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Research article

Preparation and utilization of compost and implication for selected crop productivity: The case of Guagusa Shikudad District, Northwest Ethiopia

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Abstract: *The deterioration of soil fertility is a significant issue in Ethiopia's agricultural sector. Organic fertilizers, particularly compost, can enhance soil fertility; however, compost preparation and utilization remain limited. This study aimed to identify the determinants of compost preparation and its implications for crop productivity in Guagusa Shikudad Disctict. Using a cross-sectional research design, data were collected from 124 households through surveys and interviews with agricultural experts. Quantitative data were analyzed using descriptive and inferential statistics including t-tests, one way ANOVA, Chi-square test, and binary logistic regression modeling. The results indicated that factors such as age, education, composting materials, farmer perception, economic status, extension services, farming experience, family size, and farm size significantly influenced compost preparation and utilization. The binary logistic regression model identified positive determinants (age, education, input availability, perception, economic level, extension support, farming experience, and family size) and a negative determinant (farm size). This variation was tested using a one-way ANOVA, yielding a statistically significant result (p < 0.05), which indicates a significant difference between users and non-users of compost. The results, moreover, indicate that compost utilization significantly enhances crop production and productivity. It is recommended that the district's agricultural office and stakeholders promote compost preparation and utilization among smallholder farmers through continuous capacity building and extension services.*

Keywords*: Adoption, Compost utilization, Crop productivity, Farming experience, Farm size, Guagusa Shikudad district*

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1. Introduction

In countries where agriculture is the backbone of the economy, land degradation poses a significant challenge, leading to low agricultural productivity that particularly affects smallholder farmers. This degradation, primarily manifested as soil depletion and nutrient loss, is one of the most pressing environmental issues (Yohannes, 2019). The decline in soil productivity hampers the sustainability of agricultural production in many countries across the globe. In Ethiopia, soil fertility deterioration is a critical concern, as soils suffer from low nutrient levels due to erosion, leaching, high rainfall, and topographic factors. Furthermore, improper nutrient management exacerbates soil fertility depletion, representing a major constraint to agricultural sustainability in the country (Mintesinot, 2022). As an agrarian country, Ethiopia is depending on agricultural production for the growth of the national economy and the livelihood of its population. The agricultural sector accounts for nearly 38% of gross domestic product (GDP), 80% of export earnings and 73% of total employment (ATA, 2023). However, this sector is full of problems to get high agricultural productivity (Tafesech & Tegegne, 2019). The sector is mainly operated by smallholder farmers that directly depend on agriculture for their food supply and income. The production system is still mainly rain-fed and has a low level of mechanization (Sileshi et al., 2019).

In Ethiopia, approximately 95% of agricultural output comes from subsistence smallholder farms in the highlands. Low soil fertility and inefficient soil management are significant challenges impacting productivity for these farmers (Sileshi et al., 2019; Denise & Meike, 2020). According to FAO (2017) and Mekuanint et al. (2020), the loss of soil fertility is attributed to factors such as soil erosion, excessive nutrient extraction, and complete crop harvests for food, animal feed, and fuel without sufficient replenishment in smallholder farming systems. Additionally, rugged topography, high pressure from human and livestock activities, and inadequate conservation measures further exacerbate declines in land productivity (Wassie, 2020). As a result, this has led to decreased agricultural productivity and heightened food insecurity in Ethiopia. To address soil fertility issues, the Ethiopian government has implemented various initiatives, primarily focusing on the adoption of conventional agricultural practices that rely on chemical fertilizers and pesticides. In this context, artificial fertilizers serve as the primary input for enhancing yield.

However, due to economic, infrastructure and policy related constraints, the current level of fertilizer input, which is 16 kg / ha^{-1} on average, is much lower than required to maintain soil fertility and ensure acceptable yield levels (Abegaz & van Keulen, 2007). Unfortunately, inorganic fertilizer used as major soil nutrient management is unsustainable, causing soil degradation and environmental pollution, and high prices make it unaffordable for many smallholder farmers (Byerlee et al., 2007; Adekunle et al., 2017). Through the increasing application of artificial fertilizers and pesticides, the agricultural sector faces growing challenges, in the form of soil degradation, reduced water retention capacity, frequent occurrences of crop diseases and pests. To address these issues, the agricultural community is continuously exploring and seeking sustainable agricultural solutions (Ros et al., 2020). To get good agricultural productivity, it is mandatory to use natural fertilizer nutrients input as a main source of soil fertility enhancement.

