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EFFECT OF PRE-HARVEST LOSSES ON PROFITABILITY OF PLANTAIN PRODUCTION IN BAYELSA STATE, NIGERIA

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ABSTRACT: *The study examined the effect of pre-harvest losses on profitability of plantain farmers in Bayelsa State, Nigeria. The specific objectives were to: describe the socio economic characteristics of plantain farmers, examine pre-harvest losses of plantain on profitability and determine factors that influence pre-harvest losses of plantain. A multi-stage sampling technique was used to select five (5) local government areas (Yenagoa, Ogbia, Kolokuma-Opokuma, Sagbama and Southern Ijaw) purposively based on their predominance in commercial plantain farmers and six (6) communities each from the 5 LGAs respectively, and, furthermore, eight (8) plantain farmers in each community, making a total number of two hundred and forty (240) plantain farmers. Structured questionnaire was used to elicit the required information from the selected respondents. The result indicates that 55.1% of the respondents fall between the age range of 31-50 years, with the mean age of 44 years. Males (51.9%) dominated plantain production in the study area. The majority of the plantain farmers were married (60.0%), 95.5% had formal education, 60.0% had 1-15 years of farm experience, 77.9% were part-time farmers, 98.3% had family size of 1-10 persons in their households with a mean of 5 persons, and 56.7% had farm size of 2-4 hectares. The result further shows that 56.7% used hired labour while 86.7% had no month contact with extension agent. Sucker, fertilizer, household size, and educational level had a significant relationship with plantain production at various probability levels, indicating profitability. Based on the findings, it was therefore recommended that there is a need for the farmers to put up parameter fencing to prevent theft cases which is extremely high and adversely affects net farm income. However, government and non-governmental organizations can support in terms of granting farmers' soft loans in order to reduce the burden.*

KEYWORDS: Pre-harvest, Stochastic profit function, Profitability, Plantain, Regression analysis.

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INTRODUCTION

Musa spp is a perennial crop which originated from Southeast Asia and New Guinea and were introduced in Africa before 2500 years ago (Mbide, Doutrelepont, Vrydaghs, Swennen, Swennen, Beeckam, Langhe, & Maret, 2005). In this continent, *Musa* production is carried out predominantly in sub-Saharan African countries with plantain production concentrated in the West and covering 32% of the world production (Cauthen, Jones, Gugerty, & Anderson 2013; Ayanwale, Fatunbi, & Ojo, 2018). In Nigeria, the plant is an important fruit crop which grows in the southern part of the country (Baiyeri & Ajayi, 2000; Tshiunza, Lemchi & Tenkouano, 2001). The demand for plantain has increased tremendously in the last one decade as a number of local processing industries have emerged, which use it industrially for making bread, cakes, biscuits (Ayanwale, Fatunbi & Ojo, 2018). With increasing urbanization, bananas and plantains are fast becoming more and more important as cash crops, in some cases providing the sole source of income to rural population, thereby playing an important role in poverty alleviation (Frison & Sharrock, 1999). Despite the economic importance of plantain as a source of energy food, which provides 25% of carbohydrate in the diet of people in Nigeria (Noupadja & Tomekpe, 2004), the country has an annual plantain production of 1.9 million metric tonnes out of the world 92 million metric tonnes (FAO, 2006). This gap is relative to the fact that over 90% of *Musa* producers in Africa are smallholder farmers who produce for consumption and income (Alabi, 2013; FAO, 2020a).

