Effect of Poverty Diseases and Adaptive Capacities to Climate Change On Farmers' Incomes Along River Niger in Edo and Kogi States, Nigeria.

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ABSTRACT
Climate variability also has the potential to worsen existing vulnerabilities such as Malaria, HIV/AIDS and Tuberculosis. This study examined the effects of poverty diseases and adaptive capacities to climate change on farm income along river Niger in Edo and Kogi States, Nigeria. Questionnaires were collected from 358 respondents using multistage sampling techniques from Edo and Kogi States. Descriptive statistics and different functional forms of ordinary least squares (OLS) were used as analytical tools. The results revealed that increase in farm size and age will lead to 1.27% and 1.83% increase in farmers' income respectively. The major constraints identified by the respondents were lack of funds and credit challenge (94.40%), distance to health centres (93.90%) and access to freshwater supplies (82.70%). It was concluded that the majority 83.80% of respondents had malaria diseases. The study recommends that to reduce the effect of poverty disease, there is a need for policy makers to engage communities when making decisions relating to their health.

INTRODUCTION

Poverty is a major cause of diseases and a barrier to accessing health care when needed according to the World Health Organisation (WHO, 2020). Poverty diseases are closely tied, with each factor aiding the other (Stevens *et al.,* 2016). This relationship is financial, i.e. the poor cannot afford to purchase those things that are needed for good health, including sufficient quantities of good quality food and health care. Disease, in most cases, can also cause poverty. This is partly due to the costs of seeking health care, which includes not only out-of-pocket spending on care (such as consultations, tests and medicine), but also transportation costs and any informal payments to health care providers which can reduce farmers' scarce resources (Bennett *et al.,* 2019). Poverty disease is a term sometimes used to collectively describe diseases, disabilities and health conditions that are more prevalent among the poor than among wealthier people. In many cases, poverty is considered the leading risk factor or determinant for such diseases and in some cases, the diseases themselves are identified as barriers to economic development that would end poverty (Singh *et al.,*2018). At the global level, there are three primary poverty-related diseases (PRDs) acquired immune deficiency syndrome (AIDS), malaria and tuberculosis (TB). Developing countries account for 95% of the global AIDS prevalence, 98% of active tuberculosis infections and 90% of malaria deaths occur in sub-Saharan Africa (WHO, 2020). Diseases of poverty kill approximately 14 million people annually (Stevens *et al.,* 2016). For example, malaria attacks an individual on average of four times in a year with an average of 10 to 14 days of incapacitation in Africa (Ekemhonye, *et al.*,2020). On a global perspective, between 400 and 900 Million of children under the age of five experience acute malaria annually in this malaria endemic region and this number may 1 UNDER PEER REVIEW double by year 2020 if effective control measures are not implemented (Multilateral Initiative on Malaria, 2018). In 2017, an estimated US$ 3.1 billion was invested in malaria control and elimination efforts globally by governments of malaria endemic countries and international partners (WHO, 2020). The most serious threats facing human health today are deeply complex. The issue of poverty is also at the roots of the diseases in Africa (Ekemhonye, *et al.*,2020). Poverty impacts on self-treatment, health seeking behaviour and capacity for disease prevention at home and community level. In the public sector, poverty generates underdeveloped health services, with poor quality of care and low coverage of the population, which in some countries may be as low as 30-40 percent. Poverty diseases, therefore, have a direct impact on farmers' incomes, wealth, labour productivity and labour market participation of both the sick and the caregivers (Ajani *et al.*, 2018). In Nigeria, poverty diseases, such as malaria, constitute serious economic burdens to households through incapacitation and diversion of vital households' productive resources to treatment of the sick (Ugbomoiko, 2018). Global warming is likely to increase disease, death and injury from heat waves, floods, storms, drought, and fire, which expand the geographic range of malaria, HIV/AIDs and TB in the poor countries of the world (Oluyole *et al.*, 2017). Gaps in knowledge of climate and health research is still in a rather primitive stage and many of the direct and indirect health effects of climate change in the region have not been fully identified or understood. Hence, although a lot is known about the science of climate change, there remain many uncertainties of its potential impact on health. (Intergovernmental Panel on Climate Change. IPCC, 2020). Yet, this message has failed to penetrate public discussions on climate change and health policies. At the moment, few studies that have considered diseases and climate change were at global perspective or regional aggregates. This research has focused on two States along River Niger in Nigeria for easy use by policy makers. Thus, the study is expected to add to the scanty knowledge in this area of research. There is the need to investigate farmers' perception of climate change in the study areas and the various adaptation measures taken to mitigate the effect of poverty diseases.