The application of organic fertilizers is considered an economically viable and environmentally friendly method. Organic fertilizers are rich in organic matter, trace elements, and bioactive substances. Long-term application of organic fertilizers can improve soil structure, enhance soil fertility, and promote the proliferation and activity of soil microorganisms (Li et al., 2018). Organic fertilizers are an alternative environment friendly approach with multi-advantages over chemicals fertilizer, and they seem to be promising to support sustainable agriculture (Worku, 2021). Soil organic matter has crucial importance for maintaining soil quality by improving biological, physical and chemical soil conditions. Thus, compost is a good organic fertilizer because it contains nutrients as well as organic matter that greatly contribute to fertility and soil productivity. Compost offers nutrients to the soil, increases its water holding capacity, and helps the soil to maintain good soil health, and thereby providing better aeration for germinating seeds and plant root development (Haile, 2017; Wu et al., 2020). However, understanding the soil fertility management practices and their determinants in a particular agricultural system in relation to compost has been given little attention in Ethiopia (Mengistu, 2011).

The preparation and utilization of compost in Ethiopia remain underdeveloped due to various factors, including a shortage of inputs, lack of awareness, and income levels (Guagusa Shikudad Woreda Agricultural Office, 2021). Several studies have empirically investigated the adoption decisions and contributions of agricultural technologies such as organic and inorganic fertilizers, to improve the income of smallholder farmers (FAO, 2017). Research by Obisesan et al. (2013), Benjamin (2015), Combary (2016), and Gelgo et al. (2017) focused on fertilizer technology adoption. However, empirical studies on organic fertilizer application in Ethiopia are limited. For instance, Gedfew and Sisay (2019) identified factors influencing the use of organic fertilizers among smallholder farmers in the Sekela district of the Amhara region. Similarly, Zelalem (2019) conducted research on the use and application of organic fertilizers for cereal crop production in Ethiopia. Other studies have explored the effects of combining compost with mineral fertilizers on soil carbon content, nutrient yield, and agronomic nitrogen use efficiency in maize-potato cropping systems in Southern Ethiopia (Zeleke et al., 2022). Additionally, Sewale (2020) examined local practices regarding compost preparation and utilization in Enarji Enawga Woreda, East Gojjam Zone. Despite these efforts, there is a notable gap in the literature concerning the contribution of compost to crop productivity and the factors affecting its preparation and utilization in Ethiopia. Therefore, this study aims to identify the factors influencing the preparation and utilization of compost and its contribution to potato (Solanum tuberosum) productivity in Guagusa Shekudad Woreda.

2. Materials and Methods

2.1. Description of the study area

The study is conducted in Guagusa Shikudad District, situated between 10° 44’ N to 10° 48’ N and 37° 0’ 30" E to 37° 3’ 30" E in Awi Administration Zone, Amhara National Regional State. It is bordered by Ankesha Guagusa to the west, Banja District to the north, and by the West Gojjam Administration Zone to the east and south (see Figure 1). The total area of the district is 296.04 km² (Guagusa Shikudad District Agricultural Office, 2021). The district experiences a high annual rainfall, ranging from 1,200 to 2,000 mm, with an average of 1,750 mm. Monthly temperatures typically range from 17°C to 27°C. The topography features both plains and rugged landscapes, with elevations varying between 1,800 and 3,100 meters above sea level. According to the Guagusa Shikudad Administration Office (2021), the total population of the district is 110,187, comprising 54,404 males and 55,783 females.

