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**Original Research Article**

# Factors Affecting Smallholder Farmers' Adoption of Soybean Production Technologies in Kondala District Oromia Western Ethiopia

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**Abstract:** This study examines on the adoption and intensity of soybean production technology in the Kondala district. A two-stage sampling procedure was followed to select the sample households for the study. The study is based on primary data collected from 185 sample-selected households. Four rural kebeles were selected by using simple random sampling. The semi-structured interview schedule was developed, for collecting the essential quantitative data for the study and secondary data were used as additional data sources. Descriptive statistics and the Tobit model were used to analyse the data. This study also identifies soybean production technologies such as recommended seeding rate, recommended fertilizer applications, land allocation. The result of the descriptive statistics showed that the majority of farmers 57.3% were adopters and the remaining 42.7% were non adopters. In terms of land allocation and use of technologies there was a statistical significance difference in technology usage between adopters and non-adopters. The Tobit model results indicated that household ages, education level, farm experience, membership in cooperatives, access to agricultural inputs, participation in non-farm activities, and frequency of extension contact positively and significantly influenced the adoption and intensity of the use of soybean technologies. Whereas, distance from the market centre showed, a negative relationship with the adoption and intensity of adoption of soybeans production technology. The overall finding of the study underlined the high importance of institutional support in the areas of extension; membership in cooperatives and market to enhance the adoption of an improved soybean production package. Therefore, policy and development interventions should give emphasis to the improvement of such institutional support so as to achieve wider adoption which increases the productivity and income of smallholder farmers.

**Keywords:** Adoption, Intensity, Kondala, Soybean, Technology Tobit.

## 1. INTRODUCTION

### 1.1. Background

Soybean is used as a high-protein food source and the utilization and consumption of the crop is becoming popular in SSA (Joubert *et al*., 2013). It was first introduced to Ethiopia in 1950’s because of its nutritional value, multi-purpose use such as improving food security, soil fertility improvement and recovery of raw material for oil industry, and wider adaptability in different cropping systems. In the country, most people, especially members of the Ethiopian Orthodox Church, consume soybean oil which is free of animal products during their fasting period. Thus soy-based oil is used as a dairy alternatives and serves as a good option for these people while they are fasting (Scaboo, A., 2019). Currently, the cultivation of soybean in Ethiopia covers 36,636 hectares of land with 812, 355 tons of production per year (Hailu& Kaleb, 2014). Similarly, in the Kondala district soybean production started ten years ago and the production was continued by the SG-2000 project, in the district for the past five years (2011-2015) for enhancing technologies and practices that have been promoted to smallholder farmers by the public extension system. According to the district agriculture and natural resource office, the crop used for food meal (wet), and Nifro, and it is used as cash and crop rotation for soil fertility management. Wallo, Jalale, and Gishima are the varieties known by the farmers of the study area (KDANRO, 2019).

Even though farmers of the district have such favourable conditions for soybean production, the practices are not known by all farm households the production and productivity of the soybean was very low (14 qt/ha) and below the national average (24.9 qt/ha) (KDANRO, 2018). For example, a study done by Ashanafi and Oliyad overlooked the production technologies and focused on the soya bean variety. It failed to see the intensity of adoption by taking only the index of land cultivated (Ashenafi & Oliyad, 2020). Hence this study focuses on the possible inter-relationships between the various practices and intensity of adoption of a package of technologies rather than a single commodity or technologies which includes seeds of high-yielding varieties, inorganic fertilizers, and land allocation. By considering those gaps and issues, this study tried to investigate why some farmers adopt the full package of the technologies and others adopt partially or not adopt at all and why productivity was less than the national average. Therefore this study tried to analyse factors affecting the adoption decision of recommended soybean production technologies and analyse the intensity of adoption of soybean technologies by farmers in the study area.