MATERIALS AND METHOD

Area of Study

The study was conducted in two of the states along river Niger in Nigeria. The selected states are Edo and Kogi. Edo State has a total land area of 19,794 km^2 and a population of 3,745,253 National Population Commission (NPC) projection, 2018. It lies approximately between Latitudes 05º44ʽN and 07º34ʽN and Longitudes 05º04ʽE and 06º43ʽE. Average rainfall in the state ranges between 1,500 mm at the extreme north of the state and 3,500 mm in the south. Temperature averages are 25ºC in the rainy season and 28ºC in the dry season (Edo State Agricultural Development Programme, 2010). Kogi State is located in the north-central zone of Nigeria; it has a total land area of 29,833 km^2 with a Population size of 3,777,825 National Population Commission (NPC) projection, 2018. It lies on latitude 7º 49ʽN and longitude 6º 45ʽE with sedimentary rocks and alluvium along the river beds which promote agricultural activities. The state has an average maximum temperature of 33.2ºC and average minimum temperature of 22.8ºC. Kogi state has two distinct seasons, dry season lasts from November to February and rain season lasts from March to October. Annual rainfall ranges from 1016mm to 1524mm. (Kogi State Agricultural Development Programme, 2012).

Sampling Procedure

The multi-stage sampling technique was used for the study. Edo and Kogi state are located along river Niger. The first stage was the purposive selection of three farming Local Government Areas from each of the State. The Local Government Areas that were selected in Edo State are Etsako East, Etsako central and Esan south while Kogi, Lokoja, and Bassa Local Government Areas were selected from Kogi State. The L.G. As were purposely selected because they constitute centres of intensive agricultural activities along river Niger. The second stage was the random selection of 2 villages per Local Government Area using a balloting method, giving a total of 12 villages. The third stage was the random selection of 358 farmers based on the sampling frame of farm households obtained from the State's ADPs. The sample selection was based on the Yamane sample selection model at 5% precision level and 95% confidence limit (Yamane, 2013). The model was employed to select respondents across villages premised on the population of each village.

$$n = \frac{N}{1 + N(e)^2} \qquad (1)$$

Where:

n = the sample size,

N = the population size,

e = the level of precision.

Method of Data Collection

Data for this study were collected from primary sources. The data were obtained through administration of questionnaire to elicit information from the respondents on the socio-economic characteristics of the farmers such as age, marital status, gender, education, household size, farming experience, farmland size, the extent of awareness of poverty diseases, annual income, types of treatment used and various adaptation measures to poverty diseases. The researcher was assisted by trained enumerators from the State's Agricultural Development Programme to carry out data collection.

Methods of Data Analysis

Objectives were achieved using descriptive statistics tools such as, mean, frequencies, percentages and using different functional forms of ordinary least squares (OLS) the effect of poverty diseases and adaptive capacities to climate change on respondents' incomes (Y). The functional form double log, linear, exponential and semi log that produces the best fit was chosen as a lead equation in the analysis. The total income of the respondents represents the dependent variable i.e. Y.