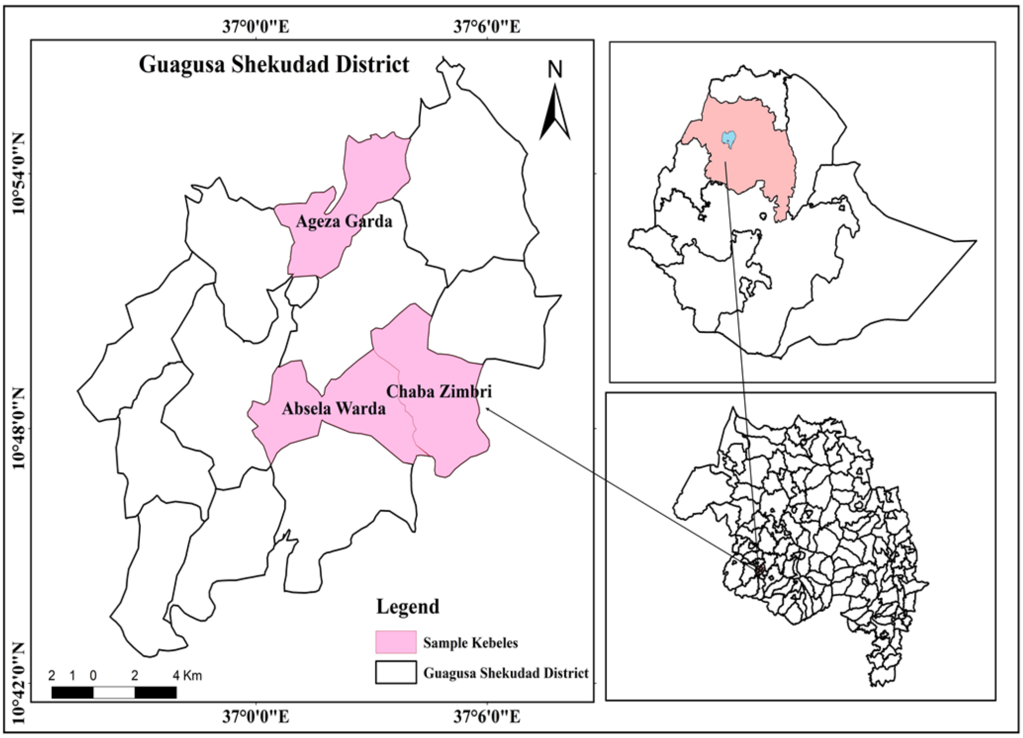

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Figure 1: Map of the study area

2.2. Research design

The study utilized an explanatory research design to examine the determinants of compost preparation and utilization. It employed cross-sectional data collection techniques through household surveys. A quantitative research approach was implemented to uncover key findings regarding compost utilization and its contribution to crop production and productivity in the study area.

2.3. Sample size determination and sampling techniques

A multistage sampling procedure was employed to select respondents for the study. Initially, Guagusa Shikudad District was purposively chosen as the target area due to the researchers' familiarity with the region. This district is well-known for its potato production, although current output levels are not encouraging, which prompted an investigation into the area. Next, the district comprises 14 *kebele* administrations (the smallest administrative units in Ethiopia). Among these, four *kebeles* are located in the Dega agro-ecological zone, while ten *kebeles* are in the Woina Dega agro-ecological zone. Using purposive sampling techniques, one *kebele* (Agiza Garda) was selected from the Dega zone, and two *kebeles* (Chaba Zimbri and Abisla Ward) were chosen from the Woina Dega zone. Finally, to determine the sample size needed for the questionnaire, Kothari's (2004) sample size formula was utilized, as detailed below.

$$n= \frac{z^2.p.q.N}{e^2(N-1)+z^2p.q} \quad (1)$$

Where, n = sample size

z = value standard variation at 95% confidence level (1.96)

p = sample proportion or result of plot study (0.03),

q = 1 – p

N = number of total household population,

e = 5% error term

Using systematic sampling techniques and the sampling frame obtained from *kebele* administrations, a total of 124 sample households were determined for the questionnaire survey. From the total of 124 sampled household heads, 58 were adopters of compost and 66 were non-adopters. Using proportional stratified sampling techniques, 45 household heads were selected from Absila district, 41 from Chaba Zimbri *kebele*, and 38 from Agiza Garda for the study.

For the key informant interviews, six development agents (DAs) and three experts from the District Agriculture Office (specializing in natural resource management, crop and plant science, and environmental protection) were purposively selected based on their field experience.

2.4. Data sources and data collection methods

Data from selected households (both from adopters and non-adopters) were collected using questionnaire and interview. The structured questionnaires were prepared and addressed to the respondents to identify the factors that affect preparation and utilization of compost. In addition to questionnaire, interviews were conducted with Gagusa Shikudad Woreda Agriculture Office experts and *kebele* DAs.

