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Impact of climate change on sustainable livelihood of the rural population of delta state, Nigeria

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ABSTRACT

This study examines the impact of climate change on the physical environment and its indirect impact on the livelihood of the rural population of Delta State, Nigeria. It aims to ascertain the perceived effects of climate change on the physical environment and on the occupations of the population. Data for the study were obtained from questionnaire administered to a sample of the population selected through multi-stage sampling. The first stage involves the selection of one LGA from the 25 LGAs in the state. Second, random selection of four settlements from twenty-two (22) identified rural settlements. Third, is the systematic of 240 household heads. Descriptive statistical methods and the Student t-test were used to analyse the data collected for the study. The study revealed that perceived effects of climate change on the physical environment: namely, off- season rainfall, highly sensitive temperature, sporadic and heavy rainfall, flooding, extinction and scarcity of certain species of plants have indirect impact on the population manifested in decrease in output from primary activities, reduction in size of primary sector labour force, rural poverty, scarcity of primary products and high costs of primary products. There was a significant ($t=-2.21$, $df=9$, $p<0.05$) difference in the main and second occupations of the population. The study recommends sustainability of human activities and environmental education of the population to enhance sustainable use of land related resources such as water, land and vegetation.

Keywords: Climate change, sustainable livelihood, rural population, primary occupations, Delta State.

1. INTRODUCTION

The human population depends on resources from the various components of the environment for livelihood: namely, atmosphere, hydrosphere, biosphere and lithosphere. Livelihood comprises the activities, assets, income and necessity of life of the people (IFRC, 2021). It simply refers to the way the population harnesses the environment to meet the needs of living in the short- and long-run. The long-run situation of livelihood is commonly referred to as

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sustainable livelihood. It is an enduring condition of individuals or population to provide for themselves in a viable manner over time. Serrat (2017) defines sustainable livelihood as the ability to absolve external shocks or stress and to recover from such through maintaining or improving one's livelihood. Hence, it can be conceived as the intersection between development and environment in both rural and urban areas.

Livelihood in the rural areas is hinged on the population's economic activities or occupations over space and time. These activities, according to Igben (2014) are land-intensive and centred on the exploitation of resources from the biotic component of the ecosystem. These activities include agriculture, fishing, lumbering, hunting etc. Thus, the rural population's livelihood is affected by factors that impact on the environment. One of such factors is climate change.

Though the phenomenon of climate change has become a household issue in recent time as a result of the increasing vagaries in weather situations, its meaning is subject to varied interpretation according to the scientific knowledge of the users particularly in the rural areas. To some persons, it means irregularities in rainfall regimes and resultant flooding, to others it is the increase in sensitive temperature experienced by them particularly at night, yet to others it means the severity or otherwise of the harmattan or dry spell. What is certain, however, is that the global climate is changing as global surface temperatures have risen on the average by about 0.5ºC in the last century (IPCC, 2013). United Nations for Climate Change Convention (UNFCC) (2000) defines the phenomenon as a change global temperature caused by human activity directly or indirectly due to modification of the composition of the atmosphere and which in addition to natural climate variability observed over comparative time period.

According to Igben, (2013) climate change refers to dynamics in the atmospheric condition caused by increase in global temperature. The adverse effects of climate change on the physical environment have been considered by several studies (Ayoade, 2004; Khile, 2007; Medugu, 2009; Odjugo, 2010). Yet others (Odjugo, 2000; Olanrewaju, 2006; Ayinde, 2010; Igben, 2013) dwelled on its effects on human population, livelihood and health.

The links between climate change and sustainable livelihood particularly in the rural areas formed the fulcrum of Cipryk (2009) study of the impact of potential climate change on agricultural livelihood in Ethiopia, using a livelihood framework. The study revealed that livelihood is sustaining shocks that impede promotion into sustainable livelihood in addition to increasing levels of physical and economic vulnerability as a result of climate change. Thus, leading to food insecurity and families depending on unsustainable livelihoods. Similarly, Muringai *et al* (2019) asserted that changes in climate affect the productivity and distribution of marine and freshwater fish species negatively in the communities around Lake Kamba in Zimbabwe, hence impacting on their livelihood.