The implicit function is thus stated in Equation (2);

$$Y=f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, X_{14}, X_{15}, X_{16}..u) \qquad (2)$$

Where,

Y = Total respondents' income (Naira)
X_1 = Age (Years)
X_2 = Education (Years)
X_3 = Farm size (Hectares)
X_4 = Fertilizer (Kilogram)
X_5 = Amount of seeds (Naira)
X_6 = Labour (Man-day)
X_7 = Cost of treatment of poverty disease (Naira);
X8 = Gender (male =1, female =0)
X_9 = Marital status (Married=1,0 otherwise)
X_{10} = Distance to health centres (Kilogram)
X_{11} = Distance from farm to market (Kilogram)
X_{12} = Days absent from work (hour)
X_{13} = Irrigation (hectares)
X_{14} = Low adaptive capacities (Dummied 1 and 0 otherwise);
X_{15} = Moderate adaptive capacities (Dummied 1and 0 otherwise).
X_{16} = High adaptive capacities (Dummied 1 and 0 otherwise).
U = Error term

Four functional forms of OLS regression were tried and the lead equation identified. The dependent variable was total income of respondents' in naira while independent variables were age, education, farm size, fertilizer, seeds, labour, amount spent on poverty disease, gender, marital status, distance to health centres, distance from farm to market, days absent from work, irrigation, low adaptive capacities, moderate adaptive capacities and high adaptive capacities.

The double log functional form was chosen as the lead equation and used in the discussion of the result. This was done due to the following criteria: goodness of fit of the functional form, based on the value of the coefficient of multiple determination (R^2), signs of regression coefficients, significance of t-values and magnitude of F-ratio. The other results are in the appendix.

RESULTS AND DISCUSSION

The result in Table 1 revealed that, the value of coefficient of multiple determination (R^2) was 0.5071 which implies that 50.71% variation in the respondents' incomes was explained by the explanatory variables included in the model. The F-statistic indicates that the overall regression is significant at $p<0.01$ meaning that the independent variables jointly affected income.

The results also revealed that age had a coefficient estimate of 1.83 and significant at $P< 0.01$, thus implies that a year increase in age will lead to increase in respondent income by 1.83%. This is agreeing with a priori expectation since all the independent variables were expected to bear positive signs. This finding was in agreement with Defiesta (2014), who reported that older farmers have greater years of experience in farming which is highly correlated with the level of knowledge and skill related to farm income.

Farm size was significant at $p<0.01$ level, which implies that a unit increase in hectare of farm land would result in an increase in respondents' incomes by 1.27%. This finding is in line with Defiesta (2014), who reported that farmers with large landholdings stand a better chance of diversifying their farming practice to adapt to climate change than those with small landholdings

Furthermore, distance to health centres was significant at $p<0.05$ with coefficient of 0.019. This implies that 1₦ increase in transport to health Centre's will lead to increase of

Table 1: Estimates of Effect of Poverty Diseases and Adaptive Capacities to Climate Change on Respondent's Incomes.

Variable	Pooled	Edo State	Kogi State
Constant	20.008 (5.45)***	20.548 (3.65)***	19.343 (3.66)***
Age (Year)	1.825 (5.62)***	1.688 (3.40)***	1.812 (3.89)***
Education (Year)	0.043 (0.76)	0.049 (0.60)	0.040 (0.49)
Farm size (Ha)	1.265 (13.05)***	1.181 (9.43)***	1.244 (8.93)***
Cost of Seeds (₦)	0.051 (0.77)	0.025 (0.26)	0.114 (1.14)
Fertilizer (Kg)	0.144 (0.17)	0.111 (0.09)	0.228 (0.19)
Labour (man-day)	0.369 (1.23)	0.209 (0.46)	0.320 (0.73)
Cost of treatment (₦)	-0.029 (-0.90)	-0.040 (-0.87)	-0.028 (-0.59)
Low adapter	-0.230 (-0.97)	-0.507 (-0.73)	-0.148 (-0.43)
High adaptive	0.044 (0.20)	-0.144 (-0.48)	0.093 (0.30)
Gender	0.155 (0.70)	-0.106 (-0.40)	0.137 (0.43)
Marital status	-0.283 (-1.58)	-0.013 (-1.09)	-0.214 (-0.81)
Distance to health centres (Km)	0.019 (2.34)**	-0.011 (-0.56)	-0.027 (-2.34)**
Distance from farm to market (Km)	0.027 (1.94)*	0.004 (0.27)	0.041 (2.06)**
Days absent from work (hour)	-0.101 (-1.94)*	0.365 (0.77)	-0.143 (-1.93)*
Irrigation (hectares)	-2.93e-07 (-0.73)	-0.106 (-0.40)	-2.17e-07 (-0.38)
R^2	0.507	0.492	0.516
Adjusted R^2	0.486	0.449	0.471
F-ratio	23.460	0.000	0.000