The problem of food losses has been a notable challenge in food production and supply chains in different countries of the world. The total food lost globally every year is estimated to be able to feed about 1.5 billion people (Gustavsson, Cederberg, Sonesson, & Emanuelsson, 2013). Several national and multinational level policy measures have acknowledged the need for tackling the problem of pre-harvest food losses (Nkwain, Odiaka, Ikwuba, Fatty, & Gam, 2022). These are reflected in the Sustainable Development Goal (SDG). SDG 12.3 states that by 2030 there should be a reduction of food losses along the production and supply chain, including pre- and post-harvest losses (United Nations 2016; Nkwain *et al.*, 2022). Pre-harvest losses occur before the harvesting process begins and such losses at this stage are sometimes due to poor site selection, storm, poor stalking, and the variety of seedlings cultivated. Similarly, Verma, Plaisier, Wagenberg, and Achterbosch (2019) argued that the absence or inadequate participation of agricultural research institutes and extension services can lead to lack of adequate information and unavailability of crop varieties suitable to local conditions which is believed to affect the growth and maturity of crops. Producers are unable to meet the needs of their increasing households and consumers due to production constraints ranging from natural, agronomic, biotic to human-induced factors. According to Ayanwale, Fatunbi and Ojo (2016), for over 20 years, research works on plantains have tilted towards socio-economic and post-harvest studies, with little or no emphasis on the agronomy and pre-harvest losses. It is important to note that due to the morphology of this crop, in most producing countries, pre-harvest losses are far more than post-harvest losses (Nkwain, 2022). According to Cauthen *et al.* (2013), in West and Central Africa, particularly in Nigeria, Ghana and Cameroon, 30-50% and sometimes up to 80% of plantains and bananas are lost at pre-harvest stages. This, in addition to the losses recorded by other producing countries, reduce yields and render millions of people who depend on banana and plantain products food insecure in the continent. In 2019/2020, 81% of banana producing households in Boyo Division in Cameroon were food insecure because of pre-harvest losses of bananas (Nkwain, 2022). Meanwhile, in Tanzania,

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the food situation of 38.3% of the producing households was reported bad while that of 53.8% was very bad (Muchuruza & Melchior, 2013).

Future food insecurity situations in Nigeria can partly be reversed by revisiting and encouraging certain crops that farmers have the capacity to produce at a lesser cost, especially plantains, in the Southern region of the country due to their economic importance. Plantain and banana production may be one of the means of tackling this problem of poverty ringing in every part of rural areas in Bayelsa State, because the crop is one of the primary commodities for investment across Bayelsa State and South-South of Nigeria (Kainga, Nnadi, Morgan & Apkas, 2016). According to Tchango, Bikoï, Achard, Escalant and Ngalani (1999), and Cauthen *et al.* (2013), the cost of producing a hectare of plantains is relatively cheaper than that of cassava, maize and rice. This therefore means that if there is an increment in investment in this sector, yields will increase as farmers will be able to minimize or prevent losses. Regrettably, in many producing states, especially in Bayelsa State, there is no or little data on the pre-harvest losses. Therefore, this study aimed at preventing the pre-harvest losses of plantain on profitability as well as possible ways of enhancing the future food security situation of the consumers in Nigeria towards the achievement of the second Sustainable Development Goals (SDGs) in 2030.

Objectives of the Study

i. Examine the socio economic characteristic of plantain farmers in Bayelsa State.

ii. Examine pre-harvest losses of plantain on profitability.

iii. Determine factors that influence pre-harvest losses of plantain.

Hypotheses

i. Pre-harvest losses of plantain farmers are not influenced by socio-economic characteristics.

ii. Profitability of plantain farmers are not influenced by pre-harvest losses.

METHODOLOGY

Multi-stage sampling technique was used for this study. Firstly, five (5) local government areas (Yenagoa, Ogbia, Kolokuma-Opokuma, Sagbama and Southern Ijaw) were purposively selected due to the predominance of plantain farming in these areas. The second stage involved the purposive selection of six (6) communities each from the five LGAs for their predominance in plantain farming. Furthermore, eight (8) plantain farmers in each community were randomly selected, making a total number of two hundred and forty (240) plantain farmers. A list of farmers was collected from the ministry of agriculture. Data for this study were collected from a primary source. This was obtained by using structured questionnaires. The questionnaires adequately achieved the objectives and hypotheses of the study. The data were analyzed using both descriptive and inferential statistics. The models are specified below:

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Stochastic Profit Function

The profit function analysis is also used to test the effect of prices of individual resource inputs and socioeconomic variables on maximum variable profit (Arene, 2002; Kainga *et al*., 2017). The profit function model is explicitly specified as follows:

$\prod^* = \beta 0 + \beta 1PPS + \beta 2PPF + \beta 3PPL + \beta 4THEFT + \beta 5STW + \beta 6PDU + e$ …… (i)

where:

$\prod_{ij}$ = amount of maximum variable profit (₦)

PPS = per unit price of plantain sucker (₦)

PPF = per unit price of fertilizer/organic manure (₦)

PPL = per unit price of labour (₦)

THEFT = number of plantain bunches missing

STRONG WIND = number of plantain logging (stem breakage)

PDU = production unit in (ha)

Beta 0 to Beta 7 = parameters to be estimated

e = stochastic error term.