## 2. METHODOLOGIES

### 2.1. Description of the Study Area

Under this topic, the location and area, climatic condition, socio-economic condition, and bio-physical of the study district are explained. This research was carried out in Kondala district which is one of the 22 districts of the west Wollega zone of Oromia National Regional State, bordered by the Begi district in the west, Kelem Wollega zone in the south and southeast, Benshangul Gumuz region in the north and Babo-Gambel and Mana-Sibu in eastern direction. It was established in December 2005 after being separated from the Begi district. Currently, the district has 36 administrative kebeles of which 32 are rural kebeles and the remaining 4 are small towns. Gaba Dafino town is the administrative centre of the district located in the eastern part of the west Wollega zone 211 Km away from the zonal town (Gimbi) and 652 km to the west of Addis Ababa (KDANRO, 2019).

#### 2.1.1. Population and Land Use

The total population of the district is 112,479 of which 48% are men and 52% are women; 6,617 or 5.89% of its population are small town dwellers (KDHO, 2019). The district has a total land area of 129,832 hectare of which 32,898 hectare is covered by annual crops (KDANRO, 2019). The most widely cultivated crops in the study area include coffee, maize, oil seeds (soybean, Niger seed, Sesame, Sunflower), and horticultural crops. Coffee, Khat, and legumes are cash crops of the district. In addition to this soybean production become the dominant income-generation agricultural activity. Among 32 rural kebeles, 10 kebeles are favourable for the production of soybeans.

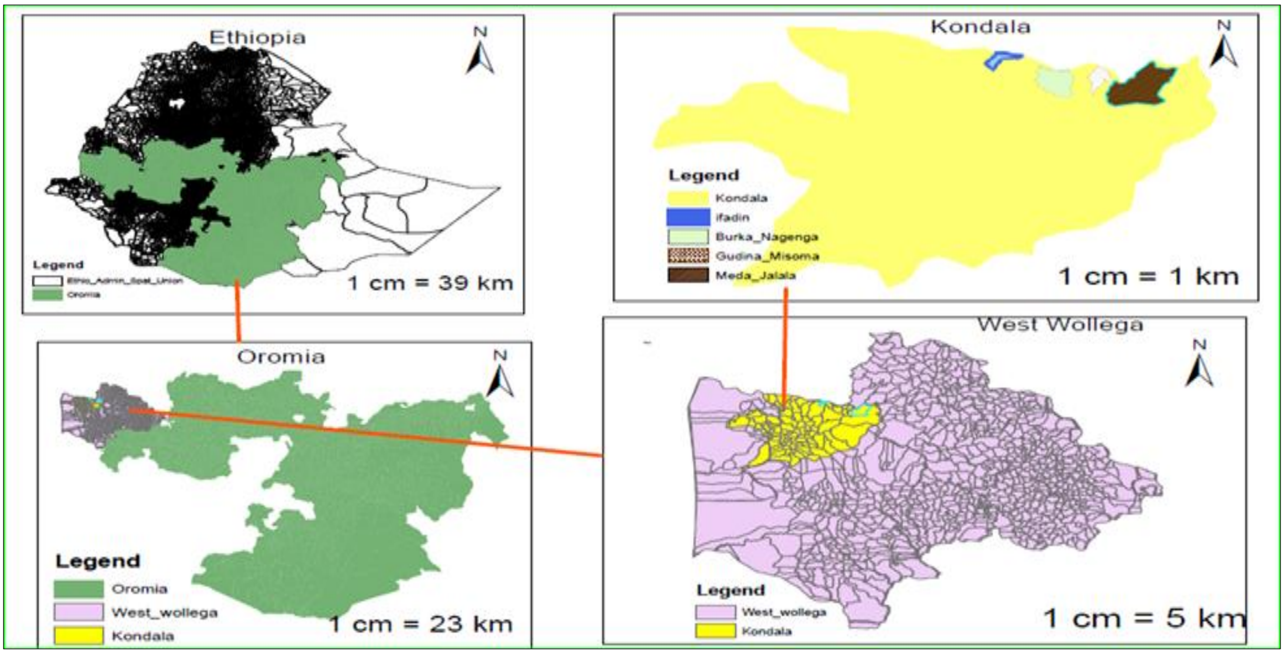


**Fig 1: Map of the study area**

### 2.2. Sampling Methods and Sampling Procedures

The study was undertaken in the Kondala district, west Wollega Zone, of Oromia. A two-stage sampling technique was applied. This study defines the survey population at two levels, namely at the rural kebeles level and at the farm household level. First, four rural kebeles were selected from ten soybean producer kebeles using simple random sampling. In the second stage, 185 farm household heads were selected using probability proportional to the size of each of the four selected rural kebeles. Lastly, each farm household was obtained using a systematic sampling technique. The total sample size was determined following Yemane's (1967) formula as follows.

