

Analysis of Efficiency and Effect of Climate Change on Periwinkle Harvesters in South-South, Nigeria

*Eteyen E. Nyong; and Glory James

*Department of Agricultural Economics ,Akwa Ibom State University, Nigeria

Eenyomg16@gmail.com

Abstract

This study examines the analysis of efficiency and effect of climate change on Periwinkle Harvesters in Akwa Ibom State. The objectives were to assess the socioeconomic characteristics of the periwinkle harvesters, determine technical efficiency of periwinkle harvesters, determine the effect of climate change on periwinkle harvesters. Analytical methods used included, descriptive statistics, four - point likert scale and multiple regression. The results showed that majority of periwinkle harvesters were female (63%), 46.30% of the respondents were married, 42.59% were single and 11.30 % were divorced. A total of 55% had secondary education, 28.8% had primary education and 16.3 % had no formal education. Majority of the respondents engaged in periwinkle harvesting as their major occupation, 47.4% earned above the mean income level of 36,962.50. From the results, handpicking was the most commonly used method of harvesting. The respondents were all aware of the existence of climate change but only a few of them had knowledge about the nature of effect, climate change has on harvesting. From the findings the major constraints faced by the harvesters was sea rise and presence of predators, like snake. The results of the perceived effect of climate change on periwinkle output showed that the salt content of the sea has no effect on the quantity of periwinkle harvested. Furthermore, the result showed that an increase in rainfall leads to decrease in the catch rate of periwinkle. For sea rise, the result of the yes category compared to the base category, showed that from the harvesting experience of the respondents, the quantity of periwinkle harvested increases as the sea rises. While the "No" category, compared to the base category showed that rise in sea level has no effect on the quantity of periwinkle harvested. The study recommends, amongst others; that policy makers and NGOS should create an awareness on the nature of the effect of climate change on periwinkle harvesting.

Key Words: Periwinkle, Harvesters, Efficiency, Climate Change,

Introduction: Agriculture is at the center of the economy, providing the main source of livelihood for the majority of Nigerians. Agriculture in Nigeria is the foundation of the economy as it keeps the people stable in what they do Nyong, &Nweze, 2012), (Megan, 2018). According to CIA (2012) Agriculture contribute 40% of the Gross domestic product (GDP) and employs about 70% of the working population in Nigeria. Agriculture is also the largest economic activity in the rural area where almost 50% of the population lives. Fisheries is an important sector of agriculture that contributes about 3.00-5.00% to the agriculture share of the Gross domestic product. Nigeria is a Maritime nation with a vast population of over 160 million people and a coastline measuring approximately 853 kilometers. Fish production as an enterprise in this country possesses the capacity to contribute significantly to the agricultural sector (Osagie, 2012) ,Nyong, &Nweze, 2012). Therefore, the maintenance and sustainability of the life process of these aquatic organisms is undoubtedly important due to their economic role in the society of all fisheries

products, shellfish has been noted to have a highest biological value in terms of high protein in the body, low cholesterol content and higher protein assimilation (Amieghene, 2005). Periwinkle, botanically called *Tympanotonus fuscatus* is one of the fisheries products common to the coastal areas of Nigeria, most especially Rivers State. They are found at the inter-tidal zone of brackish water, creeks, estuaries and lagoons in the Niger Delta area (Adebayo-Tayo, *et. al.*, 2006). It is of economic importance as it serves as a source of protein to many Nigerians. It also serves as a source of income to the collectors and marketers, thus forming an important industry in the entire Niger Delta region of the country Nyong, &Nweze, 2012). Furthermore, the shells of these periwinkles are used in place of gravels in the building industry, as decorative arts and in the production of animal feed (Akinrotimi, 2009).

Periwinkle shell fish contribute significantly to food security and livelihoods. It's provides essential nutrition for people