Inefficiency Model

$\prod_{ij} = \delta_0 + \delta_1 Z1_{ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z5_{ij}$ …….. (ii)

where:

$\prod_{ij}$ is the profit inefficiency of the ith farmer and jth observation of the farmer

δ_0 is the constant

δs are the parameters to be estimated

Z_1 = farmers age (years)

Z_2 = marital status (Dummy: married = 0, single = 1, divorced = 2, widowed = 3)

Z_3 = household size (number of persons per home)

Z_4 = educational level (years of schooling)

Z_5 = farming experience (number of years spent farming plantain).

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The Multiple Regression Model

Regression equation was employed in determining the effect of socio-economic factors on pre-harvest losses of plantain. The multiple regression model used was given as:

$Y = \beta_o + \beta_1X_1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + e$ …… (iii)

where:

Y= Pre-harvest losses in Naira

β_o = Constant

X_1= Gender (1 = male, 2 = female)

X_2 = Age (years)

X_3 = Marital Status (Dummy: 1 = single, 2 = married, 3 = divorced, 4 = widowed, 5 = separated)

X_4 = Family size (numbers)

X_5 = Educational level (years)

X_6 = Years of farming experience (years)

X_7 = Farm Size (hectares)

$\beta_1 - \beta_7$ = Coefficients of linear regression

e = Error term.

RESULTS AND DISCUSSION

Socio-Economic Characteristics

Age

The majority (55.1%) of the plantain farmers were between the age bracket of 31 and 50 years. The mean age of the respondents was 44 years. The result therefore indicates that most of the farmers are young and energetic, since they are in their active age. The result conforms with the works of Kainga, Sipki and Ekiyor (2019) who observed that plantain farmers in Bayelsa State had 32.0% respondents between the age bracket of 41 and 50 years. Thus, it was observed that more younger persons were involved in plantain farming. The result also conforms with the findings of Kainga, Nnadi, Morgan, and Akpas (2016) in which the majority (90%) were between the ages of 30 and 50 years. Similarly, the result conforms with the findings of Ayanwale, Fatunbi and Ojo (2018) in which 74.3% of the respondents were between the ages of 26 and 59 years in their baseline analysis of the plantain value chain in southwest Nigeria. This gives an indication that the youth were becoming gainfully employed and that they were now realizing their potential, instead of solely depending on "white collar" jobs unlike in the past. The result also agrees with the findings Bethel and Morgan (2020) which revealed that 84% of cassava farmers in Bayelsa State, Nigeria were 20-50 years old. In the same vein, the

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result is in conformity with the works of Morgan, Wasini and Larry (2021) which revealed that socio-economic factors, such as age, had a positive relationship and technical efficiency. However, this disagrees with the findings of Amet (2017) which found out that in Cameroon and Gambia, rice farmers were quite old (51 years).

Sex

Majority (51.7%) were males while the remaining 48.3% were females. This implies that plantain production in Bayelsa State, Nigerian is mainly dominated by males. The result agrees with the findings of Kainga, Nnadi, Morgan, and Akpas, (2016) in which a 60% majority of plantain and banana farmers were males in Bayelsa State, Nigeria. The result also agrees with the works of Kainga, Sikpi and Ekiyor (2019), who observed that 62.0% of male farmers were involved in plantain farming in Bayelsa State while the women and children were mostly used in daily farm routines, that is, the men were considered the major investors while the women assist them. Similarly, the result also conforms with the findings of Chukwunta (2014) that the majority (54.9%) of the farmers in Enugu State were males. However, the result of Amet (2017) gives a contrary view of 60.4% female rice farmers in Cameroon and the Gambia.