2.5. Data analysis techniques

The quantitative data collected through household survey were coded and entered in SPSS version 20 and analyzed using both descriptive and inferential statistical tests such as independent t-test, ANOVA and Chi-square. The inferential statistics were used to show the degree of statistically significant relationship between dependent and independent variables. The Chi-square test was employed to show the degree of significant association between dependent and discrete/categorical explanatory variables (sex, age category and economic status). Independent t-test was used to show statistically significance mean differences among user and non-user farmers of compost in relation to continuous explanatory variables (farm size, farming experience and family size). The binary logistic regression model was used to identify the positive and negative determinant factors, and one-way ANOVA test was used to test the significant variation of potato production among treatments (with compost and without compost). The qualitative data collected through key informant interview was analyzed thematically to substantiate the findings (Kothari, 2004).

2.5.1. Binary logistic regression modeling

Binary logistic regression was employed because the dependent variable is dummy, specifically the adoption of compost for enhancing potato productivity. In this model, the dependent variable is coded as 1 for adopters of compost and 0 for non-adopters.

Model specification

Binary logistic regression is a model used to show the determinants of binary dependent variable and one or more explanatory variables that may be continuous or categorical (Stat News, 2011). Following Maddala (1992) and Gujarati (1995), the logistic distribution function for the adoption of agricultural inputs can be specified based on the following equation **(Equation 2):**

$$\text{Pi} = \frac{1}{1+e^{-z(i)}} \qquad (2)$$

Where, P_i = is the probability of the use of compost input for the i^{th} farmer and it ranges from 1 –2 (i.e., the binary variable, p = 1(user), p = 2(non-user). e^{zi} = stands for the irrational number e to the power of Zi. Zi = a function of n-explanatory variables which is also expressed as: $Zi = B_0+B_1X_1+B_2X_2+\ldots+B_nX_n$. Where, B_0 – is the intercept, B_1, B_2 … B_n are the logit parameters (slopes) of the equation, X_1, X_2,…X_n = explanatory variables in the model. The slopes tell how the log-odds ratio in favor of use of compost changes as an explanatory variable changes. The relationship between P_i and X_i which is non- linear can be expressed as follows (**(Equation 3) :**

$$\text{Pi} = \frac{1}{1+e^{\text{B0+BiXi+}\cdots\text{BnXn}}} \quad (3)$$

Therefore, in this study binary logistic regression model was used to identify the determinants of farmers' use of compost inputs and to show the relative significant relationship of the explanatory variables with the dependent variables **(Table 1).**

Model assumption and model of fitness

In a given study, before taking the selected variables into the binary logistic regression model, it is necessary to check for the existence of multi-collinearity among the continuous variables and verify the associations among discrete variables. The reason for this is that the existence of multi co-linearity will affect seriously the parameter estimates. The coefficients of the interaction of the variables indicate whether or not one of the two associated variables should be eliminated from model analysis (Gujarati, 2003).

Formally, the Variance Inflation Factors (VIF) technique was employed to detect the problem of multi-collinearity for the continuous explanatory variables. The VIF value is equal to 1; therefore, there is no multi-collinearity problem among the factor variables. A VIF value greater than 10 is used as a signal for the strong multi-collinearity (Gujarati, 1995). A multi-collinearity measurement associated with the VIF (Xi) is specified as in **(Equation 4).**

$$\text{VIF (Xi)} = (1-Ri^2)^{-1} = VIF = \frac{1}{1-Ri^2} \quad (4)$$

Where, Ri^2 is the coefficient of multiple determinations when the variable Xi is regressed on the other explanatory variables. Additionally, there are also associations between discrete variables, which can lead to the problem of multi-collinearity or association. To detect this problem, contingency coefficients were computed from the survey data. Contingency coefficient is a Chi-square based measure of association where a value 0.75

or above indicates a stronger relationship (Healy, 1984). The coefficient contingency is expressed as follows **(Equation 5):**

$$C^2 = \frac{X^2}{n+X^2} = C= \sqrt{\frac{X^2}{n+X^2}} \quad (5)$$

Where, C = Coefficient of contingency, n = total sample size and x^2 = a Chi- square value Therefore, in this study multi-collinearity diagnostic test was used to identify the situation whether the correlations among and between th explanatory variables were strong or not.

