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RESEARCH ARTICLE

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Adoption of Improved Sorghum Variety (Melkam) and Its Impact on Household Food Security in Babile District, Eastern Ethiopia

Abdukerim Ahmed Mumed[1*], & Abdi Hassen Habib[2]

1. Department of Rural Development and Agricultural Extension, Kebri-dehar University, Ethiopia
2. Department of accounting and finance, College of Business and Economics Kebri-dehar University, Ethiopia

***** Correspondence: abdukerim2019msc@gmail.com (A.A.M).

Abstract

This study aimed to examine the adoption of an improved sorghum variety (melkam) and its impact on smallholder farmers' food security in Babile district, Eastern Harerghe zone, Oromia regional state, Ethiopia. A mixed research methodology was used to utilize both quantitative and qualitative strategies for data gathering and analysis. A multistage sampling process was applied to choose the 320 sample household heads. Literature was reviewed for secondary data. The results of the descriptive statistics indicated that 47.5% and 52.5% of the sample households adopted and did not adopt enhanced sorghum varieties, respectively. According to the findings of the binary logistic regression, factors that positively influenced farmers' decisions to adopt improved sorghum varieties included years of education, land holding, incomes, the availability of credit services, extension contact, and farmer cooperatives. In contrast, factors that adversely impacted farmers' judgments included household head age and market distance. Hence, this upshot concludes that improving educational levels, creating a fine line for credit access, and enhancing farmer cooperatives are needed to improve sorghum variety adoption.

Keywords: adoption, food security, impact, improved (melkam), sorghum, Babile

INTRODUCTION

Significant agricultural productivity losses are caused by climate change, which endangers global food security (Lesk et al., 2016). For instance, the agriculture sector shared about 25% of climate-associated disasters in the last decade and subsequently lost around 25 billion USD (Karki, 2020). The development and use of climate-smart and resilient crop varieties are the keys to a more sustainable solution for mitigating climate change effects (Makate et al., 2019). Significant agricultural productivity losses are caused by climate change, which endangers global food security (Lesk et al., 2016). The world's most widely grown cereal crop is used as a source of food and support (Techale et al., 2022). Sorghum is the most significant cereal for people in dry and semiarid areas of Africa, where 300 million people rely on it for their daily diet (Adebo, 2020; Zhao et al., 2019).

Sorghum's demand as a product has significantly grown since it became a food item (Mundia et al., 2019; Sissoko et al., 2019). Sorghum production has increased at an average yearly rate of 2.5%, while sorghum consumption and usage have increased in the developing world (Sultan et al., 2019). Millions of Ethiopian farmers depend on sorghum as a primary food crop grown in practically all of the country's regions (Semahegn & Teressa, 2021).

In 2020, out of the whole grain crop space enclosed by breakfast cereal, i.e., 10.2 million hectares, 14.97% (1.88 million hectares) was shielded by sorghum, third status following teff and maize (Teressa et al., 2021). Similarly, out of the total national grain production, cereals contribute to 87% (253 million quintals), with sorghum shares amounting to up to 16% (47 million quintals) (CSA, 2018). Sorghum production has considerably increased in the last five years by 1.7; million tons of yield production. This was obtained from adoption and sorghum varieties improvement (Demeke & Di Marcantonio, 2019). Nearly 4.5 million smallholder farmers cultivated sorghum in 2019 (Demeke & Di Marcantonio, 2019) while production in yield and productivity increased from 1.2 loads/ha to 2.5 loads/ha (Amare et al., 2020).

The Oromia, Amhara, Tigray, and SNNP areas, which account for 41% of the total land and output, grow sorghum as their primary crop (CSA, 2018; (Deribe & Kassa, 2020). Sorghum is the third-largest food crop in Oromia after maize and teff and the fourth-largest producer after maize, wheat, and teff, with an average yield of 25.22 q/ha (Lemma et al., 2020). Low adoption of improved sorghum varieties, a shortage of resistant varieties, inadequate management practices, post-harvest loss, and unfavorable ecological conditions were the main obstacles to sorghum output and productivity (Legesse et al., 2019).