Marital Status

Table 1 indicates that 60.0% of the plantain farmers were married. About 28.3% were single while 5.7% and 6.7% were divorced and widowed respectively. This could be due to the fact that family men and women required family income to cater for their families. Thus, an increase in family income will lead to an increase in output, and in turn improve their standard of living. The result conforms with the findings of Kainga, Nnadi, Morgan and Akpas (2016) in which 85.0% of plantain farmers in Bayelsa State were married. Similarly, the result conforms to findings of Amet (2017) in which 92.0% of rice farmers in Cameroon and Gambia were married. The result also agrees with the findings of Akinyemiju, Laogun and Opabode (2009) in which the majority (89.5%) of banana and plantain farmers in Southwest Nigeria were married.

Educational Level

The result shows that 5.0% of the plantain farmers in the study area never attended school, that is, they had no formal education, while 95.0% of the respondents had one form of the formal education or the other. Out of the 95.0% of the respondents that had formal education, about 8.3% attended primary school, 60.0% attended secondary school while 26.7% attended higher institutions at various levels. The mean years of schooling of the plantain farmers in the study area as estimated was about 12 years. This implies that most of the farmers had mostly secondary education; the farmers are therefore classified as literates. Nevertheless, with the present global computer and internet age, literacy goes beyond the ability to read and write. The result agrees with the findings of Ovharhe, Emaziye, Okpara, Agoda and Benson (2021) in which a greater percentage (34.1% and 23.5%) of maize farmers in Delta State, Nigeria attended secondary and tertiary school respectively. The result also concurred with the work of Morgan (2016) who found out that the majority (56.7%) of catfish farmers' in Bayelsa State, Nigeria attended secondary school. However, the findings of Amet (2017) disagree with the result in which the majority (36.0%) of the rice farmers in Cameroon and Gambia had no formal education.

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Farming Experience

The majority (60.0%) of the respondents have been cultivating plantain for about 1-15 years. Only 40.0%% have been in the business of plantain production for a period of 16-20 years. The mean farming experience is 15 years. This implies that farmers in the study area have acquired enough experience in plantain farming; therefore, adoption of innovation will pose no problem. The result is in consonance with the study of Kwaghe (2006) which found out that farmers with many years of experience in farming are more willing to change towards adopting current recommended techniques. The result is also in line with the work of Morgan (2016) who reported a positive relationship between farming experience and technical efficiency. The result also conforms with that of Kainga, Sikpi and Ekiyor (2019), who observed that 65.0% of plantain farmers in Bayelsa State had farming experience of 1-15 years.

Farming Status

Table 1 shows that 77.9% of plantain farmers were part-time farmers while 21.1% were full-time. This implies that the majority of the respondents augment the business with other activities or enterprises. The result agrees with the works of Kainga and Adeyemo (2013) who observed that 77.8% were part-time farmers, which implies that they augment the business with other sources of funds, in Kolokuma/Opokuma Local Government Area of Bayelsa State. However, the result does not agree with the findings of Kainga, Nnadi, Morgan and Akpas (2016) in which 75.0% of plantain farmers in Bayelsa State were full time farmers. This could be as the result of plantain farmers diverting to other sources of income generation in augmenting the business.

Household Size

The result shows that the majority of plantain farmers (98.3%) had a family size of 1-10 persons in their household while 1.7% had greater than 10 persons in their household. The mean of the family size is 5 persons. From the result, it is clear that the respondents have moderate family size, which is a little above the recommended average size of 4 per family in Nigeria. Family labour is recognized as a major source of labour supply in the area as it determines the labour output. The result conforms with the findings of Kainga, Sikpi and Ekiyor (2019), that the majority 84.0% of plantain farmers in Bayelsa State, Nigeria had a family size of 1-10 persons. Similarly, the result also agrees with the work of Morgan, Wasini and Larry (2021) that cassava farmers in Ogbia Local Government Area of Bayelsa State, Nigeria had 91.5% of the respondents with family size 1-10 persons.

Farm Size

The majority (56.7%) of the respondents had farm sizes of between 2 and 4 hectares while 36.7% had farm size of less than 1 hectare and 6.6% of the respondents had farm size greater than 4 hectares. An average farm size of 2 hectares was recorded. The result therefore implies that the majority of the farmers in the study area are small-scale farmers. A relatively small size could be as a result of the system of land distribution and flooding and land fragmentation. Bayelsa State's land area is mostly covered by water especially during the rainy season, because of its swampy nature, which is not good for plantain production. Plantain production requires a flood free zone. This result agrees with the findings of Ibrahim (2002), who stated that small-scale farmers are those that cultivate farm land, not more than 2 hectares. The result also

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conforms with the findings of Kainga, Sikpi and Ekiyor (2019), who observed that 80.0% of plantain farmers in Bayelsa State had farm size less than 1-2 hectares.

