EFFECT OF WEATHER ADAPTATION MEASURES ON TECHNICAL EFFICIENCY AMONG PLANTAIN FARMERS IN AKOKO SOUTH-WEST LOCAL GOVERNMENT AREA, ONDO STATE, NIGERIA

Olapade-Ogunwole, Folayimi* and Akanbi Oluwafemi Nathaniel**

***Department of Agricultural Economics, Ladoke Akintola University of Technology Ogbomoso, Oyo State, Nigeria.**

****Department of Agricultural Economics, Ladoke Akintola University of Technology Ogbomoso, Oyo State, Nigeria.**

ABSTRACT

The study observed that weather measures has a significant impact on technical efficiency among plantain farmers in the study area and therefore recommended that more females should be encouraged to participate in plantain farming, farmers should be encouraged to appreciate education so as to enable them adopt improved adaptation measures and technologies. Government should also make greater investments in transportation infrastructure and storage facilities. The study examined the effects of weather adaption measures on technical efficiency among plantain farmers in Akoko Southwest local government area of Ondo State. The respondents were selected through a multistage sampling technique. A total of 105 respondent were selected and primary data was used, gathered through a well structured questionnaire. Three analytical techniques were employed for the study namely, descriptive statistics analysis, stochastic production frontier and double hurdle regression model.

The descriptive analysis result showed that about 61.9 percent were male. Majority of the farmers (34.3 percent) were within the age bracket of 31-40years. The average age of the respondents was 42 years; about 81.9 percent of the respondents were married; the mean household size was 5 members; the average farming experience was 13 years; the average farm size was 2.1 acres; 58.1 percent of them took plantain farming as their primary occupation 71.4 percent of the sampled plantain farmers practiced Christianity.

The study revealed that majority (60.0 percent) of the plantain farmers practices adaptation measures aimed at mitigating the effect of weather change on their technical efficiency with majority of them (93.3 percent) growing diverse varieties of plantain.

The estimates of the stochastic frontier production function for determinants of technical efficiency and inefficiency revealed quantities of land, suckers, fertilizer and pesticide, years spent in school, primary occupation and change in planting time were all statistically significant at 1%, 1%, 10%, 5%, 10%, 10% and 5% respectively.

The result of the double hurdle regression models showed that only primary occupation was significant determinant of adoption of weather adaptation measures by the farmers. Whereas of degree (extent) of adoption of weather adaptation measures, farming experience, primary occupation and total revenue were significant at 1%, 10% and 15% respectively.

The result of the study also revealed the major constants affecting plantain farming in the study area. The most common are non-availability) of storage facilities and markets with (56.2 percent) and (54.3 percent respectively). Other constraints faced by the farmers include storage of lab our or lack of capital, lack of equipment or high cost of irrigation facilities, lack of access to weather and climate forecast information and so on.

Keywords: Technical efficiency, Double hurdle regression model, Weather Adaptation measures, Plantain farmers

1. INTRODUCTION

Agriculture is the act of growing, processing and distribution of food and other products through intensive plant cultivation. An example of agricultural product is plantain which has been an important staple food for both the rural and urban populace in Nigeria for a very long time. Plantain belongs to the family Musaceae and can be used for cooking at any stage of ripeness. It has a lot of health benefits some of which are; the presence of vitamin C, it contains dietary fibre that helps regular bowel movements, it contains a high percentage of Vitamin A and are also rich sources of B-complex vitamins. Plantain is a multipurpose crop with great processing potential, it is the fourth most important food crop in the world after rice, wheat and maize and it is used as food and beverage (Philip *et al.,* 2009). Plantain has the potential to contribute to strengthening national food security and decreasing rural poverty (Adejoro*et al*., 2010). Plantain is a very versatile food in the kitchens as well as raw material for many delicacies and snacks (Aina*et al.,* 2012). It is called 'Ogedeagbagba' (Yoruba), Ayaba' (Hausa)

and 'Ogadejioke' (Igbo). Plantain capable of lowering cholesterol and helps to relieve constipation and hence prevention of raising blood pressure and muscle cramp.

