019) to answer the general objective of the study was to analyze the determinants of adoption and intensity of adoption of improved soya bean varieties. The study was based on cross-sectional data collected from 146 (adopters=48 and non-adopters =98) randomly selected soya bean-producing farmers. Among the sample respondents from the chewaka district, 78.72% were male-headed and the remaining 21.28% were female-headed while in Gobusayo 90.38% and 9.62% were male and female-headed producers, respectively. Descriptive and econometric analyses were used to analyze data. Based on the analysis result sex, education, farm experience, training, and size of livestock owned has a significant and positive impact on adoption and intensity of improved soya bean. While distance to the nearest market was statistically significant and negatively affected influenced the adoption and intensity of improved soya bean varieties.

Analyses of Factors Determine the Rate and Level of Improved Soybean Variety Adoption Under Smallholder Farmers in North-Western Ethiopia was undertaken by (Welay, 2020). A total of 167 soybean producers (67 improved and 100 local soybean producers) were taking using systematic and random sampling methods. The data were collected through face-to-face interviews and analyzed the descriptive and Tobit model. The majority of the sample households were male heads (91%) and (9%) of them were female-headed households. The Tobit analysis showed that participation in the demonstration, cooperative membership, Training, soybean output, seed cost, and distance to the nearest market was the main factors that determining improved soybean varieties adoption and adoption level in the study area. The four former variables have statistical significance and positive effect whereas the latter two variables have statistical significance and negative effect on the adoption and adoption level of improved soybean variety respectively.

Samuel and Wondaferahu (2015) performed the study to answer the general objective of determinants of Adoption of Soybean and its Impact on the Livelihood of Smallholder Farmers in Jimma Zone. A total of 106 households were randomly selected from the member list of each Kebele from 43 villages using a structured questionnaire and analyzed using a logistic model. The majority (90%) of the sampled households were male-headed and having an average experience of 23.9 years. The logit model result revealed that education level, training access, access to extension service, are significant and positive determinants of Soya bean adoption.

Although age, distance to the market, and family size are significant and negative has effects on the adoption of Soya bean.

The study was done on "Factors affecting adoption and degree of adoption of soybean in Ilu-Ababora Zone; South-Western Ethiopia". The data were collected using a cross-sectional survey from 185 households (146 adopters and 39 non-adopters) and selected using multi-stage sampling procedures. The logistic regression model was implemented to analyze those factors that affect the adoption of soybean in the study area. The result of this study showed that 92% were male-headed households and the remaining 8% were female-headed households. The result of this study revealed that the overall adoption rate of soybean in the study area was 78.9% that was very high. The analysis result implies that sex, farm size, training access were statistically significant and positive determinants of Soya bean adoption (Samuel and Efrem, 2017).

The study was undertaken to answer the general objective to assess the level of adoption of improved soybean production technology and to identify the major factors affecting the adoption of improved soybean production technology in Pawy district, Ethiopia. A multi-stage sampling procedure was employed to selecting 123 farm households. The primary data were collected from the households by using the structured questionnaire survey and focus group discussions analyzed by descriptive statistical analysis, inferential statistical, and Tobit model to determine the relative influence of explanatory variables on the dependent variable. The majority 80.5% were male household heads and the rest 19.5% were female household heads. The majority of the female household heads were found in the low adoption category. The number of livestock owned by a household in TLU affects positively and significantly the level of adoption of soybean production technology at $P < 0.01$. A positive and significant relationship between extension contact and adoption of soybean production technology at $p < 0.05$ (Fitsum, 2016)

2.5. Factors Affecting Adoption and Intensity on other New Crop Technologies in Ethiopia

Different scholars in the smallholders' agricultural sector of Ethiopia have undertaken different adoption studies. Some of the studies are discussed as follows:

Yenealem et al., (2013) studied the determinants of adoption of improved maize varieties for male-headed and female-headed households in the West Harerghe zone. From the total sampled households 44.3% of households and 15.2% of female households farmers used improved maize varieties and 92 (55.7% of male households and 84.8% of female households) farmers did not use during the main cropping season. Correctly predicted figures for adopters were about 84.3% and 93.9%; while correctly predicted sample sizes for non-adopters were 89.1% and 80% for male households and females, respectively. Cultivated farm size, number of Tropical Livestock Units, extension contact affects positively and significantly while age and distance to the nearest input market affect a negative and significant probability of adoption of improved maize varieties.

Afework and Lemma (2015) conducted a study on the determinants of improved rice varieties adoption in the Fogera district of Ethiopia. The study was based on cross-sectional data and selected 151 rice-producing farmers using. The study used the Univariate Probit model to address factors that influence the decision to participate in improved rice varieties adoption. Out of the total randomly selected households, 57% were adopters and 43% were non-adopters of improved rice seed. Household size, education of the household head, land, rice farming experience, access to new cultivars of rice, off-farm income, and institutions affect positively and significantly while the distance to the nearest village market, access to the main market, distance to access agricultural extension office affect negatively and significantly the probability of participation in improved rice cultivation.