$$n = \frac{N}{1 + Ne^2} ------------------------------------ (1)$$

**Table 1: Population and sample size of the study kebele's**

| Sampled Kebeles | Total population | | | Sample Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Fema | Tota | Males | | female | | Total | | Overall | | |
| | | | | Ado | Non | Ado | Non | Adop | non | Mal | female | Total |
| Ifadin | 316 | 38 | 354 | 16 | 14 | 2 | 2 | 18 | 16 | 30 | 4 | 34 |
| Burka Nagaa | 584 | 58 | 642 | 32 | 24 | 3 | 2 | 35 | 26 | 56 | 5 | 61 |
| Burka Misoma | 425 | 35 | 460 | 24 | 16 | 2 | 1 | 26 | 17 | 40 | 3 | 43 |
| Madda Jalala | 453 | 44 | 497 | 25 | 18 | 2 | 2 | 27 | 20 | 43 | 4 | 47 |
| Total | 1778 | 175 | 1953 | 97 | 72 | 9 | 7 | 106 | 79 | 169 | 16 | 185 |

### 2.3. Types of Data, Data Sources and Collection Methods

There were two types of data used for this study. Primary data sources include semi-structured interview schedules, focus group discussions, key informant interviews, and informal discussions. Primary data were the main source of data for this study. The secondary data source includes a review of relevant works of literature at different levels of the district administrative office, documents, and reports that enabled the researcher to extract information useful for supplementing primary data. A survey was conducted in four kebeles namely Ifadin, Burka Nagenya, Gudina Misoma, and Mada Jalala to collect primary information on soybean production technologies. Both qualitative and quantitative data were collected from primary and secondary sources to identify important independent variables that affect household adoption. A focus group discussions and key informant interviews were undertaken with people who know what is going on in the community during the production on soybeans in the past three years. Both key informant interviews and focus group discussions were purposively selected through non-probability sampling.

### 2.5. Methods of Data Analysis

Descriptive and econometrics analyses were employed to analyze the collected data. In this study, the first option (adoption index) was employed to obtain values used for the calculation of intensity (Ketema & Kebede, 2017). Among the recommended soybean production technologies three practices (land allocation, seed rate, and fertilizer rate) were included to calculate the index value. The adoption index is a continuous dependent variable calculated using the formula presented above with a value ranging from 0 to 0.97. Thus based on the value a farmer practices all technologies it takes the value of up to 1(adopter) and if not it takes 0 (non-adopter) Roger, (2003). Accordingly, the adoption index was calculated using the following formula.

$$ALi = \sum_{i=1}^{n} \frac{\left(\frac{ASi}{TASi} + \frac{SRi}{FSR} + \frac{FAi}{RFA}\right)}{NP} ------------------------ (2)$$

$ALi =$ Adoption index of the ith farmer,
$NP =$ Number of practices,
$I = 1, 2, 3 \dots\dots\dots.. n$, n is the total number of respondent farmers
$ASi =$ Area under an improved variety of soybean of the ith farmer,
$TASi =$ Total area allocated for soybean production (improved variety + local) of the ith farmer,
$SRi =$ Seeding rate applied per unit of area for the ith farmer,
$FSR =$ Recommended seeding rate per unit of area,
$FAi =$ Fertilizer amount applied per unit of area,
$RFA =$ Recommended fertilizer amount per unit of area
The Tobit model was applied to identify factors affecting the adoption and intensity of the use of soybean production. The model also has both discrete and continuous parts. Following Maddalla (1992), the Tobit model can be specified as follows:

Where:

$$ALi^* = B0 + BiXi + Ui ------------------------------ (3)$$

$$Yi = Yi*, \text{if} > 0, (Yi* = BiXi + Ui) ---------------------- (4)$$
$$= 0 \text{ if } B0 + BiXi + Ui \leq 0$$

$ALi^* =$ is the latent variable and the solution to utility maximization problem of intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit.
AI =is adoption index for $i^{th}$farmer,
Xi= Vector of factors affecting adoption and intensity of adoption,

Bi= Vector of unknown parameters, and
Ui =is the error term which is normally distributed with mean 0 and variance $\sigma 2$.
As cited in McDonald and Moffit (1980) the following technique was used to decompose the effects of explanatory variables into adoption and level of adoption. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial \mathrm{E(ALi)}}{\partial \mathrm{Xi}} = \mathrm{F(z)\beta i} ----------------------------- (5)$$

Where, $\frac{\beta iXi}{\partial i} = \mathrm{Z}$

The Change in the probability of adopting a technology as independent variable Xi changes is:

$$\frac{\partial \mathrm{F(Z)}}{\partial \mathrm{Xi}} = \frac{\mathrm{f(z)\beta i}}{\partial} ----------------------------- (6)$$

The change in the level of adoption with respect to a change in an explanatory variable among adopters is:

$$\frac{\partial \epsilon \left(\frac{\mathrm{ALi}}{\mathrm{ALi}} *> 0\right)}{\partial \mathrm{Xi}} = \mathrm{\beta i}\left[1 - \mathrm{Z}\,\frac{\mathrm{f(z)}}{\mathrm{F(Z)}} - \left(\frac{\mathrm{f(z)}}{\mathrm{F(Z)}}\right)^2\right] ------------------ (7)$$

Where, F (z) is the cumulative normal distribution of Z, $f(z)$is the value of the derivative of the normal curve at a given point (i.e., unit normal density) and Z is the z − score for the area under normal curve, ß is a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

### 2.5.3. Variables and Their Working Hypothesis

The dependent variable in this study was operationalized as the adoption and intensity of soybean production technologies which is treated as a continuous variable. Technologies include improved variety, seed rate, and fertilizer rate) that takes an index value $0 < \chi \leq 1$ with 0.97 if a household cultivates soybean production technologies and0, if the household did not use soybean production technologies.

**Table 2: Variables and Their Definition**

| No | Variables | Variables & their characteristics | Variable description and measurement | Exp sign |
|---|---|---|---|---|
| 1 | Age | Continuous | numbers of years of household heads | +/- |
| 2 | Sex | Dummy | 1 if the household head is male, 0 otherwise. | + |
| 3 | Farm size | Continuous | Total land holding in ha | + |
| 4 | Livestock owned | Continuous | Total livestock owned by a household in (TLU) | + |
| 5 | Farm experience | Continuous | Experience in farming of the households in year | + |
| 6 | Off-farm income | Continuous | Income of farmer from non-farm activities in a year | + |
| 7 | Perception of farmer on soybean technology | Categorical | 5 ,4,3,2,1 for very highly perceived, highly perceived, neutral Lowly perceived, very lowly perceived respectively | + |
| 8 | Marital status | Categorical | Married=2, 3=divorced widowed=4 | + |
| 9 | Distance to the nearest market | Continuous | Distance to the main market in kilometer | - |
| 10 | Education level | Continuous | Educational status, 0 for no read and write, otherwise1,2,3 class attended | + |
| 11 | Frequency of Extension contact | Categorical | Frequencies of extension contact: a value 4, 3, 2, 1 and 0 for, every month, every fortnight, every week, every day and no contact respectively | + |
| 12 | Cooperative member | Dummy | 1 if the household is a member, 0 otherwise | + |
| 13 | Access to media | Dummy | 1 if the household listen to radio, 0 for no. | + |
| 14 | Participation in training | Dummy | 1 if the household get training 0 otherwise. | + |
| 15 | Access to inputs supply | Dummy | 1 if the household gets inputs 0 otherwise | + |

## 3. RESULT AND DISCUSSIONS

### 3.1. General Characteristics of the Respondents

The sample respondent of the study area consists of both male and female individuals. The male respondents were found to be 91.35 % of the total sample household whereas the remaining 8.65 % were females. Male household headed were more than females household headed. Regarding their house, of the total respondents 84(45.41%) constructed their houses with corrugated iron sheets and 101 (54.6 %) were grass-roofed houses. Concerning their religion, all respondents were Muslim faith followers.