Adaptation refers to the adjustments in ecological, social or economic systems in response to actual or expected climate stimuli and their effects or impacts which moderates harm or exploit beneficial opportunities. Adaptation also involves taking action to minimizes the negative effects of weather variability. Adaptation to weather remains the most popular options to manage the impacts of weather change of agriculture in the world today. Sowunmi and Akintola (2010) observed that th4e decline in crop yield and food production could be attributed to the reduction or changes in rainfall, increased temperature, increased relative humidity among others which are agents of weather. Adaptation to weather requires that the farmers perceive the changes in the prevailing weather conditions and then identify useful adaptation strategies. Fatuase*et al.,* (2015) reported that farmers' perception of weather change is a necessary prerequisites for adaptation. The effects of weather change on the environment, economy and social life of the people, most especially arable farmers' whose livelihood depends largely on rainfall cannot be overemphasized (Fatuase*et al.*, 2015). With these serious effects which weather change portends for arable crop production such a plantain, an understanding of the effects of weather and weather adaptation measures by farmers become necessary.

2. LITERATURE FRAMEWORK

Plantain consists of long, overlapping leafstalks and bears a stem which is 1.22 to 6.10 in high (Oladiji*et. al*, 2010), with a life span of about 15years. The fruits grow in clusters each

Separate plantain of the cluster being about 1 inch in diameter and somewhat longer than a banana fruit. Plantain fruit requires about two and a half to four months after shooting before the fruit becomes ready for harvesting or a total of about eight to twelve months after planting. According to Akinyemi et al., (2010), plantain production in Nigeria has witnessed a steady rise or more than 20 years. Some of the factor limiting the availability of plantaininclude; land, labor, storage, cultural practices, pests and diseases, post harvesting handling and unfavourableclimatic conditions. Plantain requires a hot humid environment and average air temperature of about 30^{O}_{C} and rainfall of at least 100mm per month for its optimum performance. Rainfall should be well distributed throughout the year and dry seasons should be as short as possible. A deviation

from the weather requirements will cause considerable impacts on plantain production. Efficient plantain production to a larger extent depends on the climatic requirements.

Weather/Climate Trend in Akoko South-West LGA Ondo State

Climate change has been observed in Ondo State over the years. This is evident in Babatolu (2014) research where he noticed that rainfall distribution in Ondo state during the period of (1961-2000) showed wide variability. The highest rainfall in the decade was recorded in 1963 (2,440.94mm) and the lowest was recorded in 1997 (1,217.10mm). Rainfall decreased generally between the period of (1991-2000) meaning that rainfall distribution along the axis of Ondo State is quite varied (Ikhilck and Aifesehi, 2001). Although Olaniran (2002), agreed that the likelihood of flooding around Ondo state regions is as a result of abundance of rainfall. He further explained the flooding is common in these areas in the month of July as evidence that the area is experiencing normal rainfall but not normal in its frequency. The temperature patterns vary widely in Ondo state ranging from 81.9Fin March which is regarded as the warmest to 75.0F in August which is regarded as the lowest temperature of the whole year.

The climate in Oka is tropical. In winter, there is much less rainfall in Oka Akoko than in summer.

3. RESEARCH METHODOLOGY

The study was carried out in Akoko southwest local government area of Ondo State whose capital is Akure.

Population of the study

The population of the study comprises all plantain crop farmer provided they were available, available, accessible and had a resident or farm located within the area.

Sampling Techniques and Size

For the purpose of the study, multi-stage random sampling procedure was adopted for the selection of the respondents. The stratification sampling procedure helped in avoiding selection bias. The first stage involved random selection of local government in Ondo state in which Akoko South-west and Oka town was considered. The second stage was based on random selection of two wards which was dominated by plantain farmers. Thirdly, 65 plantain farmers representing 1/3 of the farmers and 40 farmers representing ½ of the plantain crop farmers were sampled randomly from each of the two wards respectively. In all, a total number of 105 farmers were sampled for the study.