Thus, variance inflation factor (VIF) was used for testing the existence of multi-collinearity problem among and between continuous variables; and Coefficient of Contingency was used for discrete variables. There are different statistical testes for determining the significance or goodness of fit for logistic regression models. These are Pearson chi-square, Likelihood Ratio test, Hosemer-Lemeshow Goodness-of-Fit test and Nagelkerke Pseudo R-square. Goodness of fit of the model can also be measured by considering how well the model classifies the observed data or by examining how likely the sample results occur, given the estimates of model parameters. The goodness-of-fit is considered to be good if the overall correct classification rate exceeds 0.05. The goodness-of-fit test statistic is greater than 0.05, as we want a well-fitting model; the model's estimates fit the data at an acceptable level. Therefore, in this study Pearson chi-square and Hosemer-Lemeshow Goodness-of-Fit test were used to test the model-of-fitness of the study (Gujarati, 1995; Maddala, 1992) In addition, to investigate the contribution of compost to potato (*Solanum tuberosum*) productivity ANOVA test with 95% CI was used by using Statistix 8 software.

Table 1: Measurement and expected sign of explanatory variables

Variables	**Measurement of variables**	**Expected signs**
Independent variables		
Sex of households	Dummy (1=Male, 2=Female)	-
Age of households	Categorical (1=young, 2=Adult, 3=Old)	_
Educational level	Dummy (1=Literate, 2=Illiterate),	+
Economic status	Categorical (1=Low, 2=Medium, 3=High)	+
Extension support	Dummy (1=Yes, 2=No)	+
Input access	Dummy (1=Yes, 2=No)	+

Perception	Dummy (1=Positive, 2= Negative)	+
Family size	Continuous	+
Farm size	Continuous	+
Farming experiences	Continuous	+
Dependent variable		
Adoption of compost preparation and utilization	Dummy (adopter and non-adopter)	

2.6.Ethical considerations

Ethical considerations are fundamental concerns that should be carefully considered in any kind of research. So, in this research ethical considerations were carefully taken into account. The researchers first planned to obtain an informed consent from all participants involved in this study, including the farming community, the development agents, local administrators and others. The researchers also safeguard the confidentiality and privacy of our research participants during the survey. In this regard, the researchers assured them that the personal or sensitive information collected during the research would be kept confidential and that their names would not be mentioned in the report of the study to prevent the identification of individuals or communities. During all forms of data collection, the researchers also respected the communities' culture and tradition.

3. Results and Discussion

3.1. Demographic and socio-economic characteristics of respondents

The study found that approximately 76.7% of the respondents were male, while 23.3% were female (see Table 2). Additionally, the results indicated that sex did not have a significant relationship with the preparation and adoption of compost at the 0.05 level. Specifically, 24.2% of non-adopters and 22.4% of adopters were female, whereas 77.6% of adopters and 75.8% of non-adopters were male among the 124 total respondents. The Chi-square test results revealed statistically insignificant association between the sex of the household head and the use of compost (Table 2). This implies that there is no notable difference in compost usage between adopters and non-adopters based on gender.

The study revealed that among the 58 adopters, 20.7% were young, 27.6% were adults, and 51.7% were elderly. In contrast, among the non-adopter sample households, 57.6% were young, 33.3% were adults, and 9.1% were old individuals. A Chi-square test was conducted to assess the significance of the association between age group and compost utilization. The results indicated a significant association between the age group of households and the adoption of compost ($\chi^2 = 30.076$, $p < 0.05$) (Table 2). Additionally, among the 58 adopters, 22.4% were illiterate, while 77.6% were educated. Conversely, among the non-adopters, 72.7% were illiterate and 27.3% were educated. The Chi-square test demonstrated a significant association between the educational status of household heads and the adoption of compost inputs at a 95% confidence interval ($\chi^2 = 31.267$, $p < 0.05$).

The participants of the study expressed the opinion that the economic level of household heads significantly affects the preparation and utilization of compost inputs on their farmlands. This is attributed to the fact that preparing and transporting compost requires both human labor and traditional transportation methods that require money.