### 3.1.1. Land Use Pattern in the Study Area

The major crops grown were maize, sorghum, soybean, groundnut, khat, and to some extent homestead coffee. All the crops produced by farmers were used for the purpose of both consumption and sales. In the study area, the average land used for the major crop production such as maize and soybean were 0.59 & 0.23 hectares for the adopters and 0.47& 0.015 hectares for the non-adopters respectively (Table 3).

**Table 3: Descriptive Statistics of the Major Crops of Sample Farmers (Ha)**

| Variables | Adopters(N=106) | | Non adopters(N=79) | | T-test |
|---|---|---|---|---|---|
| | Mean | Std. Dev | Mean | Std. Dev | |
| Total farm size | 1.894 | 0.652 | 1.451 | 0.663 | 29.58*** |
| Soybean | 0.215 | 0.147 | 0.015 | 0.001 | 7.63*** |
| Maize | 0.596 | 0.243 | 0.476 | 0.252 | 25.53** |
| Sorghum | 0.573 | 0.201 | 0.554 | 0.221 | 28.54** |
| Groundnut | 0.231 | 0.156 | 0.163 | 0.139 | 15.93*** |
| Khat | 0.150 | 0.097 | 0.101 | 0.073 | 16.51*** |
| Coffee | 0.020 | 0.040 | 0.000 | 0.010 | 5.00*** |
| Sweet potato | 0.090 | 0.040 | 0.080 | 0.050 | 21.32*** |
| Other,(Spices) | 0.110 | 0.050 | 0.090 | 0.060 | 22.57*** |
| Annual + perennial | 1.910 | 0.640 | 1.440 | 0.650 | 30.96*** |

### 3. 1.2. Livestock of the Respondent Farmers

The survey results showed that the average cow and ox owned were 1.80 and 4.71, for the non-adopters and 4.83 and 2.43 for the adopters respectively. This means most farmers have a minimum of one ox and a maximum of four oxen. This is relatively larger in the crop-livestock mixed system. In general, in the study area, the sampled household has a better position in their livestock. This is an indicator of soybean production technology adoption (Table 4).

**Table 4: Descriptive Statistics of Livestock Population the Sampled Households**

| Variables | Non adopters (79) | | | Adopters (106) | | | Over all mean | T-test |
|---|---|---|---|---|---|---|---|---|
| | Min | Max. | Mean | Min. | Max. | Mean | | |
| Tropical Livestock Unit | 3.10 | 17.2 | 8.80 | 3.50 | 21.40 | 9.150 | 9.68 | -0.739 |
| Oxen | 1.00 | 2.00 | 1.80 | 1.00 | 4.00 | 2.430 | 2.09 | 0.738* |
| Cow | 1.00 | 10.0 | 4.70 | 1.00 | 12.0 | 4.830 | 4.72 | -0.648 |
| Heifer | 0.00 | 6.00 | 1.10 | 0.00 | 6.00 | 1.050 | 1.05 | 0.015 |
| Calf | 0.00 | 2.00 | 0.29 | 0.00 | 2.00 | 0.304 | 0.30 | -0.271 |
| Sheep (adult+ young) | 0.00 | 1.00 | 0.02 | 0.00 | 1.00 | 0.057 | 0.06 | 0.156 |
| Goat (adult+ young) | 0.00 | 1.00 | 0.09 | 0.00 | 4.00 | 0.359 | 0.33 | -0.524 |
| Donkey (adult+ young) | 0.00 | 1.00 | 0.09 | 0.00 | 4.00 | 0.359 | 0.10 | 0.191 |
| Chicken | 0.00 | 1.00 | 0.13 | 0.00 | 1.00 | 0.188 | 0.354 | 0.930 |

**Source**: Own computation (2019), (*) Significant at 10%

### 3.2. Soybean Production Technologies and Practices

### 3.2.1. Land Allocation and Cultivation

Regarding the land allocation, the results of descriptive statistics showed that the area covered by soybeans for sample households varied among respondents. The mean and standard deviation of total land cultivated for soybeans were 0.2150 hectares and 0.1470 hectares for adopters and 0.015 hectares and 0.001 hectares for non-adopters respectively (Table 6). This showed that there is a statistical mean difference between adapters and non-adopters in terms of land allocation and cultivation for soybean production technologies. The finding is supported by (Idrisa *et al.* 2010). The focus group discussions have also supported this idea.