Method of Data Collection

The study used primary data that were collected through structured questionnaire from a cross section of plantain farmers. Data that were collected included input-output data, socio-economic factors weather change adaptation strategies used by farmers, technical efficiency level adopted in plantain production, effects of weather change and other relevant information.

4. RESULTS AND DISCUSSION

Technical Efficiency of the Respondents

Table 1 revealed the technical efficiency of the respondents in the study area. The technical efficiency indices range from 24-93 percent for the plantain farm. The average technical efficiency in the study area was 71 percent. The implied that for the average farmers to achieve the technical efficiency of its most efficient counterpart, then the farmer could realize a 24 percent cost saving, (1.71/93).For the most technically inefficient farmer, then he has to achieve a 74 percent cost saving (1-24/93), to become the most efficient farmer. The result corroborated the findings of Iheke (2008) where the average technical efficiency was 77percent.

Table 1: Distribution of technical efficiency

Efficiency (%)	Technical efficiency
>00	11
86-90	11
81-85	12

76-80	18
71-75	12
66-70	13
61-65	3
56-60	4
51-55	8
46-50	2
41-45	5
36-40	1
31-35	4
<30	1
Mean (%)	71
Minimum (%)	24
Maximum (%)	93

Source: Field survey, 2019.

Weather Adaptation Measures

Table 2 showed various adaptation measures practiced by the plantain farmers in the study area in order to mitigate the negative effect of weather on plantain production and thus revealed that 93.3 percent of them grows diverse varieties of plantain species. 89.5 percent of them grows varieties of short plant duration, 65.7 percent of them grows flood tolerant varieties of plantain 63.8 percent grows drought tolerant varieties, 59.1 percent of them were using irrigation for their production, 57.1 percent of them were using farmyard manure, 53.3 percent of them increased their usage of pesticides, 47.6 percent of them grows diseases/per resistant varieties, 45.7 percent of them were practicing frequent weeding of their plantain farm, 44.7 percent of them were using fertilizers. 39.1 percent of them adopted diverse planting methods for their production, 37.1 percent of them change their planting and harvest time of their produce and 20.0 percent of them of them left their farm to cultivate on another.

Table 2: Weather adaptation measures available to the respondents in the study area

Adaptation practices	Frequency	Percentage
Grow diverse varieties	98	93.33
Grow drought tolerant varieties	67	63.81
Grow flood tolerant varieties	69	65.71
Grow disease/pest resistant varieties	50	47.62
Grow short duration varieties	94	89.52
Grow less water intense varieties	47	44.76
Change planting location	21	20.00
Change planting/harvesting time	39	37.14
Change planting methods	41	39.05
Irrigation practice	62	59.05
Reduce tillage	47	44.76
Use of fertilizer	42	40.00
Frequent weeding	48	45.71
Increased used of pesticides	56	53.33
Use of farm yard manure	60	57.14

Source: Field survey, 2019.

Level of Technical Efficiency Among Plantain Farmers

Determinants of Technical Efficiency and Inefficiency Among Plantain Farmers Using Stochastic Production Frontier

Table 3 the maximum likelihood parameters estimates of the stochastic frontier production function. Quantities of land, sucker, fertilizer, pesticides were all significant in the efficiency model. Quantities of land a negatively related to technical efficiency implying a unit decrease in land resource used plantain farming decreases the technical efficiency by -36.7 percent. The result is significant at 1%.

Sucker is positively related to technical efficiency indicating a unit increase in plantain sucker will increase the rate of technical efficiency. This result is significant at 1%. More so, fertilizer is negatively related to technical efficiency implying a unit increase in the use of

fertilizer on plantain farms in the study area decreases the technical efficiency by -5.7 percent. This is not in line with apriori expectation but the result is significant at 10%

Also, pesticides is positively related to technical efficiency implying an additional use of pesticides on plantain farms in the study area increases the technical efficiency by 8.7 percent. The result is significant at 5%.

Meanwhile, from the technical inefficiency model; Years spent in school is positively related to technical inefficiency implying farmers with more years of education exhibited higher level of technical inefficiency by 10.9 percent. This is not in accordance with apriori expectation but the result is significant at 10%.

