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How to cite: Ola, A.B. 2022. Climate change effects and livelihood-adaptation strategies by the urban poor in Ibadan, Nigeria. *Town and Regional Planning*, no. 81, pp. 24-38.

Climate change effects and livelihood-adaptation strategies by the urban poor in Ibadan, Nigeria

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Research article

DOI: http://dx.doi.org/10.18820/2415-0495/trp81i1.3

Received: August 2022

Peer reviewed and revised: September-October 2022

Published: December 2022

**The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article*

Abstract

As with many developing countries, one of Nigeria's major challenges to socio-economic development is climate change. This article examines the effects of climate change on the livelihood activities of the urban poor in Ibadan, Nigeria. Adopting a cross-sectional survey design, the research relied essentially on primary data. A structured questionnaire was used to obtain primary data from 481 purposively selected urban residents engaging in different livelihood activities. Data collected were analysed using descriptive and inferential statistical techniques. The Respondents' Agreement Index was used to measure the respondents' awareness of climate change and climate change adaptation strategies. Tobit Regression Model was used to analyse the factors influencing climate change adaptation strategies, while the effects of climate change on residents' livelihood were measured using Multinomial Logistic Regression. Findings revealed that respondents were involved in diverse livelihood activities, ranging from trading to civil service. Long dry seasons, excessive heat, irregular rainfall patterns, and frequent floods make respondents aware of climate change. Low patronage by buyers, low productivity, and reduction in income were the major effects of climate change on livelihood activities. Diversifying income sources was the main adaptation strategy. Strengthening the physical planning system to build the city's resilience and adaptive capacity to climate-related disasters was recommended.

Keywords: Adaptation strategies, climate change, diversification, livelihood, rainfall pattern, sustainable development goals

KLIMAATSVERANDERING-EFFEKTE EN LEWENSBESTAAN-AANPASSINGSTRATEGIEË DEUR DIE STEDELIKE ARMES IN IBADAN, NIGERIË

Soos baie ontwikkelende lande, is klimaatsverandering een van Nigerië se grootste uitdagings vir sosio-ekonomiese ontwikkeling. Hierdie artikel ondersoek die uitwerking van klimaatsverandering op die lewensbestaanaktiwiteite van die stedelike armes in Ibadan, Nigerië. Die navorsing het hoofsaaklik op primêre data staatgemaak. 'n Gestruktureerde vraelys is gebruik om primêre data te verkry van 481 doelbewus geselekteerde stedelike inwoners wat betrokke is by verskillende lewensbestaanaktiwiteite. Data wat ingesamel is, is ontleed deur gebruik te maak van beskrywende en inferensiële statistiese tegnieke. Die Respondente Ooreenkomsindeks is gebruik om die respondente se bewustheid van klimaatsverandering en klimaatverandering-aanpassingstrategieë te meet. Tobit-regressiemodel is gebruik om die faktore wat klimaatsverandering-aanpassingstrategieë beïnvloed te ontleed, terwyl die uitwerking van klimaatsverandering op inwoners se bestaan gemeet is met behulp van multinomiale logistiese regressie. Bevindinge het aan die lig gebring dat respondente betrokke was by diverse bestaansaktiwiteite wat wissel van handel tot staatsdiens. Lang droë seisoene, oormatige hitte, onreëlmatige reënvalpatrone, en gereelde vloede maak respondente bewus van klimaatsverandering. Lae frekwensie van kopers, lae produktiwiteit, en vermindering in inkomste was die belangrikste uitwerking van klimaatsverandering op lewensbestaanaktiwiteite. Die diversifisering van inkomstebronne was die belangrikste aanpassingstrategie. Die versterking van die fisiese beplanningstelsel om die stad se veerkragtigheid en aanpasbaarheid by klimaatverwante rampe te bou, is aanbeveel.