Type of Labour

The result shows that the majority (56.7%) of the respondents used hired labour while 35.0% used hired and family labour, and 8.3% used family labour. This could be as a result of recent hardship in the economy where household sizes have drastically dropped, which might have affected the usual source of labour in agricultural activities. This has given birth to more hired labour in the study area. However, the result is in nonconformity with the findings of Bethel and Morgan (2021), where majority (72.7%) cassava farmers in Bayelsa State used family labour. Also, the findings of Morgan, Wasini and Larry (2021) recorded 72.3% cassava farmers in Bayelsa State constituted both hired and family labour source.

Extension Contact

The result further shows that the majority (86.7%) of the respondents had no contact with an extension agent monthly while 13.3% of the respondents had one contact. This could be due to insufficient government employed extension agents and since the farmers could not afford private extension agents. However, the findings of Morgan (2016) had a contrary result of 58.3% of one monthly visitation of extension agent in Bayelsa State.

Table 1: Socio economic characteristics of plantain farmers

Variables	Frequency	Percentage	Mean
Age			
< 30	40	16.8	43.5
31–40	52	21.7	
41–50	80	33.4	
51–60	52	21.7	
< 60	16	6.7	
Total	**240**	**100.0**	
Sex			
Male	124	51.7	
Female	116	48.3	
Total	**240**	**100.0**	
Marital Status			
Single	68	28.3	
Married	144	60.0	
Divorced	12	5.7	
Widow/widower	16	6.7	
Total	**240**	**100.0**	

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Educational Level			
No Formal Education	12	5.0	12
Primary	20	8.3	
Secondary	144	60.0	
Tertiary	64	26.7	
Total	**240**	**100.0**	
Farming Experience (Years)			
< 5	32	13.3	14.7
6–10	76	31.7	
11–15	36	15.0	
16–20	40	16.7	
> 20	56	23.3	
Total	**240**	**100.0**	
Faming Status			
Full-time	53	21.1	
Part-time	187	77.9	
Total	**240**	**100.0**	
Household Size			
≤ 5	140	58.3	5.1
6–10	96	40	
> 10	4	1.7	
Total	**240**	**100.0**	
Farm Size			
< 1	88	36.7	
2–4	136	56.7	
> 4	16	6.6	
Total	**240**	**100.0**	
Type of Labour			
Family labour	20	8.3	
Hired labour	136	56.7	
Both	84	35.0	
Total	**240**	**100.0**	
Extension Contact (Monthly)			
None	208	86.7	
Once	32	13.3	
Total	**240**	**100.0**	

Source: *Field Survey Data, 2024*

Pre-harvest Losses of Plantain on Profitability

Table 2 shows the result of the maximum likelihood estimates (MLEs) of the stochastic frontier production function for plantain farmers. The estimates of the parameters of the production function are negative decrease functions to the factors except for wind breakage -0.0493406, which is negatively significant at 10% probability level. Similarly, all the four (4) inputs used in the model are statistically significant at varying degrees of probability. They include sucker, fertilizer, labour, theft and wind. The variance parameters of the stochastic frontier production

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function are presented by sigma squared (δ^2) and gamma (γ). The sigma square (0.3375641) is statistically significant at 1% probability level. This indicates a good fit and correctness of the specified distributional assumption of the composite error terms. Also, the variance ratio defined by Gamma (γ) is estimated at (0.5416) and is statistically significant at 1% probability level. The Gamma (γ) estimated shows the amount of variation arising from profit inefficiencies of plantain farmers. Therefore, the profit inefficiency among plantain farmers account to about 54% of the variation in the input. In other words, 54% of the variation in plantain farms output is attributed to differences in profit efficiency. Thus, the result shows that suckers are the most important factor in plantain production with an estimated coefficient of 0.054, implying that a 10% increase in the quantity of suckers would increase output of plantain by 5.4%.