*T-values are in parenthesis, *p<0.10 level of significant, **p<0.05 level of significant and ***p<0.01, level of significant. Source: Field survey, 2020*

respondent incomes by 0.019%. This agrees with a priori expectation that distance to the health Centre has a positive relationship with income.

The result also shows that days absent from work were significant at $p<0.05$, which implies that an increase in the number of days absent from work will lead to decrease in income of treatment of poverty diseases and adaptive capacities to climate change by 1.94%. The loss of work days as a result of malaria illness had accounted for decline in farm outputs reported

(Alaba & Alaba, 2018). The implication of this finding is that poor health status and climate change closely affects the productive capacity and income of respondents in the study areas.

Furthermore, result in Edo State reveals coefficient of multiple determination (R^2) was 0.4920 which imply that 49.20% variation in the respondents' incomes was explained by the explanatory variables included in the model. The F-statistic indicates that the overall regression is significant at $p<0.01$ meaning that the independent variables jointly affected income. The results also revealed that age had a coefficient estimate of 1.69 and positively significant at $p<0.01$, thus implies that a year increase in age will lead to increase in respondent income by 1.69%. with a priori expectation since all the independent variables were expected to bear positive signs.

The result in Kogi State also indicated that, the coefficient of multiple determination (R^2) was 0.5160 which imply that 51.6% variation in the respondents' incomes was explained by the explanatory variables included in the model. The F-statistic also affirmed that the overall regression is significant at $p<0.01$ meaning that the independent variables jointly affected income. The results revealed that age had a coefficient estimate of 1.81 and positively significant at $p<0.01$, thus implies that a year increase in age will lead to increase in respondent income by 1.81%. with a priori expectation since all the independent variables were expected to bear positive signs.

The result also found out that days absent from work had a coefficient estimate of 0.14 and was negatively significant at $p<0.10$ implies that an increase in hours of days absent from work will lead to decrease in farm income by 0.14%. Similar findings had been reported by Alaba and Alaba (2018). This shows how terrible diseases are to the well-being of farmers as they cannot work or command any economic value during those days which may reduce farmers' income.

The results further revealed that distance to health centres had a coefficient estimate of 0.027 and negatively significant at $p<0.05$, thus implies that a kilometre increase in distance to health centre will lead to decrease in respondent income by 0.027%. This finding could be as a result of an increase in cost of transportation because of bad roads in the areas coupled with distances from health centres to respondents' residents. This was not in agreement with a priori expectation since all the independent variables were expected to bear positive signs.

The results further revealed that distance from farm to market is positively significant at $p<0.05$, thus implies that a kilometre increase in distance from farm to market will lead to increase in respondent income by 0.041%. This finding could be as a result of proximity of market to farmland, which enables them save their cost of transporting goods and service from farm to market.

Respondents' Constraints to Poverty Diseases and Climate Change Adaptation Strategies

The distribution of respondents' constraints to poverty diseases and climate change adaptation strategies in the study area is presented in Table 2. The results from pooled data reveals that several challenges to respondents' poverty diseases and climate change adaptation strategy were identified. Among challenges identified inadequate funds and credit challenge (94.40%) had the highest, followed by distance to health centres (93.90%), Inadequate access to information on climate change through extension services (84.40%) and access to freshwater supplies (82.70%). The findings are in line with Nwalieji (2016) who affirmed that farmers need loans to invest in quality inputs; training and information to increase production and meet quality standards.