Climate change leads to diversification of livelihood. Onwumele (2015) study on effects of climate change on livelihood in the Niger Delta showed that more than 80% of household diversified into non-farm sector, which have serious implication for food production. In sum, Thakur and Bajagain (2019) asserted that climate change impacts on several sectors; agriculture, forestry and biodiversity, water resources and energy. Therefore, there is the need to adopt several adaptive measures. The afore-mentioned sectors provide livelihood for the rural population. However, a few other studies such as Kamwi *et al*, (2018) and Israr *et al* (2017) on livelihoods diversification do not ascribe the practice to climate change, hence this study seeks provide rationale for such practice vis-à-vis dynamic in the environment induced by a change in climate. For instance, Kamwi *et al* (2018) opined that various livelihood activities in different combination determine livelihood in Namibia as the population engaged in more than one economic activity. Israr *et al* (2017) study of livelihood sources in the mountainous region of Pakistan revealed that the households engaged in multiple economic activities including farm and non-farm activities for survival, though the lion share was from farm activities.

Livelihood in the study area is dependent upon land-related resources as the main occupations of the population are in the primary sector. Therefore, dynamics in the environment induced by natural or human activities would inevitably affect the livelihoods of the population. Consequently, this study investigates link between climate change, the physical environment and livelihood of the rural population. Its objectives are; (i) determine the occupational characteristics of the rural population, (ii) ascertain the perceived effects of the phenomenon on the physical environment and on the occupations of the population, and (iii) ascertain the adaptation measures of the population. The following hypothesis was postulated in this study: (i) that there is no significant difference between the main and second occupation of the sampled households.

Conceptual Framework

The conceptual framework of this study is a modification of the Multi-Phasic Response Model postulated by Davis (1963). He argued that when there is pressure on resources, the population reorganizes itself so as to relieve that pressure by attempting to increase the resources by working longer hours and doing a second job and so on. Other responses are demographic. They include

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postponing marriage, reducing fertility or out migration. Davis saw that the responses as 'multi-phasic', that is, several responses could occur simultaneously.

In applying the idea to the study area, climate change leads to pressure on available land resources, which the rural population depends on for livelihood. Therefore if there is any external impact such as climate change, the population would respond in several ways including working longer hours and doing a second job. In brief, the thrust of this models is the expansion of ways of livelihood and adaptation of the population as a result of the negative impacts of climate change.

2. MATERIALS AND METHOD

Study Area

The study was carried out in Delta State, Nigeria. Delta State is one of the thirty-six states that comprise Nigeria. It lies roughly between Latitudes $5^0$00′ and $6^0$30′ north and Longitudes $5^0$00′ and $6^0$45′ east, over an area of 22,159 square kilometres, of which more than 60 per cent is land. To the north and northwest of the state lies Edo and Ondo States respectively. Anambra State to the east and Bayelsa State to the southeast. The Atlantic Ocean, which stretches over 160 kilometres of the state's coastline bounded in the south. It comprises twenty-five Local Government Areas (LGAs), as depicted in Figure 1.

The state experiences climate ranging from humid tropical in the south to sub-humid in the north, with two distinct seasons, namely, dry and rainy seasons. While the former occurs between November and April, the latter is experienced from April till October. The average annual rainfall is about 266.5cm in the coastal areas and 190.5cm in the extreme north. In the southern part, rain falls throughout the year with the highest being in July. January, which is the driest month in this part, is characterized by rainfall of up to 2.5cm of rain in most years (Aweto and Igben, 2003). The area is also period relatively cool, dry and dusty weather called the 'harmattan' from December to February. The duration and intensity of which vary from year to year and spatially from south to north. In addition, the state experiences high temperature throughout the year, with an average ranging between 24^0C (75.2^0F) and 27^0C (80.4^0F). The daily variation in temperatures in low, about 25^0C (82^0F) in the rainy season and 28^0C (82^0F) in the dry season. Relative humidity is normally between 60 and 90 per cent (Udo, 1970).