Nevertheless, primary occupation is negatively related to technical inefficiency implying primary occupation reduces technically inefficiency of plantain farmers by -105.2%. In other words, respondents who practice plantain farming as major occupation are more likely to experience reduction in technical inefficiency by -105.2%. The result is significant at 10%.

Lastly, change in planting time is positively related to technical inefficiency implying change in the planting time of plantain sucker due to weather effect increases the technical inefficiency by 139.2 percent. This is also not in line with apriori expectation but the result is significant at 5%.

Table 3: Determinants of technical efficiency and inefficiency among plantain farmers

Explanatory variables	**Coefficients**	**Standard Errors**	**Z-value**	**P>|z|**
Constant	5.089719	0.2013965	25.27	0.000
Land size	-0.3669102	0.0529257	-6.93***	0.000***
Labor	0.0162712	0.0154154	1.06	0.291
Total cost of labor	1.23e-06	2.84e-06	3.55***	0.665
Sucker	0.000338	0.0000953	1.70*	0.000***
Fertilizer	-0.0569185	0.033413	2.01**	0.088*
Pesticide	0.0871535	0.0434074	-0.98	0.045**
Age group	-0.0193499	0.0198373		0.425
Inefficiency model				

Constant	-1.838015	1.98959	-0.92	0.356
Sex	0.0246827	0.562316	0.04	0.965
Years spent in school	0.1092642	0.0565299	1.93*	0.053*
Household size	0.1576065	0.1435925	1.10	0.272
Primary occupation	-1.051948	0.6057647	-1.74*	0.082*
Adaptation practices	0.2122481	0.681409	0.31	0.755
Rate of adoption	-1.747834	1.56252	-1.12	0.263
Change in planting time	1.391875	0.6763559	2.06*	0.040*
Sigma square	0.456654	0.0714053	0.33	0.620
Log likelihood = -87.038978				
Number of observation = 105				
Wald chi 2(6) = 59.07				
Prob > chiz = 0.0000				

N.B: ***1% significance, ** 5% significance, *10% significance

Source: Field survey, 2019.

Estimates of the First Hurdle Probit Model

The result in the first hurdle presents the determinants of adoption of weather adaptation measures. It reveals that plantain farming as a primary occupation is significant in influencing the adoption measures. The log likelihood for the fitted model was – 31.518923 indicating the parameters are jointly significant at 5%.

Therefore, primary occupation and the age of the farmer has a positive and significant relationship with adoption of weather adaptation measures by the farmers in the study area implying primary occupation and age increases the adoption of weather adaptation measures by 63.5%. In other words. Farmers who practices plantain farming as primary occupation and who are more mature are more likely to adopt weather adaption measures with the rate given by the percentage.

Table 4: Determinants of the adoption and degree (extent) of adoption of weather adaption measure

Explanatory variables	Coefficients	Standard Errors	Z-value	P>|z|
Adoption				
Constant	0.327304	0.7278315	0.45	0.653
Age group	0.0110929	0.0109615	1.01	0.312
Household	0.023147	0.0805212	0.29	0.774
Farming experience	-0.0225226	0.0175434	-1.28	0.199
Farm size	0.0451669	0.1297242	0.35	0.728
Primary occupation	0.6344827	0.3152589	2.01**	0.044**
Total revenue	-1.22e-06	1.00e-06	-1.22	0.223
Extent of Adoption				
Constant	0.5427739	0.1091412	4.97	0.000
Farming experience	-0.0111813	0.0029023	-3.85***	0.000
Farm size	-0.0041893	0.0161638	-0.26	0.795
Age group	-0.0004887	0.0016363	-0.30	0.765
Household size	0.01414	0.0133992	1.06	0.291
Primary occupation	0.0815203	0.0502916	1.62*	0.105*
Total revenue	3.98e-07	1.59e-0.7	2.50***	0.012***
Log likelihood = -31.518923				
Number of observation = 105				
Wald chi 2(6) = 5.85				
Prob > chiz = 0.4402				

N.B: ***1% significance, ** 5% significance, *10% significance
Source: Field survey, 2019.