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and some percentage of animal protein and minerals to people from the poorest countries (World Fish Center, 2008). This food security is threatened by climate change and the increasing world population. Climate change changes several parameters of the fishing population: availability, stability, access, and utilization. According to Nyong, & Nweze, (2012), Garcia (2010), the specific effects of climate change on these parameters will vary widely depending on the characteristics of the area, with some areas benefiting from the shift in trends and some areas being harmed based on the factors of exposure, sensitivity, and ability to respond to said changes. The lack of oxygen in warmer waters will possibly lead to the extinction of aquatic animals. Nyong, & Nweze, (2012). The effect of climate change on the output of periwinkle, directly has socio economic impact on the harvesters and buyers of Periwinkle shell fish and on the community at large. Having known the important role played by the abundance of this gastropod in terms of nutrient availability (protein) source of income and purchase power, to mention but a few, it is without doubt that the gradual decline in the abundance and functionality of this specie induced by changes in climate has detrimental effect on the artisanal farmers and the coastal communities (Kawarazuku & Bene, 2012). Subsequently decrease in quantity leads to increase in price associated with decrease in availability (scarcity). This is a problem not only to periwinkle Farmers and final consumers but to the Society at large because it has a direct effect on the gross margin of the community. Thus, there's a growing concern among the farmers, marketers and final consumers of this organism on how to control the alarming quantity decrease induced by climate change, maintain profitable market for periwinkle as well as sustainable nutrient supply and income stability. It is against this backdrop, the researcher sought to analyze the effect of climate change on output of periwinkle harvesters. The general objective of this research is to determine the effect of climate change on output of periwinkle harvesters. The specific objectives are to: determine the socio-economic characteristics of periwinkle harvesters; determine the Effect of climate change on periwinkle harvesting ;examine the awareness of the effect of climate change on periwinkle harvesting; and identify the constraints faced by periwinkle harvesters

Description of the study area: Akwa Ibom State is the nation's third largest petroleum producer (NPC, 2007). The state has a population of 3.9 million people, as of 2006 with a density of 35 persons per kilometer, (NPC, 2006). Akwa Ibom State is situated between latitudes $4^{\circ}32'1''$ N and $5^{\circ}3'1''$ N and longitude $7^{\circ}25'1''$ E and $8^{\circ}25'1''$ E and situated between Cross River, Rivers and Abia State on the South East. It has a total area of 8412km^2 , a shoreline of 129km long and encompasses the Qua Iboe River Basin, the eastern part of the lower Cross River Basin and the eastern half of the Imo River estuary (NES, 2000). The Qua Iboe River, Cross River, Imo River and their tributaries control the drainage,

and deposition of sands and clays. Qua Iboe River is the major hydrographic feature, which drains a greater part of the state and enters the sea at Ibeno, which is the major operational base of Mobil in Akwa Ibom State.

Sampling Technique and Sampling Size: Purposive sampling technique was use to select Oron agricultural zone, purposive sampling technique was used to select two cells. 40 farmers were randomly selected (Periwinkle harvesters) from cell . Giving a total of 80 respondents. Multiple regression is a statistical technique that can be used to analyse the relationship between a single dependent variable and several independent variables. The objective of multiple regression analysis is to use the independent variables whose value set are known to predict the value of the single dependent variable. The advantage of this approach is that it leads to a more accurate and precise understanding of the association of each individual factor with the outcomed , it also consider the effect of more than one explanatory variable on some outcome of interest. It evaluate the relative effect of this explanatory variable on the dependent variable when holding all other variables constant. This reasons makes multiple regression most suitable approach for analysing this objective.

Mathematical $Q=F(X^1, X^2, X^3, X^4...X^n)$

$Q=b^0 + X^1b^1+X^2b^2+X^3b^3+ X^4b^4 +X^5b^5 +X^6b^6.....+U.....(\text{Eqn } 1)$

Where

Q =Periwinkle quantity harvested in kg/farmer(dependent variable)

$X_1 \dots X_6$ =Independent variables

X^1 = Rise in sea level

X^2 =salinity

X^3 =rainfall

X^4 =Temperature

X^5 =Age measured in Years

X^6 =years of harvesting experience

U =Error term

b^1 to b^6 = parameters

Use the questionnaire in the Appendix section for more details on how this research captured the climatic variables. Rise in sea level, salinity, rainfall and temperature.

Result and Discussion: Socioeconomics characteristics of the respondents: Table 1 shows the economic characteristics of the respondent .The distribution of

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respondents according to Gender reveals that 62.50% of periwinkle harvesters are female, while about 37.50% are males. This implies that both males and females were involved in periwinkle harvesting, but majority of the harvesters were females. This result is in consonance with the findings of Nyong, &Nweze, 2012) who reported that periwinkle harvesters are majorly females (70%) and (30%) are males. Also analysing the Age variable it shows that 31% of the periwinkle harvesters were within the age bracket of 16-25, also 31% were within the age bracket of (26-35%) and (8%) were within the age bracket of 36-45%. The mean age of harvesters was 32 which implies that the harvesters are mainly in their economically active age, this also indicate the dominance of young age in harvesting business. This corroborate with findings from Nyong, &Nweze, 2012), Akinrotimi *et al.*, (2009), Ajanle & Aregbor (2015), Zacharia *et al.*, (2013) and Nyong & Bassey 2019) who reported that 70%, 74%, 72%, 51.6%, and 61.67%, respectively, of fisher folks are within the age bracket of 20-40 years.