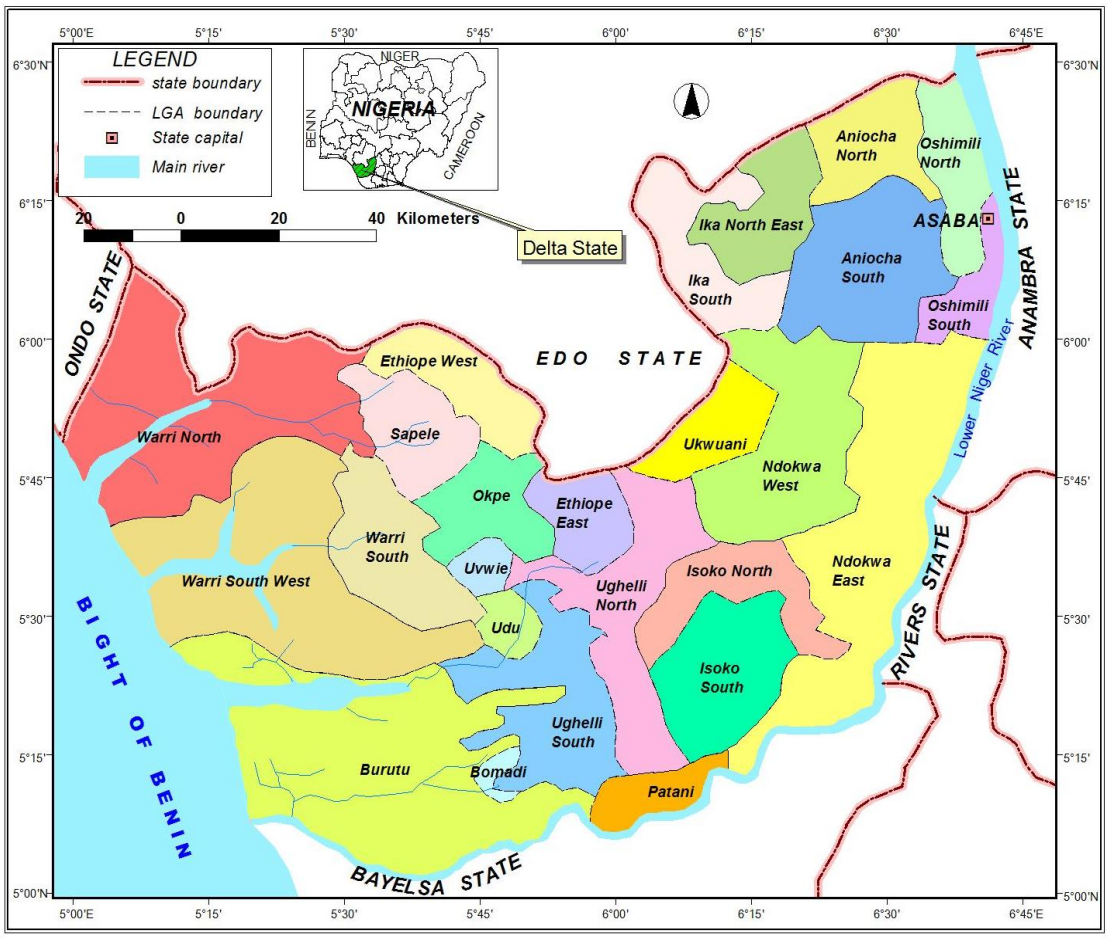

Figure 1: The Study Area

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Furthermore, the state covers four ecological zones: namely, coastal barrier island or ridges, mangroves, fresh water swamp and lowland rainforest. Ikporukpo (1996) classified zones into the outer delta, which characterized by mangrove forest and the inner delta which comprises wet lowland evergreen rainforest. The different ecosystems provide source of livelihood for the population (Igben, 2012).