Cereal is a critical component of Ethiopia's current agricultural policy since it may be used to replace imported goods and achieve food security. Sorghum variety improvement policies and strategies in Ethiopia have a lengthy history dating back more than 50 years, starting in the middle of the 1950s at the Haramaya College of Agriculture with Oklahoma State University's partnership effort (Semahegn & Teressa, 2021). Research has been carried out to advance innovations in food security, cultivation practices, and variety improvement (Feyissa et al., 2019). In Ethiopia, better sorghum varieties have been issued at the regional and national levels over the past forty years for lowland areas, but adoption of these types has been slow.

In the Eastern Harerge zone, sorghum and maize comprised 28.11%, 26.55%, 31.18%, and 29.67%, respectively, of the cereal cultivated areas and the zone's production (Markos et al., 2020). In the past, economic analyses of technology adoption have tried to explain adoption behavior based on a person's endowments and personal qualities, inadequate knowledge, risks, and institutional restrictions, as well as input availability and infrastructures (Balehegn et al., 2020; Mwangi & Kariuki, 2015; Umar, 2014; Workineh et al., 2020).

The factors driving the adoption of sorghum technology vary across the nation because of variances in farmer-specific and farmer-associated (natural resource, cultural, social-economic, market, and institutional) factors. Studies on the use of new technologies reveal that local conditions affect

adoption differently. Therefore, it is necessary to perform focused research on adopting technology in regions where extension and research programs have been established to comprehend the critical elements influencing adoption in these regions (Nkonya et al., 1997).

Yet, information concerning the adoption of the technologies and locally specific factors influencing adoption in the *Babilel* district needed to be empirically documented and often better understood. Understanding the nature of these factors and quantifying the extent to which each of these factors contributes to or hinders the adoption of the *melkam* sorghum variety was of paramount importance in enhancing sorghum technology uptake. As a result, this study was carried out to examine the factors contributing to the adoption of the improved sorghum variety (melkam) in the Ethiopian region of Oromia's Babile district's East Harerghe zone.

RESEARCH METHODOLOGY

The Study Area's Description

In the eastern lowlands of Ethiopia, the Babile District is located near the semi-arid cents between the Oromia and Harari Regions, some 560 kilometers southeast of Addis Abeba. Harer, the zone's capital city, is located 15 kilometers from the Babile district. The Somali Regional State borders Baabile on the south and east, the Harari Regional State on the north and west, Fedis on the west, and the Gursum district on the north. Geographically, the district is situated at 42021'E longitude and 08 9,90'N latitudes, with an elevation ranging from 950 to 2000 m above sea level. The mean annual minimum and maximum temperatures are between 18 and 28 degrees Celsius, and the mean annual rainfall and humidity are between 700 and 900 millimeters and 33 and 38 percent, respectively (Amentie et al., 2016). The woreda was divided into 22 kebeles, 20 rural and two urban, by the present administrative division.

The total population of the Babile district was estimated to be 118,537 (DANR, 2020) of the district. Out of this, males were for 59,298 (50.02%) while females were 59,139(49.8%). There are around 10,874 households in the woreda. The sex ratio is 8,985 homes with male heads (82.6%) and 1,889 households with female heads (17.4%) (Gudeta, 2017).

The district's primary source of income is agricultural produce. Rainfall is essential for crop development, and the area's most important crops are maize (29%), sorghum (30%), groundnuts (25%), and sweet potatoes (17%), which account for 17% of all cultivated land (District Agricultural and Natural Resource Office secondary data,220). Most households also raise livestock. For the traction necessary to cultivate agricultural lands, oxen are used. In contrast, keeping cattle was done so that milk might be sold.

Research Design

The information needed to understand the factors influencing the adoption of the melkam sorghum variety was collected using a pass questionnaire research methodology with quantitative and qualitative procedures.

Sample design and choice of sample size

Techniques for sampling in stages were used. Initially, the Babile area was selected for its potential for sorghum cultivation, and crop technology pilot tests were conducted in the district. In the second stage of the sampling process, out of 20 sorghum producer *kebeles* of the district, five (5) *kebeles* be situated randomly selected. In the third step, household heads were divided up as *melkam* sorghum variety cultivators and non-cultivators using a categorized sample. Lastly, 320 family heads were carefully chosen via a simple random selection skill by lottery.