The results of frequency distribution of respondents according to major occupation reveals that majority 62.5% of the respondent in the study area practice periwinkle harvesting as their major, source of livelihood while a percentage of 37.5 had alternative source of livelihood. This implies that the household in the study area had periwinkle harvesting as their major occupation and that it was enough to meet their family financial obligation. This disagrees with the findings of Nyong & Bassey 2019) who reported that Fisheries activities alone was not enough to meet the financial obligation of the respondent. The distribution of respondents according to method of fishing in Table 4.1b shows that majority of the respondent with a percentage of 92.5% used handpicking method of harvesting, 20% of the respondents used netting and 5% used bottom fishing. This implies that handpicking is the most widely used method of harvesting periwinkle in the study area. Nyong & Bassey 2019), Table 1 shows the economic characteristics of the respondent .The distribution of respondents according to Gender reveals that 62.50% of periwinkle harvesters are female, while about 37.50% are males. This implies that both males and females were involved in periwinkle harvesting, but majority of the harvesters were females. This result is in consonance with the findings of Nyong, &Nweze, 2012), Akinrotimi *et al.*, (2009) who reported that periwinkle harvesters are majorly females (70%) and (30%) are males. Also analysing the Age variable it shows that 31% of the periwinkle harvesters were within the age bracket of 16-25, also 31% were within the age bracket of (26-35%) and (8%) were within the age bracket of 36-45%. The mean age of harvesters was 32 which implies that the harvesters are mainly in their economically active age, this also indicate the dominance of young age in harvesting business. This corroborate with findings from Akinrotimi *et al.*, (2009),

Ajanle & Aregbor (2015), Zacharia *et al.*, (2013), Nyong, &Nweze, 2012) and Omeje *et al.*, (2022) who reported that 70%, 74%, 72%, 51.6%, and 61.67%, respectively, of fisher folks are within the age bracket of 20-40 years.

The Perceived Effect of Climate Change on Periwinkle Harvesting: Assessing the perceived effect of climate change on periwinkle harvesting, multiple regression model was used, with quantity of periwinkle output as the dependent variable, while salinity, Temperature, Rainfall, sea level, age and harvesting experience has the independent variable. From the results of Table 2 below, the estimated R-square of 52% implies that 52% of the variability of the dependent variable is attributable to the explanatory variable. F statistic is significant at 1% which shows that the model used is significant. The result for salinity was significant at 10% and this implies that in the past five years compared to the base category, the salt content has no effect on output of periwinkle harvested. This is because periwinkle concentrate under the roots and decaying red mangrove trees and small collection of water during low tide. Nyong & Bassey 2019); (Egonwam., 2018). Explicitly periwinkle are found at the edges of the lagoon were they are being handpicked and not inside the main water body.

Rainfall was significant at 5% probability level. This means that, compared to the base category, the "Yes" and "No" category is negatively significant and has an inverse relationship with output of periwinkle harvested. This implies that an increase in rainfall leads to a decrease in the catch rate of periwinkles, Notably, in dry season with no or little amount of rainfall, quantity of harvested periwinkle increases than in the rainy season because the mangrove swamp Will be dry and easily access than in rainy season were the swamp and dry lands will be covered with flowing water this results agrees with the findings of Meyenede *et al.* (2006). Also the results in the Table 4.3 shows that for the variable 'sea rises" the 'yes' category compared to the base category was positively significant at 5% probability level. This implies that "sea rise" is directly proportional to the "quantity of output harvested" meaning that from periwinkle harvesters experience, the quantity of periwinkle harvested increases as the sea rises. This disagrees with the aprioro expectation which state that when there is a Rise in sea level the quantity of periwinkle harvested reduces because the natural habitat of the periwinkle will be denatured with outflow of water, thus making handpicking difficult. Since periwinkle inhabit mangrove swamps were the substratum is muddy and rich in detritus Nyong & Bassey 2019) and not in the main water body, increase in sea level affect their ecosystem. The results also shows that age is positively related with the quantity of periwinkle harvested at 1% probability level which implies that the older an harvester, the more his/her output. Harvesting experience had a positive significant at 1% probability level, which explains that as years of experience increases, the amount of periwinkle harvested increases. This research agrees with the

findings of Nyong & Bassey 2019) who observed that harvesting experience is important in determining the profit level of fisher folks. The more the experience, the wider their level of understanding.