The study revealed that 79.3% of adopting farmers received extension services, compared to only 24.2% of non-adopters. Among the adopters, 20.7% did not have access to extension services, while 75.8% of non-adopters also lacked this access. The probability of utilizing extension services was significantly associated with compost utilization ($\chi^2 = 37.446$, $p < 0.05$). This indicates that extension services play a significant role in the adoption of compost, contributing to increased potato productivity. Interview participants also confirmed that household heads who received proper extension services were more likely to prepare and use compost on their farmlands. Regarding access to composting materials, 70.7% of adopters had access to the necessary materials, while only 31.8% of non-adopters did. Conversely, 29.3% of adopters and 66.2% of non-adopters lacked the inputs needed to prepare compost ($\chi^2 = 18.658$, $p < 0.05$).

The implications of demographic and socio-economic variables indicate that these factors significantly influence the adoption of compost. Factors such as age, education level, and economic status can affect farmers' willingness and ability to utilize compost effectively. Understanding these variables helps tailor extension services and interventions to promote compost adoption, ultimately enhancing agricultural productivity and sustainability.

Table 2: Distribution of categorical variables and compost user category

Variable		User		Non-user		Chi-square test value	Sig. level
		No	%	No	%		
Sex	Male	45	77.6	50	75.8	0.58	.810ns
	Female	13	22.4	16	24.2		
	Total	58	100	66	100		
Age	Young	12	20.7	38	57.6	30.076	0.000*
	Adult	16	27.6	22	33.3		
	old	30	51.7	6	9.1		
	Total	58	100	66	100		
Education level	Literate	45	77.6	18	27.3	31.267	0.000*
	Illiterate	13	22.4	48	72.7		
	Total	58	100	66	100		
Economic status	Low	9	15.5	31	47	29.191	0.000*
	Medium	15	25.9	26	39.4		
	High	34	58.6	9	13.6		
	Total	58	100	66	100		
Extension support	Yes	46	79.3	16	24.2	37.446	0.000*
	No	12	20.7	50	75.8		
	Total	58	100	66	100		
Input access	Yes	41	70.7	21	31.8	18.658	0.000*
	No	17	29.3	45	66.2		
	Total	58	100	66	100		
Perception	Positive	36	62.1	23	34.8	9.171	0.002*
	Negative	22	37.9	43	65.2		
	Total	58	100	66	100		

* significant at 95% confidence interval; ns =Not significant at 95% confidence interval

Source: Survey result

3.1.1 Compost preparation and utilization with continuous explanatory variables

To investigate the relationship between compost preparation and utilization with continuous variables such as farm size, family size, and farming experience, an independent t-test was conducted to compare adopters and non-adopters. The mean scores for family size, farm size, and farming experience for both groups are presented in Table 3.

Family size is a crucial factor in agricultural activities. A large family can provide more labor for intensive agricultural tasks (Gelgo et al., 2016; Bernard, 2022). Based on this premise, it was hypothesized that family size would significantly influence the adoption of compost preparation and utilization. The average family size for adopters was 7.00, with a standard deviation of 1.298, while non-adopters had an average family size of 3.80 and a standard deviation of 0.933. The independent t-test revealed a significant mean difference in family size between the two groups at a 95% confidence interval (t = 19.494, p = 0.000), suggesting that households with larger family sizes are more likely to adopt composting practices.

Farm size also significantly impacts farmers' decisions to adopt improved agricultural inputs. The study found that the average landholding size for adopters was 1.62 hectares (SD = 0.791), while non-adopters had an average of 4.05 hectares (SD = 0.773). The independent t-test indicated a significant mean difference in farm size at a 99% confidence interval (t = -17.238, p < 0.01), suggesting that households with smaller land holdings were more effective in preparing and utilizing compost compared to those with larger farms. This result is consistent with Bernard (2022).

As shown in Table 3, there is a significant difference in the mean years of farming experience between adopters and non-adopters: adopters averaged 18.98 years of farming experiences (SD = 4.228) while non-adopters averaged 7.69 years (SD = 1.334). This indicates a greater variation in farming experience among the two groups, with more experienced farmers showing a higher tendency to prepare and utilize compost. The findings from the interviews further supported this result, as the participants noted that farmers with extensive experience are more likely to adopt composting practices compared to those with fewer experiences. This result was also supported by Majbar et al. (2021).