Data types and source of data: quantitative and qualitative data were collected from primary and secondary sources to obtain the necessary information for this study.

Methods of Data Collection

Household survey interview schedule: To generate quantitative information at the household level, the survey was undertaken using an interview schedule. The structured interview schedule mainly consisted of the issues related to the demographic, socio-economic, market, and institutional variables relevant to the study were collected from the respondents. On the other hand, data on determinants and adoption status of improved (*melkam*) sorghum variety by smallholder farmers over the past five years in the study area were collected. The surveys were carried out with the help of extension agents (DAs) in each target *kebele*s.

Focus Group Discussion (FGDs)

To have detailed information and complement the information obtained from the household survey; primary qualitative data was gathered by discussions with purposively selected participants. This technique emerged as a qualitative data collection approach and a bridging strategy for scientific research and the local knowledge (O. Nyumba et al., 2018).

In total, ten FGDs, two (2) FGDs at each selected five (5) *kebeles*, by considering their socio-economic background or stratified in two groups adopter and non-adopters (male and female-headed household) were organized to generate detailed information related to the research question. The necessary checklists developed to guide the discussion were made in the local language (Afan Oromo), and the time of debate was held fifty minutes (50) in selected group discussions directed by the researcher.

Key Informant Interviews (KII)

Additional information from key informants needs to be added to the core data gathered from sample household heads. Key informants from the district agricultural and rural development office were interviewed, along with innovation agents from the target kebeles and community people (men and women) from each of the five kebeles. Using the necessary checklists developed to guide the discussion, the discussion was conducted in the local language (Afan Oromo).

Techniques for Analyzing Data

To discuss the survey's results, descriptive statistical analysis techniques were used, employing frequency, percentages, means, and standard deviation. The presence of statistically significant differences and the traditional association between those adopters and non-adopters in terms of the hypothesized variables were examined using the Chi-square test and t-test. Qualitative information was organized and constructed coherently.

Econometric model specification

A binary logistic regression was used to examine the parameters affecting the adoption of the enhanced (melkam) sorghum variety. This model was chosen due to the benefit of showing the relative effects on the likelihood of technology adoption and accurately predicting the adoption extent. It develops when the independent variables are a mix of continuous and dichotomous characteristics, and the response variable is a dichotomy. Lastly, the data was analyzed using (SPSS ver.21 and STATA ver.13).

Selection, Definition, and Explanation of Variable

Adopting an enhanced (melkam) sorghum variety is the study's explanatory variable. It's a discrete variable with a value of 1 if smallholder farmers have been growing the melkam sorghum variety for at least five years and have an interest in continuing to do so and a value of 0 otherwise.

Consequence variable: Household food security, determined by daily calorie intake, is the study's outcome variable. Kcal/AE/day is a continuous variable used to measure it at the household level. Accordingly, the Household Caloric acquisition approach measured sample respondents' food security situations/status.

Independent (Explanatory) Variables

Independent variable: From different studies reviewed, explanatory variables were postulated to affect the dependent variable.

RESULT AND DISCUSSION

Adoption of the improved (melkam) sorghum variety as of right now

The study interviewed 320 farmers, of whom 152(52.5%) were users, and 168 (47.5%) were non-users.

As noted from qualitative data collected through KII in the study area, most farmers produce improved sorghum (melkam) variety in the past five years. Farmers prefer the melkam sorghum variety for many reasons: it has a good yield in production, stock for livestock feed, has good drought resistance, and a white color seed for attraction of market and food.