LITLAMORAO TSA PHETOHO EA MAEMO A LEHOLIMO LE MAANO A HO IKAMAHANYA LE MEKHOA EA BOIPHELISO KE BATHO BA FUTSANEHILENG BA LITOROPONG TSA IBADAN, NIGERIA

Joalo ka linaha tse ngata tse ntseng li tsoela pele, e 'ngoe ea liqholotso tse kholo tsa Nigeria ho nts'etsa pele moruo ke phetoho ea maemo a leholimo. Sengoliloeng sena se hlahloba litlamorao tsa phetoho ea maemo a leholimo mesebetsing ea boipheliso ea mafutsana a litoropong Ibadan, Nigeria. Ho amohela moralo oa lipatlisiso tse fapaneng, boithuto bona bo itšetlehile haholo ka lintlha tse ka sehlohong. Lenane la lipotso le hlophisitsoeng le ile la sebelisoa ho fumana lintlha tsa mantlha ho tsoa ho baahi ba 481 ba khethiloeng ho ipapisitsoe le tsebo ea bona ea morero oa litoropo, 'me

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ba etsang mesebetsi e fapaneng ea boipheliso. Lintlha tse bokelletsoeng li ile tsa hlahlojoa ka ho sebelisa mekhoa e hlalosang le ea lipalo. Ho ile hoa sebelisoa lenane le hlophisitoseng ho hlahloba kapa ho lekanya tsebo ea ba nkileng karolo ka phetoho ea maemo a leholimo le mekhoa ea ho ikamahanya le maemo a leholimo. Tobit Regression Model e ile ea sebelisoa ho sekaseka lintlha tse susumetsang maano a ho ikamahanya le maemo a leholimo, athe litlamorao tsa phetoho ea maemo a leholimo bophelong ba baahi li ile tsa lekanyetsoa ho sebelisoa Multinomial Logistic Regression. Liphuputso li senotse hore ba nkileng karolo ba ne ba ameha mesebetsing e fapaneng ea boipheliso, ho tloha khoebong ho ea ho basebeletsi ba sechaba. Linako tse telele tsa komello, mocheso o feteletseng, mekhoa ea lipula tse sa tsitsang le likhohola khafetsa li etsa hore ba arabetseng ba elelloe ka phetoho ea maemo a leholimo. Tšehetso e fokolang ea bareki, tlhahiso e tlaase, le ho fokotseha ha chelete e kenang e bile litla-morao tse khōlō tsa phetoho ea maemo a leholimo mesebetsing ea boipheliso. Mehloli e fapaneng ea chelete e ne e le leano le ka sehloohong la ho ikamahanya le maemo. Ho ile ha khothaletsoa ho matlafatsa tsamaiso eat hero ea litoropo le maemo a likoluoa a amanang le boemo ba leholimo.

1. INTRODUCTION

The persistent change in climatic elements across the world in recent times has heightened a global concern, as it is increasingly becoming a threat not only to the sustainable development of global communities, but also to the totality of human existence (Rathoure & Pathel, 2020; Zadawa & Omran, 2020). Climate change generally affects livelihoods, ecosystems, and the socio-economic development of societies, and has been defining the direction of human well-being and development (Otitoju & Enete, 2016: 23; Shiru, 2018: 871). As argued by Aniah *et al*. (2016a: 32), cities in developing countries are especially vulnerable to the impact of climate change, due to their weak capacities to withstand shocks. In addition, the characteristic poor urban planning, the high rate of urbanisation, and the expansion of slums associated with many third-world cities exacerbate the impacts of climate change on city dwellers (Onyenechere, 2010: 137-138; Haider, 2019: 8), particularly the urban poor who are mostly confined to ecologically fragile areas and are less resilient to the consequences of climate change (Ogbuabor & Egwuchukwu, 2017: 221).

In Nigeria, evidence of changing climate and the potentially profound implications for livelihood security abound in literature. Climate change is reflected in the increases in the country's temperature; irregular rainfall patterns; rise in sea level and flooding; loss of biodiversity; drought, and desertification between 1941 and 1970 (Elisha, 2017: 2; Ebele & Emodi, 2016: 5; Olaniyi, 2013: 57). Between 1960 and 2020, annual rainfall decreased by 2-8mm across most of the country; it increased by 2-4mm in a few places (Audu, Ejembi & Igbawua, 2021: 346; Building Nigeria's Response to Climate Change [BNRCC], 2011: 7). This pattern was equally observed in Ibadan during the same period (Figure 1). Nigeria has also experienced climate extremes since 2002 (Akande, 2017: 2-3; Amanchukwu, 2015: 75). Floods are the most common recurring disaster in the country (Federal Government of Nigeria, 2013: xix). The durations and intensities of rainfall have increased since 1990, producing large run-offs and flooding in many places (Enete, 2014: 234). Rising sea level and ocean surge in Southern Nigeria have submerged villages in Lagos and some places in the Niger Delta region (Anabaraonye, 2019: 1394-1395). In Northern Nigeria, a flood in 2010 affected 2 million people in Jigawa State (Elisha, 2017: 3). Severe nationwide floods in 2012 resulted in unprecedented damage and losses to human settlements and livelihood located downstream (Akande, 2017: 6; Federal Government of Nigeria, 2013: 37-39). Okafor (2021: 2539) reported that the 2012 floods led to destruction of 82,361 and 152,575 hectares of farmlands in Rivers and Kogi States, respectively, with 85% of the affected farmlands located in the downstream area of the States. In Cross River State, 18 markets and 4,743 shops were destroyed as a result of the 2012 floods (Okafor, 2021: 2539).