Delta State has a population 4,098, 391 persons, made up of 2,074,306 males and 2,024,085 females, with about a quarter of the population living in urban areas (NPC, 1991; 2006). The people of the state are engaged in numerous economic activities which include agriculture, fishing, hunting, trading, manufacturing etc. While people in the rural areas engage mostly in the primary sector occupations, those in urban areas are involved in trading, manufacturing, transportation etc. (Igben, 2021)

Research Design

The design of this study is descriptive and it involves mere description of variables as they occur. Ogundipe *et al* (2006) asserted that the design elicits understanding of the present condition through a scientific observation of a phenomenon or variable in the real world situation. This design was adopted to elucidate the livelihood of the rural population as affected by climate change.

Population and Sample

The population for the study include persons living in the rural areas and whose means of livelihood is dependent upon the physical environment in the study area. This definition therefore restricts the target population to persons engaged in primary sector occupations. A household was used as a unit of the survey and the household head or his representative was a unit of observation. In this study a household was taken as a group of persons living in the same apartment and feeding from the same kitchen. The adopted the multi-stage sampling technique at three levels. First, it involves the random sampling of one LGA from the 25 LGAs in the state. In the chosen LG., a total of twenty-two (22) rural settlements were identified, out of which four settlements were randomly selected with the aid of the table of Random Numbers. The selected settlements are Owhrode, Ukpiovwin, Ovworhokpokpor and Ekrota.

The systematic random sampling was used to choose households in the selected settlements. A household was randomly selected, thereafter subsequent households were chosen at regular interval until the targeted was obtained. One person, the household head or his representative was interviewed with the aid of a well-structured questionnaires worded in line with the aim of the study. Sixty (60) households each were targeted in the four settlements thus, 240 households were interviewed. The questionnaire covered information on the various means of livelihood of the respondents, perceived adverse effect of climate change on the physical environment and their means of livelihood. The questionnaire was pre-tested and adjusted before its administration on the sampled population.

Data Analysis

Data derived from the questionnaire were code and analysed with the aid of descriptive statistics. The SPSS version 23 was used to facilitate the process of data analysis. In addition, the hypothesis posed hypothesis that that there is no significant difference between the main and second occupations of the sampled household was tested using the Student's t-test. In doing this, the distribution of the respondents' main occupations was compared with the distribution of their second occupations.

3. RESULTS AND DISCUSSION

Demographic Characteristics

The demographic correlates considered in this section include age and sex characteristics of the household heads sampled for the study. These characteristics are determinants of the occupations of the households which form their means of livelihood. Table 1 presents the age and sex structure of the sampled.

Table 1: Age and Sex Composition of Household Heads

Age Cohort (Years)	A		B		C		D		Total	%
	M	F	M	F	M	F	M	F		
Less than 20	1	0	3	0	0	0	2	0	6	2.5
21 - 30	3	1	5	2	4	2	6	0	23	9.6
31 - 40	6	4	8	5	8	2	8	1	42	17.5

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41 - 50	14	3	12	4	13	1	10	2	59	24.6
51 - 60	10	4	7	4	17	2	8	8	60	25.0
Above 60	8	6	3	7	9	2	11	4	50	20.8
Total	**42**	**18**	**38**	**12**	**51**	**9**	**45**	**15**	**240**	**100.0**

Source: Field work, 2021

Key: A. Owhrode, B. Ukpiovwin, C. Ovworhokpokpor D. Ekrota

Table 1 shows that majority of 169 persons (70.2%) of the total sample population were more than 40 years old. Out of this number, 60 respondents or 25.0 per cent were between 51-60 years, followed by those between 41 and 50 years old (59 respondents or 24.6%) and those above 60years with 50 respondents or 20.8 % per cent. Others include 42 respondents or 17.5 per cent for those between 31-40 years, and 23 respondents or 9.6 per cent and 6 respondents or 2.5 per cent respectively for 21-30 and below 20 years old. In addition, majority of 176 household heads (73.3%) were males while 64 households or 26.7% were females. The finding of higher percentage of male-headed households is in accordance with the previous studies by Igben (2012, 2014) and the National Population Commission (NPC) documented Household statistics of 2000. The statistics showed that 83 per cent of households in Nigeria have males as their heads while females headed only 17 per cent. However, the difference from these statistics in the study area, according to Igben (2012) is due to the fact6 that most women bear the burden of livelihood, either as a primary bread winner due to unemployment of their husbands, who as a result had to be away in search of employment.