Socio-economic characteristics of Sample respondents (Dummy variable)

The survey result revealed that among improved sorghum adopter households 82.24% and 17.76% were male and female heads, respectively. Cross-tabulation between improved sorghum (*Melkam)* variety adoption and the sex of sampled households indicated that about 82.24 %, whereas 17.76% of adopters were female. This demonstrates that men's households in the research area were better adopters than women's households. The statistical analysis reveals a connection between the sex of the family head and the increased adoption of sorghum varieties in the research area (Table 1). Involvement in off-farm/non-farm activity- According to the study results in Table 1 below, out of the total respondents, around 50.3% of the sample respondents have been involved in non-off-farm activities, while the remaining respondents have not. The cross-tabulation between improved sorghum *(melkam)* variety adoption and household participation in non-farm activity indicates that about 64.47% were adopters and 37.50 % were non-adopter farmers. The result agreed with the narrative qualitative data collected from FGDs. They claimed that among the non-farm activities sample households engaged in to gain additional income in the research field were small trade, houses, housework, Chet trading during the summer, and the sale of charcoal. These activities let them purchase better seeds and pay for other expenses.

Regarding Access to extension service: out of the total respondents, about 49.38 % of sample respondents have access to extension service, and 50.62% did not have access to extension service. The cross-tabulation between improved sorghum (*melkam*) variety adoption and household access to extension service indicates that about 65.79% were adopters, and 34.52% of non-adopter farmers have access to extension service in the study area. This implies that those households with service provided were better adopters than the non-adopter group. According to the statistical analysis, there was a connection between using extension services and implementing the improved sorghum (melkam) variety (Table 1). Access to credit service sampled households, 162 (50.62%) households got access to credit service in the 2020/21 production year. In the two groups, 99 (65.13%) users and 63 (62.50%) les used credit services. Accessibility to improved sorghum varieties: out of the total sampled home, about 55.94% of sample respondents have improved (*melkam*) sorghum varieties in the study area. The cross-tabulation between improved (*melkam*) sorghum variety adoption and household accessibility to improved sorghum *(melkam)* variety indicates that about 67.11% of households were adopters and 35.71% of non-adopter were access to improved sorghum variety for production. The test shows there

was a significant association between enhanced (*melkam*) sorghum variety adoption and accessibility of improved sorghum *(melkam)* variety (Table 1).

The above result agreed with the narrative result of qualitative data collected through FGD, indicating that those households with access to enhanced sorghum varieties were more adopters than those not accessible to improved (melkam) sorghum varieties in the study area.

***Farmer cooperative**:* From the total households, about 53.75% of sample respondents have participated in the farmer cooperative. The cross- tabulation between *melkam* sorghum variety adoption and farmer cooperatives shows that about 73.68% were adopters, and 39.29% of non-adopter farmers have participated in farmer cooperatives. The Chi-square analysis reveals a strong correlation between increased farmer cooperation and the adoption of better sorghum varieties (Table 1)**.**

Market information: About 47.81% of the sample got market information from tested respondents. The cross-tabulation between improved *(melkam*) sorghum variety adoption and household market information resulted in 57.24% of them being adopters and 39.29% of non-adopter farmers having market information. The result shows no association between market information (independent variable) and adoption (dependent variable) of the sorghum variety (Table 1).

Table 1. Summary statistics and proportional difference Ch2- test for independent dummy variables

Variables		Adopter (152)		Non-adopter (168)		Total (320)		Chi^2value	P-value
		N	%	N	%	N	%		
Sexhh	Male	125	82.24	119	70.83	244	76.25	5.7303**	0.019
	Femal	27	17.76	49	29.17	76	23.75		
Off/Non-farm	Yes	98	64.47	63	37.50	161	50.31	23.25***	0.000
Activity	No	54	35.53	105	62.50	159	49.69		
Access to	Yes	100	65.8	58	34.52	158	49.38	31.20***	0.000
extension serve	No	52	34.2	110	65.48	162	50.62		
Access to credit	Yes	99	65.13	63	62.50	162	50.62	24.37***	0.000
service	No	53	34.87	105	37.50	158	49.38		
Farmer coop	Yes	112	73.68	60	35.71	172	53.75	46.27***	0.000
members	No	40	26.32	108	64.29	148	46.25		
Accessibility to	Yes	102	67.11	77	45.83	91	55.94	14.65***	0.000
IMSV	No	50	32.89	91	54.17	141	44.06		
Market	Yes	87	57.24	66	39.29	153	47.81	0.97^{NS}	
information	No	65	42.76	102	60.71	167	52.19		

