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Determinants of Adoption of Teff Row Planting Practice: The Case of Baso Liben Woreda, East Gojjam Zone, Amhara Region, Ethopia

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Abstract

The factors that affect adoption of row planting method in teff production in the area is not studied and documented. Therefore, the main aim of this study is to assess the status of adoption of Teff row planting technique and its determinants as well as to assess the yield difference between row planting and broadcasting practice on Teff grain production. Descriptive cross-sectional study design was used and data were collected from 147 households. Three kebeles in the woreda namely: Yelemelemem, Yeduge and Yegelawu were selected purposively. Structured interview schedule, key informant interview, and focus group discussion were used to collect the data. The data were checked for completeness, coded, entered, and analyzed using SPSS version 20.0. Descriptive and inferential statistical technique such as chi-square test and t-test were also used. Moreover, binary logistic regression analysis was used to identify determinants of adoption of Teff row planting practice. The result reveals that 53.1 percent of the respondents implemented the recommended spacing between plants in the production of Teff in the study area. Educational status of the household head, household labor, land size, participation in training, membership in the association, and number of livestock owned in tropical livestock unit were found to have positive and significant effect on the adoption of recommended spacing in Teff production at 1% significance level. The study also revealed that there was a significant yield difference between adopters and non-adopters of recommended spacing. Therefore, the Woreda Office of Agriculture in collaboration with other stakeholders should work intensively to improve adoption of Teff Row Planting technology by the farmers in the study area.

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Adoption; Row planting; BasoLiben; Teff

Introduction

Agriculture plays a major role in Ethiopia economy and it accounts for 36.2% of GDP, (CIA world factbook /GDP-composition by sector, 2017). However, owing to natural and manmade causes the nation has not properly benefited from its abundant natural resources and good agricultural development policy. The sector has failed to register the desired economic development to enable its people pull out of poverty (Spielman, 2008). Recently agricultural production and productivity increase on a sustainable basis necessitated large scale adoption and diffusion of new technologies (Mehumud *et al.*, 2009).

Crops are the major agricultural commodities on which Ethiopians depend for their daily food requirement (Rashid and Assefa, 2006). Teff is the most ancient indigenous staple food and important crops for farm

income, food and nutrition security in Ethiopia. Furthermore, it is highly nutritious and important part of Ethiopia's cultural heritage and national identity, plus to that its international popularity is rapidly growing because of its health advantage for the people having celiac disease (Dekking and Koning, 2005).

Teff is believed to be originated, domesticated and diversified in the country. In a country of over 80 million people, it accounts for about 15% of all calories consumed in Ethiopia. Furthermore, approximately 6 million households grow Teff and it is the dominant cereal crop in over 30 of the 83 high-potential agricultural woredas. Furthermore, it has the largest value in terms of both production and consumption in Ethiopia and the value of the commercial surplus of Teff is second only to coffee (Minten *et al.,* 2013).

However, when grown under the current traditional management practice Teff is a labor-intensive crop because of the high rates of cultivation and weeding required (Bekabil Fufa *et al.,* 2011). Teff is a major staple food crop in Ethiopia, mostly used to prepare Injera, the main national dish in the country. In 2011/12, it was estimated that Teff accounted for 20 percent of Ethiopia‟s cultivated area, covering about 2.7 million hectares. In that year, Teff was grown by 6.3 million farmers and the total national production was estimated at 3.5 million tons and was valued at 1.6 billion USD. On the consumption side, it is found that Teff is more readily eaten by urban households (61kg/person/year) than by rural households (20kg/person/year) (Minten *et al.,* 2013).

The overall research on improved technologies for the production of Teff has never received an international attention; it is mainly because of the reason that Teff has local importance (Berhan *et al.,* 2011).

However, it has been recently argued that low Teff productivity is partly caused by the traditional sowing method of Teff seed. Traditionally farmers‟ use of Teff seed rate is 25-50 kg per hectare. This practice reduces the amount of grain production mainly due to the uneven distribution of the seed, strong competition among plants for input such as water, sunlight, and nutrients (ATA, 2013a). It is also making weeding difficult after the maturity of the plant (Fufa *et al.,* 2011). According to ATA, in recent years much of Ethiopian farmers have begun planting many of their grains in rows, which includes wheat, maize, barley and sorghum and they also started to realize this technique yields better results, reducing the competition among individual plant. However, on Teff which is a national grain of the country, most of the farmers are still following the traditional way of planting Teff seed. Therefore, it resulted in Teff grain yield reduction (ATA, 2012). Therefore, this research is intended to identify determinants of adoption of Teff row planting in Baso Liben Wereda.