### 3.2.2. Seed Rate, Sowing, Weeding and Spacing

The mean and standard deviation of the seeding rate applied was 8.21 kilogram and 3.15 kilogram for the non-adopters and 50.73 kilograms and 11.03 kilogram for the adopters (Table 6). As far as fertilizer use is concerned, it is also one of the technologies for soybean production. The fertilizer application rate of sample respondents varies between adoption categories. For this study, the average rate of fertilizer applied for soybean production by sample grower households during the 2019/20 production year was 78.9 kilogram and standard deviation of 14.52 kilograms for the adopters and 0 kilograms for the non-adopters According to the survey result, 57.4% of the respondents have sown their seed by row and the remaining 42.6% used broadcasting. During interviews, households who plant their seed through rows said that it was more beneficial for them in terms of saving seed easily hoeing weeding, and giving more production. The farmers used spacing of 22-25 cm between rows and 4 to 5.0 cm between plants (SG-2000 manual). Respondents who broadcasted their seed were also asked why they used the method and they responded that it is labour demanding and time-consuming.

**Table 5: Adoption Index and Percentages of Farmer's Level of Adoption**

| | Non adopters | Adopters | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| Adoption index score range | 0.00 | 0.01-0.33 | 0.34-0.66 | 0.67-0.99 |
| Adoption index average | 0.00 | 0.17 | 0.49 | 0.83 |
| Percentage of farmers | 42.7 | 5.9 | 31.35 | 20 |

**Source:** Own computation, 2019

### 3.3. Econometric Model Results

**Age**

As it was hypothesized, the econometric results from the Tobit model indicated that the age of the household head was positively related to the probability of soybean production technology adoption at a 1% significance level. The marginal effect depicted that as the age of household heads increases by one year, the likelihood of being a technology adopter in soybean production would be increased by a factor of 0.0087 units keeping another thing constant. It also increases the intensity of soybean production technology adoption by a factor of 0.042 and 0.006 units, on average for those adopters and for the entire sample respectively. Perhaps it is because age indirectly represents experience in farming. The implication is that the increase in farmer's age increases farmers' experience in farming and understanding more of the benefits of the technology. The result is consistent with the findings of (Martey, *et al.*, 2014).

**Education**

The education level of households positively affected the probability of adoption and intensity of soybean production at a 5% significant level. This showed that, as participation in the formal educational level of household heads increases by one year of schooling, the likelihood of being a technology adopter in soybean production would be increased by a factor of 0.031 units on average, keeping other constant. It also increases the intensity of soybean production by a factor of 0.015 and 0.02 units, on average for those adopters and for the entire sample respectively. This is because the more knowledgeable the farmer the more understanding than no read and write. The result of this study was similar with (Sudu *et al.*, 2016).

**Membership in Cooperatives**

Similar to prior expectations, the econometric results from the Tobit model indicated that membership in cooperatives of household heads was positive and significant at a 10 % probability level. Membership to one additional local farmers-based association increased the adoption decision of soybean production technology by 11.6 % on average, keeping others constant it also increased the intensity of soybean production by 5.7% and 8.3%, on average for those adopters and for the entire sample respectively. Farmers who participated more in community-based organizations such as cooperatives were likely to be informed about the technology and enhanced their likelihood to adopt the technologies in soybean production. Similar results were reported by Chagwiza *et al*., (2020) and Kebede *et al.*, (2017).