Livelihoods or Occupations of Respondents

The various economic activities the people are engaged formed their means of livelihoods. In the study area, which is rural, their occupations are their main source of subsistence. Table 2 below presents the major occupations of the sampled population.

Table 2: Occupations of Sampled Population

Occupations	**A**	**B**	**C**	**D**	**Total**	**Percentage**
1.Arable Farming	28	27	34	35	124	51.6
2.Animal Husbandry	3	1	4	0	8	3.3
3. Fishing	5	9	7	10	31	12.9
4. Hunting	6	4	3	2	15	6.2
5. Lumbering	3	6	4	4	17	7.1
6. Rubber Tapping	4	3	2	4	13	5.5
7. Palm nut Collection	4	2	1	1	8	3.3
8.Raffia Palm Tapping	2	3	1	1	7	3.0
9.Fuel wood Gathering	3	4	3	3	3	5.5
10. Others	2	1	1	0	4	1.6
Total	**60**	**60**	**60**	**60**	**240**	**100.0**

Source: Field work, 2021

Key: A. Owhrode, B. Ukpiovwin, C. Ovworhokpokpor D. Ekrota

Table 2 indicates the occupation of the respondents. These were arable farming, animal husbandry, fishing, hunting, lumbering, and tapping of rubber and raffia palm. Others were palm nut collection, fuel wood gathering and other occupations, such as picking of snails and fruit and herbal collections. Arable farming was the major occupation, employing 124 households (51.6%) of the total number of sampled households. The major crops grown were cassava, sugar cane, yams, plantains, banana, maize and vegetables. Farming is not mechanized; consequently, crude implements, such as cutlasses, hoes and axes are commonly used. While 31 households (12.9%) were engaged in fishing, 8 households or 3.3% were involved in animal husbandry. Animals commonly reared are goats, sheep and pigs. Others are birds, such as fowls and ducks, and snails.

However, 15 households (6.2%) and 17 households (7.1%) were engaged in hunting and lumbering respectively. Hunting was carried out, using dane guns and traps. Major games caught include antelopes, grass cutters, monkeys, porcupine and warthogs. The major trees felled in the area are mahogany (*Khaya Spp*), african walnut (*Lovoa trichilioides*), iroko (*Chlorophora excelsa*), abura

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(*Mitragyna ciliata*), sapele wood *Entandrophragma cylindricum*) and obeche (*Triplochiton scleroxylon*), using motorized saws, hand saws, axes and cutlasses.

In addition, 13 households (5.5%) were engaged in tapping of raffia palm (*raphia hookeri*) for wine and 8 households (3.3%) tapped palm trees for palm nuts. Fuel wood gathering employed 3 households (5.5%) of the sampled population. According to Igben (2012), fuel wood gathering is becoming a major commercial activity in the area because of increasing population and inadequate supply of electricity and kerosene required for homes and industry. Also, tapping of rubber trees for latex employed 13 households or 5.5% of the sample population. Other primary occupations identified in the study area were collection of non-timber products. These are thatches, herbs for medicine, fruits and picking of snails. Only 4 households (1.6%) were engaged in these activities.

A common feature of the sampled households is that they were engaged in more than one occupation. Hence, they have a 'second' occupation. Table 3 shows the second occupation the sampled population are engaged. Table 3 shows that the distribution of the second occupations of the sampled population. It reveals that the respondents' second occupations were also in the primary sector and therefore vulnerable to climate change. Of the 240 households that were interviewed, 162 households or 67.5% were engaged in a second occupations. A majority of 95 households or 58.6% were involved in farming. While 14 households (8.8%) were engaged in fishing, 11 households (6.8%) were involved in animal husbandry. Nine (9) households (5.6 %) each were involved in hunting and lumbering. Raffia palm tapping and fuel wood gathering formed the second occupations of 5 households (3.1%) each. Others were rubber tapping and palm nut collection which engaged 7 households (4.3%) and 3 households (1.9%) respectively.