Source: field survey, 2021

****, ***** Refers to significant at 5% and 1%, N: Number, NS: Non-significant

Socio-economic characteristics of respondents (continuous variables)

Educational household head: Average educational level of respondents was grade 2. In this study, about educational level, the mean education level of adopters was grade 2, and non-adopters' mean education level was grade 1. Based on the statistical t-test, the results showed a significant mean educational difference between consumers and non-adopters of the enhanced sorghum variety at a 1% significant level (t= 7.1653 and p=0.000). This study indicated that improved sorghum variety adopters had more years of education than non-adopters. The findings of the study, adopters of upgraded sorghum have more education than non-adopters (Table 2). The possible reason is that education increases farmers' capacity for information searching and application practice of their farming system with improved technology usage.

The above result agreed with qualitative data collected from SDGs. They stated that households with farmlands are more likely to adopt enhanced sorghum varieties because they can better diversify their crop production. This allows them to plant improved sorghum varieties on their farmed land. Adopter groups can also use the result of innovation that might boost a farmer's productivity.

Table 2. t-test results that show the correlation of the continuous variable with the dependent variable

Variable	Adopter		Non-adopter			
	Mean	Standard deviation	Mean	Standard deviation	Combine mean	t-value
Age of HH	44.28	6.88	48.7	8.63	46.812	9.812***
Educational level of HH	3.967	2.459	1.96	2.49	2.915	7.17***
Family Size HH	4.375	.0807	3.68	.087	4.081	1.66^{NS}
Farm Experience HH	10.60	1.93	9.142	2.07	9.725	1.851^{NS}
Farm size of the HH	2.01	1.99	1.17	.82	1.580	4.18 ***
Livestock holding of hh	5.99	1.495	5.285	1.27	5.453	0.512^{NS}
Farm income of HH	32710.6	4980.10	30753.	687.9	32187.	7.61***
Distance to nearest markets	8.06	5.04	9.14	2.352	8.93	2.50**

Source: Own survey, 2021

, * Refers to significant at 5%, and 1% significant level

Determinants of improved (melkam) sorghum variety adoption

The adoption of the enhanced (*melkam*) sorghum variety was examined using the discrete logistic regression model. Different econometric hypotheses were examined using the proper methodologies before performing the econometric estimation.

Model fitness

Given that the model has a P-value of 000, it is statistically significant. The household adoption probability of the enhanced sorghum (*melkam*) variety was explained by all explanatory significant

variables in the model, according to the Pseudo R-square value of 0.3497, or 34.97%. The fact that the LR chi2 (15) =154.86 and p-value (Prob > chi2) = 0.000 indicate that the logistic regression model is overall significant.

Binary Logistic Model output

Eight of the 15 predictors used in the study were significant in influencing households' adoption of the enhanced (*melkam*) sorghum variety, whereas the remaining seven were less important in determining the variation in dependent (adoption) of the improved (*melkam*) sorghum variety.

Head of household's age*:* At a 5% probability level, household age had a negative sign and strongly impacted the adoption of increased sorghum production. While other factors stay constant, the odd ratio shows that as household ages rise by one year, the likelihood of adopting an enhanced (melkam) sorghum variety declines by a factor of 0.91. It suggests that as a farmer becomes older, they use technology less than young farmers do. This is due to an increase in risk aversion and a decline in interest in long-term investments in the farm as farmers age. This finding supports an earlier hypothesis for the study and concurs with research by Awotide et al. (2014) that older farmers are resistant to adopting new technology.

The outcome is consistent with the FGDs' narrative data, which indicated that farmers prefer to adopt less technology as they get older than younger farmers.

Educational attainment of households: The research area's adoption of the *melkam* sorghum variety was found to be positively influenced by the level of education of sample household at a 5% significant level, as was predicted. When all other factors are held constant, the odd ratio shows that when the household head's educational level rises by one grade, there is a ratio of 1.76 increase in the likelihood that they will adopt an enhanced (*melkam*) sorghum variety. This may be due to the fact that farmers who are generally well-educated have easier access to information and are more aware of new technologies, which facilitates the adoption of innovations. On the other hand, educated farmers look for information that will make it simple to manage marketing and production tasks, which call for specific management abilities. The KIIs clarified that educated farmers in the research area were more inclined to adopt new concepts and technologies, as well as when they advised on new farming systems and higher educational attainment of farmers invariably enhanced adoption of improved sorghum varieties. Finding consistent with (Abady et al., 2017; Shiferaw et al., 2014).