**Distance to the Nearest Market**

It was negatively related to the probability of adoption of soybean production packages and statistically significant at a 1% level of significance. The results of this study in (Table 7) indicated that, on average each additional one kilometres of distance from the market canter the likelihood of being a technology adopter would be decreased by a factor of 0.47 units on average ceteris paribus. It also decreased the intensity of soybean technologies by a factor of -0.023 and -0.032 units for those adopters and entire samples. This indicates that farmers living at a distance from the main market centres are less likely to adopt soybean technology than those who are located closer. The longer the distance between farmers' residences and the market centre, the lower the probability of adoption of the technology. This finding was consistent with (Gedefa 2016).

**Off-Farm Income**

Off-farm income has a positive and significant effect on the probability of adoption and intensity of use of soybean production technology. The marginal effect of the Tobit model showed that off-farm income positively affected the probability of adoption and intensity of soybean production at a 1% significant level. Each additional birr off-farm income of a farmer increased the probability of adoption by a factor of 9.3 units. On average, it also increased the intensity of soybean production technology by a factor of 4.4 and 6.3 units for those adopters and for the entire sample respectively. A reasonable explanation for this is that off-farm income acts as an important strategy for overcoming credit constraints faced by the rural households in the study area. The result was similar to the findings of (Abebe, 2014) and contrary to the study of (Geta *et al*., 2013).

**Access to Inputs**

As the Tobit model result indicates, the variable access to inputs had a positive and significant influence on the likelihood of adoption of soybean production technology at less than 1% significance level (Table 7). The result of the marginal effect stated that those farmers who have access to input, from agricultural offices or cooperative farmers increase the probability of adopting the soybean technology package by 19.5% than those who have no access to inputs. Citrus Paribus also increases the intensity of adoption of the soybean production technology package by 8.6 % and 12.2 % for adopters and the entire sample respectively. A reasonable explanation for this is that a farmer's access to input is cultivated in his land with time and gets more production and motivated to adopt the technology than others. The result was similar to the findings of (Asfaw *et al.*, 2011).

**Farm Experience**

Farming experience was positively and significantly related at 10 % with the probability of adoption and intensity of soybean production technology. The result of the model illustrated that as the experiences of household heads increase by one more year, the probability of being a technology adopter in soybean production would be increased by a factor of 0.0.04 units on average, keeping other things constant. It also increases the intensity of soybean production by a factor of 0.018 and 0.026 units on average for those adopters and for the entire sample respectively. This is expected because more experienced farmers may have better skills and understanding of ways of implementing the technology. The study was similar to the findings of (Ainembabazi and Mugisha, 2014).

**Frequency of Extension Contact**

In this study frequency of contact with extension agents was hypothesized positively related to the probability of adoption and intensity of soybean production technologies and significant at 1%. The marginal effect explained that, as the frequency of contact with extension agents increases in one more day the probability of adopting soybean production technologies would be increased by 28 %. On average, it also increases the intensity of soybean production technology by 13.5% and 19.2%, for those adopters and for the entire sample respectively. The result agreed with the findings of Ofolsha *et al.*, (2022) and, Ibrahim, (2019).

**Table 6: Tobit Model Estimation for Determinants& Intensity of Soybean Production Technology**

| INTENSTY | Coef. | Std. Err. | P>t | Change in Probability(y>0) | Change in intensity | Intensity for entire sample E(y/y>) (marginal effect) |
|---|---|---|---|---|---|---|
| Age | .0084 | .0029 | 0.004*** | .0087 | .0042 | .0059 |
| Sex | .1739 | .1979 | 0.381 | .1989 | .0772 | .1095 |
| Marital status | .1073 | .1253 | 0.393 | .1125 | .0538 | .0762 |
| Education | .0293 | .0123 | 0.020** | .0307 | .0146 | .0208 |
| Farm size | .0582 | .0458 | 0.205 | .0610 | .0292 | .0414 |
| Tropical Livestock Unit | -.0075 | .0057 | 0.187 | .0078 | .0038 | -.0053 |
| Cooperative member | .1129 | .0613 | 0.067* | .1159 | .0576 | .0813 |
| Distance to the nearest market | -.0449 | .0138 | 0.001*** | -.0470 | -.0225 | -.0319 |
| Off farm in income | 8.89e-1 | 3.23e-1 | 0.007*** | 9.32e-1 | 4.46e-1 | 6.32e-1 |
| Access to inputs | .1801 | .0668 | 0.004*** | .1951 | .0865 | .1225 |
| Farmers perception | -.0058 | .0219 | 0.790 | -0061 | -.0029 | -.0041 |
| Farm experience | .0366 | .0188 | 0.052* | .0383 | .01833 | .0259 |
| Access to train | -.0961 | .0629 | 0.128 | .1003 | -.0482 | -.0683 |
| Frequency of extension contact | .2699 | .0313 | 0.000*** | .2831 | .1353 | .1918 |
| Access to media | .0029 | .0582 | 0.960 | .0031 | .0015 | .0021 |