Table 3: Distribution of continuous variables and adoption compost

Continuous variables	User			Non user			Independent t test	Sig. level
	No	mean	Sd.	No.	mean	Sd.		
Family size	58	7.00	1.298	66	3.80	.933	19.494	0.000*
Farm size	58	1.62	0.791	66	4.05	0.773	-17.238	0.000*
Farming	58	18.98	4.228	66	7.69	1.334	20.726	0.000*

experience

* significant at 99% confidence interval

3.1.2. Determinants of the adoption of compost for potato productivity

Table 4 shows the variables that were included in the binary logistic model to identify which factors serve as the best predictors of compost adoption. Among these variables, nine were found to be significant determinants of the dependent variable, with statistical significance at $p < 0.01$.

Age of the HH heads (Age): The results indicated that the age of household heads was significant at $p < 0.05$, with a positive logit coefficient and an odds ratio of 1.265. This suggests that as the age of the household heads increases by one unit, the probability of farmers using compost inputs increases by a factor of 1.265. Therefore, older farmers are more likely to utilize compost than their younger counterparts. However, this finding contrasts with studies by Mustafa-Msukwa et al. (2011) and Bernard (2022) in Malawi, which argued that age is not a significant factor in the adoption of compost. Nevertheless, it can be concluded that older farmers tend to have more experience in the preparation and utilization of compost compared to younger farmers.

Educational status of the HH heads (Education): The regression analysis revealed that the educational status of household heads was significant at the 1% level, with a positive logit coefficient and an odds ratio of 9.231 regarding the use of compost. This implies that for each unit increase in the level of literacy among household heads, the probability of adopting agricultural compost inputs increases by a factor of 9.231, holding other factors constant. This indicates that education enhances understanding and utilization of modern agricultural technologies. Consequently, more educated household heads are more likely to adopt agricultural compost inputs compared to their illiterate counterparts. These findings align with the research of Ashenafi (2006) and Hassen et al. (2012), which also demonstrated that education significantly impacts the intensity of agricultural compost use. Thus, it is clear that education plays a crucial role in the effective utilization and application of compost.

Availability of input: The binary logistic regression analysis indicated that the availability of composting materials was significant at the 1% level, with a positive logit coefficient and an odds ratio of 5.168. This suggests that the probability of farmers utilizing compost inputs increases by a factor of 5.168 for each unit increase in the availability of these materials. This finding aligns with the results of Gelgo et al. (2017), which highlighted that the use of organic fertilizers is influenced by the availability of composting materials and the income of smallholder farmers. The results indicate that the availability of composting materials increases the likelihood of using organic fertilizers by 0.4%. Moreover, the availability of inputs significantly impacts both the preparation and utilization of compost in agricultural settings. Sufficient and easily accessible organic materials are essential for successful composting (Rashmika & Edirisinghe, 2016). Additionally, the availability of fertilizer resources can shape farmers' overall approach to compost use (Gedefaw & Sisay, 2019).

Perception of farmers: As indicated in Table 4, the binary logistic regression result shows that, the perception of farmers was found to be significant at 5% level of significance and has positive logit coefficient and odds ratio of 3.039. This implies that the probability of the farmers to use compost inputs can increase by a factor of 3.039 as perception of the households' increases by a 1 unit. This finding is in line with the findings of Bernard (2022), who found that the perception and interest of farmers were a determinant factor for adoption and utilization of compost in Malawi.

Income level of the HH heads (Inco level): The regression results indicate that economic level of the households was significant at 5% level of significance and has a positive logit coefficient with 2.272 odds ratio on use of compost inputs. This implies that the probability of the households to adopt agricultural compost inputs can increase by a factor of 2.272 with a unit increase of level of economy of the households.

Extension support of the HH heads (Expert): As shown in Table 4, extension support was significant at 5% significance level and has a positive logit coefficient in the adoption of compost with odds ratio of 11.979. Households who had better access to contact with extension service providers get better information and perceived the importance of compost application to treat soils more than those who did not have access to experts. The result is similar to the findings of Ashenafi (2006) and Hassen et al. (2012). Farmers who are contacted by an extension worker are found to be better users of organic fertilizers. Similarly, Bernard (2022) found that lack of training significantly affects farmers' adoption and utilization of compost.