Cultivated land of the Households: Given that it serves as the foundation for all economic activity, particularly in the rural and agricultural sectors, the land is arguably the most crucial resource. The adoption of the enhanced (*melkam*) sorghum type in the study area was revealed to be positively influenced by the landholdings of sampled families at a 5% significant level, as was expected. The odd

ratios indicate that when household farm size increases by one hectare, the likelihood of adopting a modified (*melkam*) sorghum variety increases by a factor of 1.4 while other variables stay constant. This suggests that households in the research area with big farms would have allotted more space for the *melkam* sorghum variety than non-adopters. Larger landholdings may also enable farmers to employ risk-aversion techniques, such as the adoption of dryland crops like sorghum alongside other significant local crops. The findings of Egge et al. (2012), which discovered favorable impacts of farm size on the adoption of the new technology, are consistent with the findings of our study.

Annual farm income: As expected, the annual farm income of a sampled household was positively influence the adoption of sorghum *(melkam)*in the study area at a 5% significant level by keeping all other factors constant. The odd ratio shows that for every unit increase in household income, the likelihood of adopting an enhanced (*melkam*) sorghum variety rises by a factor of 1.3. All other factors are held constant. After taking care of basic needs, the family's total annual earnings from the sale of agricultural products are referred to as the "annual farm income." This is regarded as the main source of money for the acquisition of agricultural inputs. This suggests that households with a high level of farm income in the study area were more inclined to buy better varieties or other crucial agricultural inputs. Study is consistent with one conducted by (Mengistu et al., 2019; Smale et al., 2018).

Access to extension service: Extension serves as a bridge between technology developers (researchers) and users, giving farmers the information, they need to know about new crop types. As anticipated, it was discovered that having access to the extension service in the sampled home had a beneficial impact on the adoption of the *melkam* sorghum variety in the study area at a 5% significant level. A household's likelihood of adopting the *melkam* sorghum variety increased by a factor of 2.00, according to the odd ratio, while other characteristics remained constant. This research is consistent with studies done by (Agidew & Singh, 2018; Assan et al., 2018).

Farmer cooperative: It was predicted that farmer cooperative members would have a favorable impact on the adoption of the upgraded (*melkam*) sorghum variety. At the same time, the study supports the prediction and demonstrates that, at a 5% significance value, farmer cooperatives had a favorable and substantial impact on the adoption of enhanced sorghum variety in the studied area. The odd ratio implies that as families join social cooperatives, the likelihood that they will adopt an enhanced (*melkam*) sorghum variety rises by factors of 1.97. These findings concurred with those made by other authors (Abdoulaye et al., 2014; Okeyo et al., 2020).

Credit Access: Credit services can ease farmers' financial restrictions, and occasionally they are connected to special sorghum production. As planned, it was discovered that the sampled household's access to credit services had a 10% significant beneficial impact on adopting the sorghum (*melkam*) variety in the work area. While other characteristics stay constant, the odd ratio shows that as household

access to credit service improves, the likelihood of adopting a better (*melkam*) sorghum variety rises by factors of 1.8. This ensures that farmers can purchase agricultural inputs for better sorghum variety production since access to credit services commands the farmers' financial resources. These outcomes corroborate those of (Amare & Belaineh, 2013; Babu et al., 2018; Workineh et al., 2020).

How far it is from the major market*:* As the expected distance of sampled households from central market was found to negatively influence *melkam* sorghum variety adoption in the study area at a 5% level. Other determinants stay constant, and the odd proportion suggests that the likelihood of adopting (*melkam)* sorghum variety decreased by means of factors 0.89, as households increase the distance from the main market by 1 km. This is true that in rural areas as households are more away from the main market the probability to access inputs such as seeds, fertilizers, and others for their field operation becomes low which hinders the farmers to adopt improved technologies. This response is aligned with Embaye et al. (2017).