Effect of Adaptation Measures on Technical Efficiency

Table 5 showed various effects of adaptation measures on technical efficiency of plantain production in the study area. Hence, the technical efficiency of planting of multiple crop varieties was at 5.3 percent, the technical efficiency of growing diseases resistant varieties of plantain was at 3.3 percent, organic manure application was at 29.5 percent, irrigation practices was at 25.7, tillage was at 24.8 percent. Fertilizer application was at 16.2 percent, mulching was at 15.2 percent, shading was at 13.3 percent and technical efficiency on cover cropping was at 7.6 percent.

Table 5: Effect of adaptation measures on technical efficiency

Adaptation Measures	HI	MI	SI	NI	NP
Multiple crop varieties	57(54.29%)	22 (20.95%)	17(16.19%)	2 (1.9%)	7 (6.67%)
Tillage practices	56 (24.76%)	38 (36.19%)	20(19.05%)	5 (4.76%)	16 (15.24%)
Shading	14 (13.33%)	18 (17.14%)	4(3.81%)	2(1.90%)	67(63.81%)
Disease resistant varieties	36 (34.29%)	25 (23.81%)	14(13.33%)	2 (1.90%)	28 (26.67%)
Cover cropping	8 (7.62%)	3 (2.86%)	19(18.10%)	9 (8.57%)	66 (62.86%)
Organic manure app	31 (29.52%)	19 (18.10%)	1(0.95%)	2 (1.90%)	52 (49.52%)
Fertilizer application	17 (16.19%)	22(20.95%)	4(3.81%)	5 (4.76%)	57 (54.29%)
Mulching	16 (15.24%)	18 (17.14%)	7 (6.67%)	4 (3.81%)	60 (57.14%)
Irrigation practices	27 (25.71%)	22 (20.95%)	12 (11.43%)	3 (2.86%)	41 (39.05%)

Source: Field survey, 2019.

Constraints Associated with Plantain Farming

Table 6 showed various constraints farming in the study area and it revealed that non availability of storage facilities and market are the most common constraints with (56.2 percent) and (54.3 percent), respectively. Other constraints faced by the farmers include shortage of labor or lack of capital (8.6 percent), lack of equipment or high cost of irrigation facilities (2.0 percent), lack of access to weather and climate forecast information (39.5 percent), poor access to and control of land, tedious nature of adaptation strategies (35.2 percent), illiteracy (34.3 percent), inadequate coping knowledge (29.5 percent), poor access to adequate strategies (28.6 percent) lack of government support (24.8 percent) and lastly problem of religious belief of the farmers 12.4 percent).

Table 6: Constraints associated with plantain farming

Constraints	Very High	High	Law	Very-Law
Shortage of labor	51(48.57%)	37 (35.24%)	15 (1.24%)	2 (1.9%)
Equipment	43 (40.95%)	37 (35.24%)	9 (8.57%)	16 (15.24%)
Lack of capital	51 (48.57%)	43 (40.95%)	2 (1.9%)	9(8.57%)
Lack of Government support	26 (24.76%)	11 (10.48%)	40 (38.10%)	28 (26.67%)
Market	57 (54.29%)	23 (21.90%)	19 (18.10%)	6 (5.71%)
Illiteracy	36 (34.29%)	24 (22.86%)	13 (12.38%)	32 (30.48%)
Poor access to adequate strategies	30 (28.57%)	50 (47.62%)	12 (11.43%)	3 (2.86%)
Tedious nature of adaptation strategies	37 (35.24%)	50 (47.62%)	12 (11.43%)	6 (5.71%)
Inadequate coping knowledge	31 (29.52%)	49 (46.67%)	15 (14.29%)	10 (9.52%)
Poor access to and control of land	39 (37.14%)	44 (41.90%)	8 (7.62%)	14 (13.33%)
High cost of Irrigation facilities	43 (0.95%)	34 (32.38%)	10 (9.52%)	18 (17.14%)
Religious belief of farmers	13 (12.38%)	19 (18.10%)	21 (20.00%)	52 (49.52)
Non availability of stage facilities	59 (56.19%)	28 (26.67%)	14 (13.33%)	4 (3.81%)
Lack of access to weather and climate forecast information	41 (39.05%)	42 (0.00%)	15 (14.29%)	7 (6.67%)

Source: Field survey, 2019.