Table 3: Second Occupations of Sampled Population

Occupations	**A**	**B**	**C**	**D**	**Total**	**Percentage**
1.Arable Farming	23	21	27	24	95	58.6
2.Animal Husbandry	1	2	2	6	11	6.8
3. Fishing	3	7	3	1	14	8.6
4. Hunting	4	4	1	0	9	5.6
5. Lumbering	2	4	2	1	9	5.6
6. Rubber Tapping	3	2	1	1	7	4.3
7. Palm nut Collection	1	1	1	0	3	1.9
8.Raffia Palm Tapping	1	3	1	2	5	3.1
9.Fuel wood Gathering	2	2	0	1	5	3.1
10. Others	1	1	2	0	4	2.4
Total	41	47	38	36	162	100.0

Source: Field work, 2021

Key: A. Owhrode, B. Ukpiovwin, C. Ovworhokpokpor D. Ekrota

Other livelihood activities such as collection of non-timber products including thatches, herbs for medicine, fruits and picking of snails engaged 4 households representing 2.4 percent. The finding that the households had a second occupation is in tandem with the economic adaptation theories postulated by Boserup (1965, 1981), Simon (1982) and Kingsley Davis (1983). These theories argued that a decline in the resources base as a result of deterioration of the physical environment, in this case induced by climate change, makes the population to devise alternative ways of survival such as the practice of multiple occupation. This was also the finding of Igben's (2012) study which revealed the existence of the practice in the study area.

Table 4: Analysis of Student' t-test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Main - Second	6.80000	9.69307	3.06522	-.13400	13.73400	2.218	9	.054

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The null hypothesis that there is no significant difference between the main and second occupation of the sampled households was teste using the Student t-test. The result, presented in Table 4 shows a t-value of 2.218 which is significance at 0.05 level of confidence

Direct and Indirect Impact of Climate Change on the Population

Climate change on the livelihood of the population can be grouped into two: namely, direct and indirect. The direct impacts are those that affect the physical environment or the ecosystem while the indirect impacts affect the population which depends on the physical environment for livelihood. Table 5 depicts the direct and indirect impacts of climate change as perceived by the population. The direct impacts include, off-season rainfall, highly sensitive temperature, sporadic and heavy rainfall, flooding and extinction or scarcity of certain species of plant. The indirect impacts are decrease in output from primary activities, reduction in size of primary sector labour force, rural poverty, and scarcity of farm products and high costs of primary products.

Table 5: Effects of Climate Change on Livelihood of the Rural Population

Direct Effects	**Total**	**Frequency**	Percentage
Off- season rainfall	240	233	97.1
Highly sensitive temperature	240	175	72.9
Sporadic rainfall	240	198	82.5
Flooding	240	201	83.8
Extinction or scarcity of certain species of plant	240	143	59.6
Indirect Effects			
Decrease in output from primary activities	240	236	98.3.
Reduction in size of primary sector labour force	240	124	51.7
Rural poverty	240	128	53.3
Scarcity of primary products	240	137	57.1
High costs of primary products	240	132	55.0

Source: Field work, 2021

Furthermore, the table reveals that of the 240 households interviewed, 233 households (97.1%) and 175 households (72.9%) households are of the viewed that climate is manifested in off- season rainfall and highly sensitive temperature respectively. While 198 households (82.5%) perceived its impact on the environment as sporadic and heavy rainfall, 201 households (83.8%) perceived its impact in the form of flooding. Extinction and scarcity of certain species of plants was perceived by 143 households (58.6%) out of the total of 240 households as effects of climate change on the physical environment.