Teff production system used by the majority of farmers is very traditional, most of the farmers in the country broadcast Teff seeds, i.e. scattering seed by hand, at high seed rates. This reduces Teff yields because of the high amount and uneven distribution of the seeds makes weeding difficult and increased competition with weeds and other Teff plants lowers nutrient uptake by the individual Teff plant (Berhe *et al.,* 2011; Fufa *et al.,* 2011).

Berhe *et al.,* (2011) have conducted experiments in order to evaluate the potential of row planting with a reduced seeding rate. The results of the experiments have proved large and positive impact of application of row planting technique on Teff yields. Consequently, the Ethiopian government started promoting the technique on a very large scale. However, there is no research that has been conducted so far in the study area in relation to factors affecting adoption of Teff row planting practice. Therefore, the goal of this study was to fill this gap and provide evidence on the status of adoption and its determinants in the area. The study also examined yield difference between row planting and broadcasting practice on Teff grain production.

Materials and Methods

Multi-stage sampling technique was employed to select the sample household. First, Basoliben Woreda was selected purposively based on personal knowledge about the area. Moreover, Teff production coverage from the total cultivated land in the wereda is better than others. Secondly, from a total of 20 rural Kebeles of the Woreda, three Kebeles were selected purposively namely Yelemelem, Yedug, and Yegelawukebele. The selection of these three sample kebeles was based on the level of promotion done on Teff row planting technique in the kebeles. Based on the estimation of the woreda, Yelemelm, Yedug, and Yegelawukebeles hold the largest area of agricultural land of all 20 rural kebeles within the woreda covered by Teff grain produced through row planting method accounting 197, 125 and 414 hectares respectively. Thirdly, Teff growers in the selected

kebeles were identified; the sample size was determined using a formula provided by Yamane (1967). The sample size for each kebele was determined by using proportionate sampling techniques. Finally, 147 respondents included in the study were selected by using systematic random sampling techniques from the list of households within the selected Kebeles targeted to select the samples. Both qualitative and quantitative data were collected from primary and secondary sources. Primary data for the study has been collected from selected sample households, focus group discussants, and key informants (DAs, Woreda officials and village and cooperative leaders). Secondary information was retrieved from written documents from Woreda Agriculture and Natural Resource Development office and from other published and unpublished materials. A household survey questionnaire was used to generate quantitative data and key informant interview and focus group discussion were employed to collect the qualitative data to supplement the quantitative study and used to address issues which were not touched by the quantitative part.

A structured interview schedule was designed for household survey. The survey was conducted to collect data related to household‟s socio-demographic characteristics, farming system and the possible factors determining the adoption of row planting technique. The developed structured interview schedule was translated into Amharic for the convenience of data collection during The quantitative data was coded and entered into SPSSV20 and then analyzed by using descriptive statistics such as frequency, mean and percentage, minimum and maximum values. The statistical significance of the variables in the descriptive part was tested for both dummy and continuous variables using chi-square and t-test, respectively. Econometric Model: to identify the factors that influence the adoption of Teff row planting method, binary logistic regression analysis was employed. It is selected because of the model relevance to deal with dependent variables that are dichotomous.

Results and Discussion

The status of adoption of teff row planting practice

Information gathered from key informant interview revealed that row planting method was introduced in the area since 2013. The community members use Teff row planting method with the help of the development agents. Among the total respondents, 78 (53.1%) household heads adopted row planting method (Table 1). Of these 60 (76.9%) respondents adopted the technology before five years, forty nine (62.82 %) household heads covered more than half hectare by row planting method, nearly three fourth, 58 (74.36%) of the household heads used improved Teff variety (Quncho Teff seed) and almost two fifth, 33 (42.31) used urea and DAP to fertilize the land they cultivate.

All of the focus group discussion participants agreed that Teff productivity using row planting method is highly effective but in the context of Baso Liben there are many barriers which were raised by them. Among these, its labor intensiveness and lack of continuous support were the top most barriers. Furthermore, some of the household heads perceived that it is time- consuming, especially for those who do not have children. Due to the above mentioned reasons the technology does not expand as the government desired. In addition, the major issue in this Woreda is absence of row seeder machine which is not available in local market. To solve this problem, they are currently using plastic bottle, which is designed for the purpose of containing mineral water, as row seeder machine. Furthermore, development agents provide both theoretical and practical training about the technology. They also observe them while practicing the technology and help themtake corrective measures. Regarding the row seeder machine they communicate many times with different stakeholders to create access for the farmers but still now they could not get it. They are striving to introduce the row seeder machine to the Woreda.