Respondents in Kogi State had a higher rate of funds and credit challenge (98.30%) compared to Edo State (90.60%). The challenge of long distance to health centres was also higher in Edo State (94.40%) compared to Kogi State (93.20%). Inadequate access to information on climate change through extension services and access to freshwater supplies were also higher in Kogi State (89.40% and 87.00%) than Edo State (78.90% and 78.30%). However, pest and disease incidence were higher in Edo State (84.80%) because of high relative humidity, compared to Kogi State (77.30%). Similarly, cost of health care service and poor health care facilities were more serious in Kogi State (80.50% and 74.10%) than Edo State (78.20% and 71.60%). These findings imply that there are numerous constraints to adaptive capacity to poverty, diseases and climate change. The serious ones identified are almost the same in the two states compared. These results corroborate with the position of Ayanwuyi, *et al*., (2019) on the challenges facing the agricultural sector in Nigeria.

Table 2: Constraints to Poverty Diseases and Climate Change Adaptation Strategies.

Constraints	Pooled (n=358)	Edo State (n=180)	Kogi State (n=178)
Inadequate of funds and credit challenge	338(94.4)	163(90.6)	175(98.3)

Distance to health centres	336(93.9)	170(94.4)	166(93.2)
Inadequate information on climate change through extension services	301(84.1)	142(78.9)	159(89.4)
Access to freshwater supplies	296(82.7)	141(78.3)	155(87.0)
Cost of health care service	286(79.9)	141(78.2)	145(80.5)
Inadequate information about poverty diseases	276(77.1)	124(68.9)	152(85.4)
Increase spread of pests and diseases	290(81.0)	151(84.8)	139(77.3)
Poor sanitation	280(78.2)	129(71.6)	151(84.8)
Deteriorating state of farm road to the market centre's	268(74.9)	134(74.5)	134(75.3)
Conservative attitudes of farmers towards adoption of innovation	267(74.6)	128(71.1)	139(78.1)
High cost of farm inputs	267(74.6)	124(70.5)	143(80.3)
Poor health care facilities	261(72.9)	129(71.6)	132(74.1)
Inadequate access to modern farm tools	243(67.9)	117(65.0)	126(70.8)
Inadequate access to market facilities	238(66.5)	114(63.4)	124(69.7)
Frequent occurrence of erosion /wind storm	221(61.7)	111(61.6)	110(61.8)
Inadequate/scarcity of suitable land for cultivation	215(60.1)	98(54.5)	117(65.7)
Inadequate access to meteorological forecast	211(58.9)	118(65.6)	93(52.2)
Inadequate training on climate change variation	202(56.4)	99(60.6)	103(57.7)
Inadequate storage facilities	165(46.1)	87(50.0)	78(43.8)
Traditional land tenure system	156(43.6)	80(44.4)	76(42.6)
Instability in planning/harvesting calendar	117(32.7)	66(38.3)	51(28.6)
Shortage of water	109(30.4)	60(33.2)	49(27.5)
Withdrawal of labour force to less climate risk ventures	80(22.3)	53(29.5)	27(15.2)

Values in parenthesis are percentages. Source: Field Survey, 2020.

CONCLUSION

Based on the empirical evidence emanating from this study, it was concluded that age, farm size, distance to health centres, distance from farm to market and days absent from work were the variables affecting farmers' income in the study areas. The results also identified twenty-three major constraints to poverty diseases and climate change adaptation strategies in the study areas. the study recommended that policy makers should provide basic amenities for respondents residing along river Niger communities, such as health care Centre, markets, as well as access to farmland, to reduce challenges of income spent on traveling distance by respondents

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