Number of obs = 185 Prob > chi2 = 0.0000

LR chi2 (15) = 167.29*** Log likelihood = -69.508087

Pseudo R2 = 0.5462

106 = uncensored observations

Left-censored observations at INTNSITY<=79

## 4. CONCLUSIONS AND RECOMMENDATIONS

This study was done on the adoption and intensity of soybean production technology by rural farmers in the Kondala district. In this area, soybean is an essential crop, which serves as both food and cash crop. The main theme of this study was to assess the current status and intensity of adoption and identify challenges and opportunities in the adoption of soybean technologies with its associated agronomic practices. A two-stage sampling procedure was employed in order to draw a sample from soybean producers. In order to get the sample of kebeles and farmers simple random sampling was employed. Descriptive and econometric models were used to identify factors and to what extent those factors influenced farmer's likelihood to participate in soybean production technologies. The result of descriptive statistics indicated that from total of 185 respondents (57.3%) were adopters and 79 (42.7%) of respondents did not adopt the recommended soybean production technologies. This showed that the performance of farmers using recommended soybean production technologies such as improved varieties, land allocation, and fertilizer application has not been at the expected level.

The Tobit econometrics model was employed to estimate the effects of hypothesized independent variables on dependent variables. The result from the marginal effect of the Tobit model indicated that out of the 15 explanatory variables eight of them namely, frequency of extension contact, age of the household head, education of the households, members in cooperative, farm experiences, access to agricultural inputs, off-farm income were statistically significant in influencing the adoption of recommended soybean production technologies positively whereas distance from market centre was negatively and significantly affect adoption and intensity of soybean production technologies. Overall, from this study, it was concluded that, identified socio-economic and biophysical variables that constraints and impede adoption decisions and the intensity of soybean production technologies were identified, and in general it was concluded that, the promotion of the agricultural sector needs a package of course of action and need further intervention by governments and nongovernmental organization.

Based on the findings the following points were recommended. Education has a significant and positive effect on adoption decisions and the intensity of improved soybean production packages. In this regard, the district Education office and Agricultural office should be responsible for facilitating all necessary materials to strengthen the existing provision of formal and informal education. Farm experience increases the probability of adoption and intensity of adoption of soybean production technology. The study further established that many farmers learned about the package from other farmers. The study therefore recommends the need to strengthen farmer-to-farmer extension whereby few progressive farmers adopt the technologies of soybean by district extension experts. They would in turn disseminate the technology to the rest of the farmers in their neighbor kebele. The Agricultural office of the district should be strengthening experience sharing on best practices and scaling up to be important among farmers.

Distance to the nearest market was statistically significant and negatively affected the adoption of soybean production technologies. Hence, stockholders (district transport office & model farmers of the locality), need to establish market linkage for the farmers through the facilitation of transport which increases the probability of adoption of improved soybean production packages. The agricultural office of the district and zonal would be required to make linkage between research institutions to the farmers to overcome the seed problem. At the same time, the unavailability of inorganic fertilizers is a constraint for adoption. District cooperative agencies and primary cooperatives call for improvements in improved input (fertilizer) delivery to effectively cope with the demands of small holder farmers. Smallholder soybean farmers should be also encouraged to form or join farmers-based organizations as it offers them the opportunities to get better attention from Institutions in the Agricultural sector for the delivery of inputs.

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