Awareness of the effect of climate change on periwinkle harvesting: Table 3 shows the level of awareness of respondents on the effects of climate change on periwinkle harvesting. The result was analysed using a four point likert scale in order to capture respondents opinion towards the subject matter. The mean was obtained by adding all respondents weight and dividing by 4 giving a total of 2.25 as the bench mark. The variable "Are you aware that climate change has an effect on harvesting" ranked 1st with a weighted mean of 2.86. This implies that it is a major awareness and that majority of the respondents in the study area were aware that climate change does have an effect on periwinkle harvesting. Also the second variable "Are you aware of climate change existence" ranked 2nd with a weighted mean of 2.54. This implies that it is a major awareness as well since it's weighted mean is above the bench mark, thus an appreciable population of the respondents in the study area had knowledge about the existence of climate change. However, the variable, "Do you know the nature of effect climate change has on harvesting" ranked 3rd with a weighted mean of 2.55 and this also implies that it is a major awareness. In General, the respondent were mostly aware of the fact that climate change does have an effect on harvesting but they barely knew the nature of effect climate change has on harvesting. This concise with findings of Mustapha et al., who discovered that majority of farmers are aware of climate change especially rainfall pattern and prevailing temperature, and also Nyong & Bassey 2019)

Conclusion: The study analyzed the effect of climate change on output of periwinkle harvesters climate change is a major threat to fishing/ harvesting of periwinkle, it has been revealed that climate change constitute effective deterrent to the sustainable development of periwinkle harvesters, therefore an understanding of the effect of climate change is a vital ingredient to reducing the depletion of output of harvesters and consequently reduce the threat to livelihood of those involved in periwinkle harvesting. Hence, this study shows that not all climatic variables has an effect on periwinkle harvesting, amongst all the significance variable include, Rainfall, Salinity and sea Rise. Thus these variables have tremendous effect on output of harvesters.

Recommendation: Protective measures should be provided for the respondents in the study area in order to check and balance the negative occurrence of predators like snakes, and other dangerous animals found in the habitat that may deter harvesting process and to ensure security of lives and as well encourage easy and productive harvesting. Moreso, government at all level should support the harvesters by providing fishing equipment like canoe, engine, for harvesters to help stabilize commercial harvesting process. Again the Fisher communities should be given specialized education opportunities to widen their understanding of

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climate change and open their minds to accept innovation that will help mitigate the effect of climate change. Also an awareness should be created on the nature of effect climate change has an output of periwinkle harvesters.

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Table1 Social Characteristics of Respondents

Variable	Frequency	Percentage
Gender	50	62.50
Female	30	37.50
Male	80	100.00
Total		
Age	25	31.25
16-25	25	31.25
26-35	23	28.7
36-45	7	8.75
Above 45	80	100.00
Total		
Marital status	34	42.50
Single	37	46.30
Married	9	11.30
Divorce	80	100.00
Total		
Household size		
0-4	20	25.10
5-9	36	45.10
10-14	24	30.00
Total	80	100.00
Harvesting experience	20	25.10
0-4	36	45.10
5-9	24	30
10-14	80	100.00
Total		
Educational level		
No formal education	13	16.3
Primary level	23	28.8
Secondary level	44	55.0
Total	80	100.00
Type of fishing engaged		
Commercial	25	31.30
Subsistence	55	68.70
Total	80	100.00
Source of farm capital		
Savings	61	76.25
Loan	3	3.75
Both	16	20.00
Total	80	100.00
Major occupation		
Fishing	50	62.50
Non fishing	30	37.50
Total	80	100.00
Method of fishing		
Handpicking	74	2.50
Bottom fishing	4	92.50
Netting	2	5.00
Total	80	100.00

Source: Field 2025

Table 2: Multiple regression result of the effect of climate change on quantity of periwinkle harvested.

Variables		Coefficient	Robust Standard
Salinity	Yes	21.08	17.44
	No	28.56*	16.51
Temperature	Yes	27.69	24.98
	No	26.00	19.56
Rainfall	Yes	-53.83**	25.13
	No	-100.90**	50.96

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Sea Level	Yes	59.67***	24.41
	No	54.09**	29.24
Age		2.629***	1.238
Harvesting Experience		9.48***	3.152
Constant		94.73***	31.0204
R-Square = 0.52		F-Stat = 7.44***	

Source: Field 2025

Table 3: Awareness of the Effect of Climate Change on Periwinkle Harvesting

Variables	Weighted mean	Mean Square	Std dev.	Decision	Rank
Are you aware of climate change existence	2.54	8.69	2.48	Major Awareness	2nd
Are you aware that climate change has an effect on harvesting	2.86	8.96	2.47	Major Awareness	1st
Do you know the nature of effect climate change has on harvesting	2.55	8.03	2.34	Major Awareness	3rd
Do you think climate change affect habitat of periwinkle	1.54	8.51	1.44	Minor awareness	4th
Does climate change affect the profitability of periwinkle harvesting	1.55	8.03	1.34	Minor awareness	5th

Source: Field 2025