The study was conducted on the impact of improved maize varieties adoption on smallholder farmers' marketed maize surplus in Oromia regional state, Ethiopia. The study was based on cross-sectional data of 300 maize-producing farmers. Logit model was used to analyze the collected data to investigate the determinants of adoption. Out of 300 households, about 26% were adopters while 74% are non-adopters. Age, family size, marital status, adult-literacy, average livestock holding, access to output markets, access to credit for new varieties affects positively and significantly while access to credit for other input and distance to the main market affects a negatively and significantly adoption of improved maize varieties (Abadi, 2014).

Ermias (2013) conducted a study on the adoption of improved sorghum varieties and farmers' varietal trait preference in the kobo district, north Wolo zone, Ethiopia. The study was based on cross-sectional data of 150 sorghum-producing farmers. The study used logit and Tobit to trace the important determinants of adoption and intensity of use of improved sorghum varieties among the sample households. Out of 150 households, about 35.3% of households were adopters while 64.7% are non-adopters. Tropical Livestock Unit, participation in off-farm, perception on taste, quality of improved seed, irrigated farm size, Striga infested land, and perception on yield capacity of improved sorghum affects positively and significantly. While farm size proportion of sorghum area from total cropland, distance from FTC to home, and active labor ratio affect a negatively and significantly adoption of improved maize varieties.

The study conducted by (Wuletaw, and Daniel, 2015) on the determinants adoption of malt-barley

technology: Evidence from North Gondar Ethiopia. The study was based on cross-sectional data of 120 malt-barley producing farmers. The probit model was used to estimating the probability of adoption. Out of 120 households, about 32.5% of households were adopters while 67.5% are non-adopters. Educational status, access to improved seed varieties, and training affect positively and significantly while the social status of the household head affects negatively and significantly on the adoption of improved malt barley technology.

Factors influencing adoption of improved maize varieties in Gorogutu Woreda of Eastern Hararghe, Ethiopia did by (Mekuria, 2013). The study was based on cross-sectional data of 130 improved maize producers and the Tobit model to analyze factors affecting the probability and intensity of adoption of improved maize seed. Out of 130 households, about 43.8% of households were adopters while 56.2 % are non-adopters. The educational level of household head, size of own cultivated land, off-farm employment, access to credit, contact with extension agent, membership in a cooperative, income from chat, land size and affects positively and significantly while cosmopolitan affect negatively and significantly adoption of improved maize varieties.

The study was undertaken by Berihun et al., (2014) on the adoption and impact of agricultural technologies on farm income: evidence from southern Tigray, northern Ethiopia. The study was based on cross-sectional data of 270 randomly selected smallholder farmers. The data were analyzed using the Probit model. About 27% and 34% of the sample respondents were respectively chemical fertilizer and hybrid variety adopters while 73% and 66% of the sample respondents were respectively chemical fertilizer and hybrid variety non-adopters. Age, land ownership, irrigation use, and access to credit affect positively and significantly while the distance to the nearest market and Tropical Livestock Unit (TLU) affects negatively and significantly agricultural technology adoption.

3. DISCUSSION OF FINDINGS AND CONCLUSION

From the review, the reviewer understands different scholars' points of view. Sex of household, age of household head, education, farm experience, participation in training, and extension service affect the adoption of improved soya bean varieties positively and significantly while the distance to the nearest market affects adoption of improved soya bean varieties negatively and significantly. On the other hand, the intensity of adoption was affected by age, soya bean farm experience, participation in training, and size of livestock holding.

Most of the studies reviewed in this paper indicated that sex has a significant positive impact on the adoption of improved soya bean varieties. However, the participation of female households in the adoption process indicated that 15% of female-headed households and dominated by 85% of male household heads. Therefore, to improve the likelihood of adopting modern agricultural technologies like improved soya beans by smallholder farmers, female-headed households should get emphasis in all activities of the promotion of new technologies.

In general, from the review, I understand that the Soya bean plays an important role in generating foreign exchange earnings and supporting the livelihoods of market actors across the value chain and used for oil and Fafa industries input to produce edible industrial products. In the current scenario of our country; there is a flourishing of different huge oil factories like W.A and BK using Soya bean as a major input to their production. Those industries demand a higher amount of Soya bean as an input and create a backward linkage to Soya bean producer farmers. For instance, W.A's edible oil factory alone needs 20,000 hectares of land to run the business and 500,000 quintals of soya bean requires per year. Therefore, it can improve smallholder farmers' livelihood by creating market opportunities to supply their products directly to factories. Yet, the promotion of new Soya bean varieties and comprehensive studies on the adoption and impact of soya beans should get any attention from respective actors.



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