Determinants of teff row planting practice adoption

In the binary logic model result, the maximum likelihood estimates reveals that the adoption of Teff row planting practice was determined by the interaction of different factors: demographic, socio-economic and intuitional/organizational related factors.

To test the measure of goodness of fit in logistic regression analysis, the likelihood ratio test (LR) that says chi-square distribution with degree of freedom (DF) equal to number of independent variables included in the model (Gujarat, 2004).

The other measure of goodness-of-fit in the logistic regression model is by observing the value in the prediction table as the model correctly predicted it or not. The fit is said to be good if the overall correct prediction rate exceeds 50%. Accordingly, the prediction table shows that correctly predicted row planting adopter was

93.6% whereas correctly predicted row planting non adopter was 92.8%. However, the overall prediction was 93.2%

The model results in Table 2 shows that, among the 11 independent variables included in the model, seven variables were found to significantly affect the adoption of Teff row planting practice. The variables are briefly discussed below:

Age of the respondents had negative and significant effect on the adoption of Teff row planting practice at 1% significance level. The odds ratio implies as age of the respondents increase by one year, the likelihood of adopting row planting method decreases by 82.5 percent.

Therefore, a farmer with higher age has less chance to adopt Teff row planting technique. The elders have less interest to adopt improved Teff row planting practices because it needs high physical labor.

Education level: it had positive and significant effects on the adoption of Teff row planting method at 1% significance level. The odds ratio on Table 2 indicates that as educational status improves from one level to next better level the likelihood of adoption of Teff row planting method increases by a factor of 3.309. Therefore, educated respondents have more chance to adopt Teff row planting technique. A study conducted in different parts of Ethiopia showed that the level of education of the household head significantly affected the adoption of row planting practice.

Household labor: it had positive and significant effect on the adoption of Teff row planting method at 5% significance level. The odds ratio in Table 2 implies that as the household labor increase by one adult equivalent, the probability of adopting Teff row planting technique increases by a factor of 1.916. The information gathered from FGD participants reveals that "in the study area, row planting is labor intensive practice and it needs high labor for seeding of Teff on the farm". Therefore, the household who has large labor size has better chance to adopt Teff row planting method.

Land holding size: it had positive and significant effect on the adoption of Teff row planting method at 1% significance level. The odds ratio implies that as land size increases by one hectare the probability of adopting the practice increases by a factor of 5.18.

Table.1 The status of adoption of teff row planting method, area covered and variety

Variable	Frequency	Percentage
Adopt Teff row planting		
Yes	78	53.1
No	69	46.9
Area covered by row planting (in hectare)		
≤0.5	29	37
>0.5	49	63
Types of Teff seed in row planting		
Local	20	26
Improved (quncho)	58	74.36
Type of fertilizer used in row planting		
Urea and DAP	33	42.31
Urea, DAP, and Manure	45	58

Source: own survey data, 2018.

Table.2 The binary logistic regression result

Variables	B	S.E.	Wald	Df	Sig.	Exp (B)
Age	-.193 ***	.056	11.845	1	.001	.825
Sex	2.112	1.434	2.169	1	.141	8.265
Educational status	1.197 ***	.442	7.319	1	.007	3.309
Member of cooperative	1.307	.848	2.379	1	.123	3.696
Household labor size	.650**	.326	3.977	1	.046	1.916
Land holding size	1.645 ***	.619	7.057	1	.008	5.183
Livestock holding in TLU	.523 ***	.170	9.501	1	.002	1.686
Household income	.000	.000	1.159	1	.282	1.000
Participation in training	2.312**	1.015	5.190	1	.023	10.092
Membership in local leader	2.098 **	.947	4.903	1	.027	8.150
Credit	.259	.808	.103	1	.748	1.296
Constant	-6.449	3.062	4.435	1	.035	.002

***statistically significant at 1% level of significance; **significant at 5% level of significance

A similar finding has been reported by a study conducted in Wolaita zone, the land size owned by the household measured in hectare positively influenced the decision to adopt and apply row seeding of Teff.

Number of livestock: it was measured in Tropical Livestock Unit. It had positive and significant effect on the adoption of Teff row planting method at 1% significance level. The odds ratio in the Table 2 indicates that as the number of livestock owned by a household increases by one TLU, the likelihood of the adoption of Teff row planting practice increases by a factor of 1.686.