The indirect effects of climate change as it affects the population are decrease in output from primary activities (236 households or 98.3%), reduction in size of primary sector labour force (124 households or 51.7%), rural poverty (128 households or 53.3%), scarcity of primary products (137 households or 57.1%) and high costs of primary products (132 households or 55.9%).

Adaptation measures

In a bit for the population to cope with the vagaries of climate change on their livelihoods, adaptation measures adopted were multiple occupations, working for longer hours, out-migration and changing occupation. As presented in Figure 3, of the 240 households interviewed for the study, 162 households representing 31% adopted the practice of multiple occupations. While 223 households or 44% decided to work for longer hours, 46hh or 9% were considering moving out of the environment or have actually moved out. Only 87 households representing 16% have either changed occupation or contemplating doing so.

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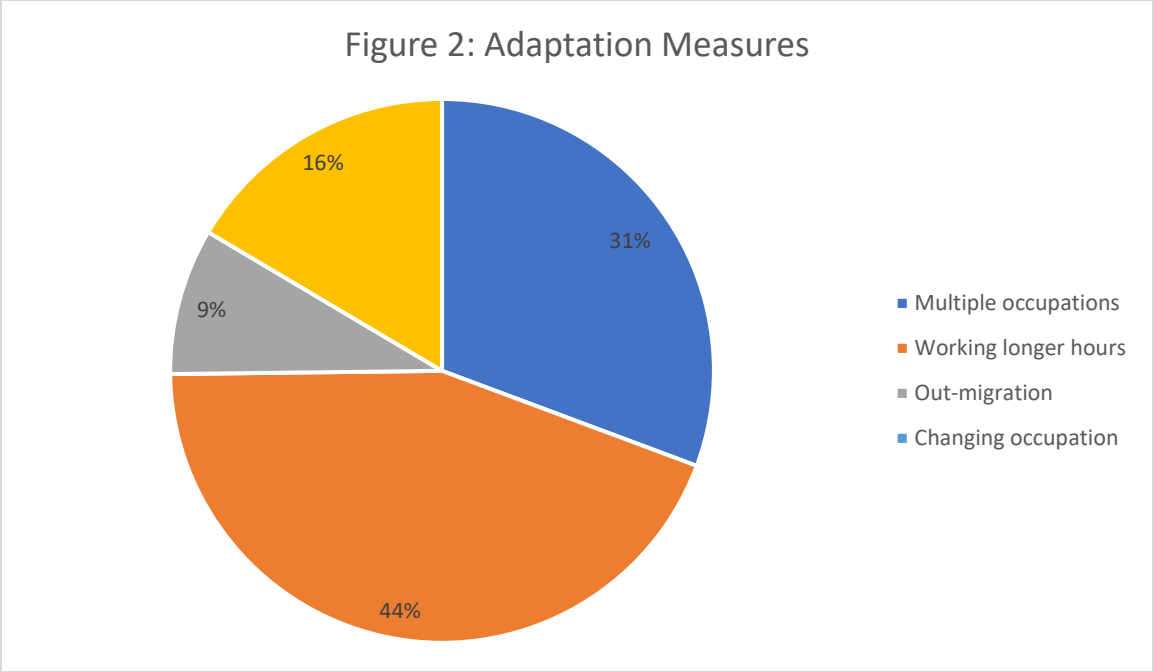

The practice of multiple occupations among the population is in line with previous studies by Igben (2012). The study revealed that the population adopts the practice due to degradation of the environment. This practice in the area can be attributed to their high expectation and action towards improving on their level of livelihood, through practicing more than one occupation at a time (Ajaegbu, 1972; Davis, 1983). The desire to improve on their livelihood is the consequence of a declining income in the primary sector, brought about by climate change. Israr *et al* (2017) study of livelihood sources in the mountainous region of Pakistan revealed that the households engaged in multiple economic activities including farm and non-farm activities for survival, though the lion share was from farm activities.

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Conflict of Interest

The author declares that they have no conflict of interest.

Data and materials availability

All data associated with this study are present in the paper.

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