Wind breakage/logging is the second most significant factor in plantain production with a negative estimated coefficient of -0.049, which is statistically significant at 1% level of probability. The implication is that a 10% increase in preventing the adverse effect of wind would increase the output of plantain by 4.9%. This is an indication that wind break/logging as a factor of production is very vital in plantain production in the study area. Theft is also a causative agent of pre-harvest losses which is a significant factor of plantain profitability with an estimated coefficient of 0.037, which is statistically significant at 1% probability level. It implies that 10% prevention of theft in plantain production would increase output by 3.7%.

The estimated coefficient for labour (0.028) is statistically significant 10% probability level and positively related to the total output. This result is in consonance with the findings of Adegeye and Dittoh (1985) that labour is one of the important factors of production.

The analysis of the inefficiency parameter is very important as a basis for informing agricultural policies on what needs to be done to improve agricultural production. The inefficiency parameters as specified are those that relate to farmers' specific socio-economic characteristics which appear to have significant roles in determining the level technical efficiency of the farmers. These were examined using sigma (δ) coefficient. Note that a negative sigma (δ) coefficient implies that the parameters have a positive effect on efficiency and vice versa.

The estimated coefficient of age of the farmers was found out to be negative and statistically significant at 10% probability level. This indicates that as the plantain farmers are a little advanced in age, they are likely to be profit efficient compared to younger farmers. The result is in contrast with the findings of Taphee (2014) in their study of resource productivity and technical efficiency of small-scale groundnut farmers in Taraba State of Nigeria.

The coefficient of farm experience was found to be positive and statistically significant at 1% probability level. This implies that as the plantain farmers get more experience, they are likely to be profit efficient compared to inexperienced farmers. This result agrees with the findings of Taphee, (2014), that efficiency level of farmers was significantly affected by farming experience.

The estimated coefficient of household size was found to be negative and was not statistically significant at 1% probability level. This indicates that household size has a negative but significant effect on profit efficiency.

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Educational level has a negative coefficient and statistically significant at 1% probability level. This implies that farmers with higher educational level have the potential to increase farm output and prevent pre-harvest losses; this could be due to level of skills and exposure of this category terms of management. Table 1 shows that formal tests for the hypothesis on the profitability of plantain farmers are not influenced by pre-harvest losses in the model. According to the result, the null hypothesis was rejected.

Table 2: Maximum likelihood estimation (MLE) of stochastic frontier production function for plantain farmers' pre-harvest losses

Variable	Parameter	Coefficient	Standard error	t-ratio
Constant	β_0	6.87165	0.9182755	7.48***
Ln(sucker) X_1	β_1	0.0541165	0.0305477	1.77*
Ln(fertilizer) X_2	β_2	0.0258184	0.0398782	0.65*
Ln(labour) X_3	β_3	0.028246	0.0513238	0.55*
Ln(theft) X_4	β_4	0.0371839	0.0458343	0.81*
Ln(wind) X_5	β_5	-0.0493406	0.0393644	-1.25*
Inefficiency Effects				
Constant		-2.172	0.1915887	-11.34***
Age of farmer (years)	Z_1	-0.0095753	0.0311343	-0.31*
Marital status	Z_2	0.222986	0.093246	0.62
Household size (Number of persons per home)	Z_3	-0.1506504	0.00346	-1.62*
Educational level (years of schooling)	Z_4	-0.4989651	0.2288617	-2.18**
Experience in plantain farming (years)	Z_5	0.0056998	0.0266369	0.21
Variance Parameters				
Sigma-squared	δ^2_s	0.3375641	0.0323367	5.087***
Gamma	Γ	0.5416	0.1206	4.659***
Log-likelihood function	Llf	-120.67706		

Source: *Data Analysis Based on Field Survey (2024) using Stata 12.1 Programme*

*, **, *** stand for level of significance at 10%, 5%, and 1%, respectively.