Farming experience: The binary logistic regression result showed that farming experience was found to be significant at 5% level of significance and has positive logit coefficient and odds ratio of 3.123. This implies that the probability of farmers to adopt compost inputs can increase by a factor of 3.123 as farming experience increases by a single unit. This suggests that farmers with high farming experience are more likely to prepare and utilize compost inputs than farmers with low farming experience. This finding is in line with the findings of Majbar et al. (2021), who found that households' farming experience and knowledge of compost utilization can significantly impact farmer's willingness to prepare and utilize compost.

Family size of the HH heads (Family): The binary logistic regression result showed that family size was found to be significant at 5% level of significance and has positive logit coefficient and odds ratio of 1.033. This implies that the probability of the farmers to adopt compost inputs can increase by a factor of 1.033 as family size increases by a single unit. This suggests that farmers with large family size are more likely to utilize compost inputs than farmers with a small family size. This finding is in line with a study conducted by Gelgo et al. (2016) in Shashemene Ethiopia and found that household size was negatively related with the adoption of compost. Similarly, Bernard (2022) revealed that inadequate labor in a farming family could significantly determine the adoption of compost.

Farm size of the household: the binary logistic regression result showed that farm size was found to be significant at 1% level of significance and has negative logit coefficient and odds ratio of 3.15. This implies that the probability of farmers to use compost inputs decreases by a factor of 3.15 as farm size increases by a single unit. This suggests that farmers with large farm size are less likely to use compost inputs than farmers with low small farm land.

Table 4: Binary logistic model results User category

Explanatory variables	B	S.E.	Wald	Sig.	Odd ratio
sex	-0.102	0.426	0.058	0.810[ns]	0.903
age	3.330	0.267	24.753	0.046**	1.265
education	2.223	0.419	28.141	0.000*	9.231
Availability of input	1.642	0.391	17.626	0.000*	5.168
Perception of farmers	1.118	0.374	8.933	0.003*	3.039
Income level	1.303	0.269	23.452	0.023**	2.272
Extension services	2.483	0.33	32.873	0.000*	11.979
Farm experience	2.093	0.913	5.25	0.021**	3.123
Family size	1.422	0.865	15.646	0.043**	1.033
Farm size	19.570	0.283	0.23	0.000*	3.15

** significant at 95% CI* significant at 99% CI; ns =Not significant at 95% CI

4. Conclusion

This study assessed the factors that determine the preparation and utilization of compost and its contribution to crop (potato) productivity in Guagusa Shekudad *woreda* of north-western Ethiopia. The results of the study showed that farmer's utilization of compost in the study area was affected by different factors. As the study revealed, age, educational status, availability of composting materials, perception of farmers, economic level, extension support, farming experience, family size and farm size of the household were the significant factors in preparation and utilization of compost in the study area while, sex was insignificant. The binary logistic regression model result showed that, age, education status, availability of inputs, perception, economic level, extension support, farming experience, family size of the households has positive influence on compost preparation and utilization in the study area while, farm size is a negatively determinant factor in utilization of compost. The respondents who participated in the interview stated that there is a great difference in preparation and utilization of compost among farmers with different perceptions, economic levels, family sizes, experts' extension support, and farming experience of the households. Based on the investigation of compost contribution to crop (potato) productivity in the study area, compost utilization plays a significant role in crop (potato) productivity in the study area. Based on the results of the study, the following recommendations are forwarded to enhance the preparation and utilization of compost sustainability of agricultural land productivity and to make the land more fertile. The smallholder farmers should improve organic farm through preparation and utilization of compost from available resources. Continuous capacity building and awareness creation is essential to enhance compost utilization. Hence, the government and other stakeholders should design capacity building programs in farmer training centers and scale up best practices among the farming community through continuous extension services. In addition, it is recommended that the contribution of compost utilization to the production of other crops in different agroecology should be investigated.

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Conflict of Interest

The authors declare that they have no competing financial interests or personal relationships regarding the work described in this article.

Authors Contribution

All authors contributed to the study's conception and design. Lakachew Ayenew and Addisu Dagnaw conducted data collection and analysis. Ayalneh Yedem also performed statistical data analysis. All authors wrote the first draft of the manuscript collaboratively and participated in editing and reviewing. All authors read and approved the final manuscript.

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