5. CONCLUSION

Based on the result of findings deduced from this study, conclusions were drawn as follows: Majority of the respondents are still their productive age. Male were more involved in plantain farming than female in the study area. Majority of the respondents were married. The respondents constituted moderate household size in the study area. Majority of the respondents attained tertiary education qualification. Most of the respondents are experienced farmers and cultivate on considerable farm size. A larger percentage of the respondents practice Christianity. Majority of the sampled respondents are primarily plantain farmers and used adaptation measures against weather effect on their production. Also, majority of the sampled plantain farmers are technically efficient.

Furthermore, the estimates of the stochastic frontier production function reveals quantities of land, sucker, fertilizer, and pesticide, years spent in school, primary occupation and change in plantain time are all statistically significant for the determinants of technical efficiency and inefficiency of plantain farmers.

Also, the result of first hurdle probit model shows that primary occupation determines the adoption of weather adaptation measures. Meanwhile, primary occupation, farming experience and total revenue determine the degree of adoption of weather adaptation measures.

Finally, most of the plantain farmers' encountered constraint which includes; non-availability of storage facilities and market, shortage of labor, lack of capital, lack of equipment high cost of irrigation facilities, lack of access to weather and climate forecast information, poor access to and control of land, tedious nature of adaptation strategies, illiteracy, inadequate coping knowledge, poor access to adequate strategies, lack of government support and lastly problem of religious belief of the farmers.

REFERENCES

[1] Adejoro, M.A., Fagbola, B.O. and Odubanjo, A.O. (2010): Research focus on banana and Plantain (*musa spp*). *Nigerian perceptive Actachorticulture* 879 – 859.

[2] Aina, O.S., Ajilola, S., Bappah, M. T., Ibrahim, I and Musa, I.A. (2012): Economic Analysis of plantain marketing in Odigbo local government. G*lobal Advanced research journal of Agricultural science.* 1(4): 104 – 109.

[3] Akinyemi, S.O.S., Aiyelaagbe, I.O.O and Akyeampong, E. (2010): Plantain (*musa spp*) cultivation in Nigeria: a review of its production, marketing and research in the last two decades. Actallortic. 879 p. 211 – 218.

[4] Babatolu, J.S. Akinnubu, R.T.and Eregha, P.B (2014): Economic analysis of plantain production in Derived Savannah zone of Osun state, Nigeria. *Asian Journal of Agricultural Sciences* 3(5). 401 – 407.

[5] Fatuase, A.I., Aborisade, A.S., and Omisope, E.T (2015): Determinants of Adaptation measures to climate change by Arable crop farmers in Owo local government area of Ondo state Nigeria. World Rural observations, volume 7 number 1 pp. 1 – 9.

[6] Ikhilek, C.I. and Aifesehi P.E.E. (2011): geographical distribution of average monthly rainfall in the western section of Benin-Owena River Basin, Nigeria, African Research Review 5(4):493 – 500.

[7] Oladiji A.F., Idoko, A.S., Abodunrin T.P. and Yakubu, M.T. (2010): Studies on the physiochemical properties and fatty acid composition of the oil from ripe plantain peel *Journal of African Earth Science*. 2(1):73 – 78.

[8] Olaniran O.J. (2002): Rainfall anomalies in Nigeria, the contemporary understanding, inaugural lecture at university of Ilorin pp. 32.

[9] Philip B., Shittu, A.M. Aiyelagbe, I.O.O. and Adedokun, T. (2009): Economic potentials of plantain and fluted pumpkin intercropping as a poverty reduction strategy in Southwestern Nigeria. *World Journal of Agricultural Science* 63: 240 – 250.

[10] Sowunmi, F.A. and Akintola, J.O. (2010): Effects of climate variability on maize production on Nigeria. *Research Journal of Environmental Science* 2(1):19 – 30.