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Factors That Influence Pre-Harvest Losses of Plantain

Multiple regression was used to analyze the factors that influence pre-harvest losses of plantain on the profit realized. Four functional forms (linear, exponential, semi-logarithm and double logarithm) were tried for the analysis. The result of the analysis reveals that of the four functional forms tried, the Double-Log Function form gave the best result based on economics, econometric and statistical criteria; hence, it was chosen as the lead equation with the highest value coefficient of multiple determination R^2. The coefficient of multiple determination (R^2) reveals that 11.23% of the variation in pre-harvest losses of plantain among the respondents is explained by the variables included in the model as measured by the F-statistics and is significant at 1% level of probability. Of the seven independent variables used in the analysis, five were significant at different levels of probability, implying that an increase in the use of these variables would affect plantain profit. Educational level and farming experience were positively related to plantain profit, while sex, marital status and household size were inversely related to plantain profit.

The positive relationship of level of education in plantain production is expected to bring about a decrease in the effects of pre-harvest losses. Theoretically, all things being equal, there is a positive relationship between profit and pre-harvest losses in the study area; that is to say, farmers who are more educated prevent pre-harvest losses.

In a related development, the positive coefficient of farming experience implies that an increase in handling pre-harvest losses will bring about an increase in profit of plantain. A 1% increase in farming experience will bring about 0.53% increase in profit. However, sex, marital status and household size are inversely related to plantain profit, implying that increased effects of these variables will bring about decrease in profit and vice versa. Sex at 1% level implies that the effects of pre-harvest losses on plantain production were more among the males. This could be because of the heavy task involved in plantain production.

Marital status was also significant at 1% probability. This implies that the more the farmers get married, the more they prevent pre-harvest losses to increase profit. This could be because married farmers need more income to cater for their families.

Household size (X_4), is significant at 1% probability and a negative relationship exists. This is to say, an increase in household size will result in an increase in the profit. Table 4.15 shows that formal test for the hypothesis on the pre-harvest losses of plantain farmers are not influenced by socio-economic characteristics in the model. According to the result, the null hypothesis was rejected.

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Table 3: Result of multiple regression analysis plantain farmers pre-harvest losses

VARIABLES	+ DOUBLE-LOG FUNCTION	SEMI-LOG FUNCTON	EXPONENTIAL FUNCTION	LINEAR FUNCTION
Constant	363694.6 (1.92)	12.06185 (30.56)***	12.1508 (12.22)***	358580.5 (4.68)***
Sex (X_1)	-93257.79 (-4.28)***	-0.4346186 (-3.62)***	-.4190437 (-3.67)***	-96340.2 (-4.14)***
Age (X_2)	-17239.08 (-0.31)	-0.0013254 (-0.17)	-.0453629 (-0.15)	-116.3454 (-0.08)
Marital Status (X_3)	-178046.2 (-5.24)***	-0.2564061 (-2.73)**	-.7217227 (-4.06)***	-73421.25 (-4.03)***
Household size (X_4)	-78802.97 (-3.13)***	-0.0548724 (-1.75)*	-.3659469 (-2.77)**	-7978.395 (-1.31)*
Educational level (X_5)	56132.52 (1.53)*	.2788574 (3.28)	0.4648269 (2.43)	39551.25 (2.39)
Farming experience (X_6)	53246 (2.93)**	0.0043685 (0.50)	0.206836 (2.18)**	1087.232 (0.65)
Farm size (X_7)	8641.171 (0.41)	-0.0458308 (-0.81)	-0.0063758 (-0.06)	-13171.26 (-1.20)*
R^2	0.2531	0.1702	0.2069	0.1924
F-value	11.23	6.80	8.65	7.89
No. of Observation	240	240	240	240

N/B: Values in parentheses are f-values,

Values without parentheses are coefficients.

***, **, * represent significant at 1%, 5% and 10% level respectively

Data Analysis Based on Field Survey (2024) using Stata 12.1 Programme

+ = Lead equation

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CONCLUSION

The results indicate that plantain production is dominated by males who are married with an age bracket of 31-50 years. Of the seven independent variables used in the analysis for the factors that influence pre-harvest losses of plantain, five were significant at different levels of probability, implying that an increase in the use of these variables will affect plantain profitability. Farmers were not fully efficient, hence, sucker, fertilizer, household size, and educational level were the variables that increased profit efficiency. Therefore, there is a need of government support in terms of revitalization and prioritizing funding of extension delivery system of the state owned Agricultural Development Programmes (ADPs). This will help to mobilize and motivate the extension agents to reach the targeted farmers with relevant information on improved farm management practices, and hence, reduce pre-harvest losses.

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