Participation in training: it had positive and significant effect on the adoption of Teff row planting method at 5% significance level. The odds ratio favors the adoption of Teff row planting practice by a factor of 10.092. Farmers who got training on Teff row planting had higher probability of adopting row planting method compared to those who did not get training.

Membership in local leadership position: it had positive and significant effect on the adoption of Teff row planting practice at 5% significance level. The odds ratio implies that participation in local leadership position favors the adoption of Teff row planting practice by a factor of 8.15. Therefore, among seven factors discussed above, education level of respondents", household labor, land holding size, participation in training, membership in local leadership position and livestock holding in TLU had positive and significant effect on the adoption of Teff row planting method. However, age of respondents had negative and significant effect on the adoption of Teff row planting practice at 5% significance level.

Yield difference between broadcasting and row planting method of teff

The result in Table 2 shows that there was a statistically significant difference between the average yield obtained from broadcasting and row planting practice. The mean yield obtained from broadcasting was 12.3 q/ha with a range of 7 (a minimum and maximum value of 9 and 16 respectively). However, the average yield obtained from row planting of Teff was 20.8 q/ha with a range of 7 (a minimum and maximum value of 17 and 24). The advantages of using raw planting method was also reported by ATA (2013), most of the farmers who employed new Teff technologies experienced yield increase across all regions. Row planting produced high yields, on average it increased yield by 70% from the national average of 12.6 quintals/ha to 20.9 quintals/ha.

Adoption of Teff row planting method in the study area is sub-optimal, almost half (53.1%) of the study participants adopted the method. There were many reasons for the underutilization. It includes time consumption, labor intensiveness of the method, and unavailability of the row seeder machine. High education level, large household labor size, large land holding size, large livestock holding in tropical livestock unit, membership in local leadership position and participation in training had positive and significant relationship with the adoption of Teff row planting method at 1% significance level. However, as the age of the respondents increase the adoption of Teff row planting method decreased and this was statistically significant at a 1% significance level. The study also identified the average yield difference obtained from broadcasting and

row planting methods. The mean yield obtained from broadcasting method was 12.3 q/ha. On the other hand, the average yield of row planting method was 20.8q/ha. This study concludes that row planting method is a vital means for Teff productivity improvement.

Recommendations

Based on the results of this research, the following core points which are presented are recommended in order to improve the adoption of Teff row planting method in the process of Teff grain production. It is better to encourage row planting practice adoption because the results of this study confirmed that application of row planting method increases substantially the yield of Teff grain production.

Education level had significant positive effect on the adoption of row planting method. Education enhances farmers' ability to perceive, interpret, and respond to new events in the context of risk. Therefore, governmental and non-governmental organizations should give emphasis on the adult education for farmers to improve farmers' awareness about the adoption of technologies and increases their access to adopt row planting in the study area.

Household labor had a significant positive effect on the adoption of Teff row planting method. The most important problem in practicing row planting of Teff crop is its labor requirement. Thus, immediate demonstration of available technologies and practices that help to reduce work burden on farmers is essential. Therefore, governmental and non-governmental organizations should give emphasis on the provision of credit for farmers to improve their financial capital to purchase improved row planting technologies like row seeder machine and hire labor and that fill the gap of a family labor shortage.

Participation in a training program on the benefit and techniques of Teff row planting had a positive and significant effect on the adoption of Teff row planting method. Therefore, short term training program should be strengthened to equip farmers with the necessary knowledge, skill and attitude relevant for the adoption of the method thereby improve productivity of the crop and contribute towards food security in the area.

Those farmers who had large landholding size adopt Teff row planting method in a better way compared to those who had small land holding size and this was significantly associated at 1% significance level. However, there may not be a possibility of expanding land holding size. So, agricultural intensification program should be strengthened. In other words producing maximum yield from existing plot of land by promoting the use of improved seed and inorganic fertilizer should be the focus. Of course, it requires improving knowledge, skill and attitude of the farmers in the area. Furthermore, it requires availing the required technologies, improving access to credit and market information.

Having many livestock (in TLU) in the house was associated with adoption of Teff row planting method adoption. Thus, the extension agent in collaboration with other concerned body must work to support those farmers with low socio economic status by arranging credit for them.

Similarly, membership in local leader position had a significant positive effect on the adoption of Teff row planting method. Therefore, extension should encourage farmers to be members of social organization in the area as it a plat forms where they could get agricultural information which could help them adopt the method.

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