Table 3. The logistic regression estimates household adoption of *melkam* sorghum varieties

Variable	Coeff.	Odd ratio	Std. Err.	Z	P>z
Household's head's sex(HHS)	-.5164	.59^{NS}	.3889582	-1.33	0.184
Head of household's age(HAg)	-.1008	.91***	.0219097	-4.60	0.000
Educational of(HH)	.1052	1.11*	.0602785	1.75	0.081
Family size of household	.0009	1.01^{NS}	.1474548	0.01	0.995
Family size in a farmland(FL)	.2860	1.33**	.1292484	2.21	0.027
Experience on a farm (HH)	.0881	1.09^{NS}	.0871965	1.20	0.231
Household average farm income(Hfi)	.0005	1.01**	.0000337	1.97	0.048
Part of HH in Off/non- farm activity	.1429	1.15^{NS}	.3887269	0.45	0.652
Total live stock holding of the HH	.0928	1.09^{NS}	.135427	0.89	0.375
Access to extension service	.6932	2.00**	.3874794	2.18	0.029
Farmer cooperative of HH	.6783	1.97**	.3845887	2.12	0.034
Household head access to credit	.5885	1.80*	.3831366	1.87	0.061
Accessibility to improved sorghum	.2530	1.28^{NS}	.3752343	0.79	0.432
Distance from market center(km)	-.1163	.89**	.0653723	-2.23	0.026
Market information	.3507	1.420^{NS}	.3818613	1.14	0.256
Cons	.778	2.17	2.408206	0.44	0.661

Total number of Obs is 320.	Log probability = -143.97764
LR chi2(15) = 154.86	Probability > chi2 = 0.000 Pseudo R - squared = .3497

Source: Own survey result, 2020.
Note: Significant levels at 10%, 5%, and 1%, respectively, are *, **, and ***. Not Significant (NS)

CONCLUSION

The household's educational qualification has a beneficial impact on the adoption of *melkam* variety, suggesting as educated farmers might be more aware of the advantages of contemporary

technologies and may be better able to look for current information. Household landholding size was another significant factor, which was positively corrected with the adoption of *melkam* sorghum variety. According to this, smallholder farmers cultivate new crop varieties by cultivating a large amount of land. Furthermore, the result found that total annual farmhouse influences improved (*melkam)* sorghum variety adoption positively; this reflects that households with a high annual product were possible to purchase value-added variety. This Investigation concluded that resource endowments of the household had played a crucial part for adoption of *melkam* sorghum variety.

The adoption of the *melkam* sorghum variety was also positively influenced by access to extension services, credit, and the social cooperative. This illustrates how the farmer's financial resources to purchase supplies are dictated by his or her access to credit services. On the other hand, adopting the enhanced (melkam) sorghum variety is negatively impacted by age, the market, and distance. This study reflects that improved *(melkam)* sorghum variety adoption is a function of demographic, socioeconomic, institutional, and market factors.

SUGGESTIONS

The study's findings led to the following recommendations being made.

- *Melkam* sorghum variety showed more significant yield production than local varieties. Woreda agricultural office at the district and other development partners should be integrated to sustain the adoption of melkam sorghum variety.
- The education office incorporated with the agriculture office should make the possible way of delivering adult education for the smallholder farmers (users).
- One of the key factors that helped the *melkam* sorghum variety be adopted was access to extension workers. Therefore, in order to maintain the extension service's beneficial contributions, the government should enhance the knowledge & abilities of extension workers or development agents at the kebele level.

Data (and Software) Availability

This study was analyzed using (SPSS ver.21, STATA ver.13, and PSM model). All data underlying the result are available as part of the article through a request from the corresponding author.

Authors contributions

All the authors contributed equally to this research study.

Competing interests

Regarding the publication of this article, the authors affirm that there are no conflicts of interest.

Ethical statement

The researcher achieved the approval of the Babile Agricultural Administration offices before each qualified participant was interviewed and observed. Each selected Kebeles administration was granted the request of the researcher. The researcher conducted a face-to-face interview with participants. During the interview, the researcher asked the participants to record the interview.

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