Droughts have also been a constant in Nigeria. In the Nigerian Sahelian region, there has been a 25% decrease in precipitation on average since 1990 (Amanchukwu, 2015: 72; Oladipo, 2010: 76). The drying up of Lake Chad from roughly 4,000 km^2 to approximately 3,000 km^2 between 1960 and 2007, respectively, is attributable to the effects of climate change in that part of the country (Dioha & Emodi, 2018: 29; Elisha, 2017: 3). Other lakes, particularly in Northern Nigeria, are also in danger of disappearing (Elisha, 2017: 4). Furthermore, temperatures have risen significantly above normal since the 1980s, with relatively higher figures in 1973, 1987, and

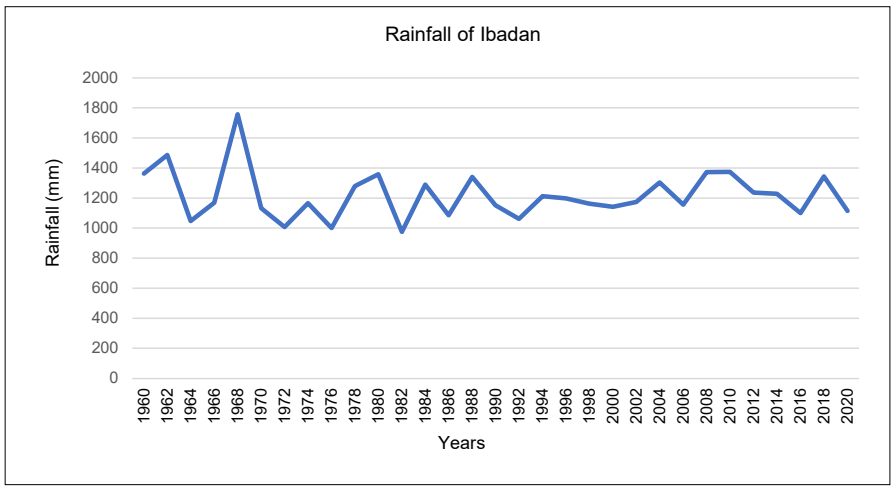

Figure 1: Rainfall of Ibadan, 1960-2020

Source: Nigerian Meteorological Agency, 2022

1998 (Enete, 2014, 234; Federal Ministry of Environment, 2014: 3-4). Temperature increases of approximately 0.2°C to 0.3°C per decade have been observed in the various ecological zones of the country (Enete, 2014: 234; Federal Ministry of Environment, 2014: 22; BNRCC, 2011: 8; Oladipo, 2010: 19). Minimum temperature in the country has increased slightly faster than the maximum temperature, resulting in the smaller temperature range. The temperature of Ibadan has followed the general temperature patterns in Nigeria (Figure 2). This warming of the environment is most significant between June and November each year (Amanchukwu, 2015: 73; Federal Ministry of Environment, 2014: 5). This phenomenon presents severe threats and erodes essential needs, capabilities, and rights especially for the poor and marginalised, thereby redesigning their livelihoods (Intergovernmental Panel on Climate Change [IPCC], 2014: 16). Livelihood activities are an integration of several activities engaged by an individual household to ensure a living. It tends to focus on income sources. Some livelihoods are directly climate sensitive, such as rain-fed agriculture, seasonal employment in agriculture (for example, fishing and pastoralism), and tourism (IPCC, 2014: 16), while other livelihoods are indirectly climate sensitive such as artisanship and trading (Mutangi, 2013: 497-499).

The effects of climate change on livelihood activities, especially agriculture, in Nigeria are well documented. As observed by Ogbuabor and Egwuchukwu (2017: 220), higher temperatures, lower rainfall, drought, and desertification reduce farmlands, lower agricultural productivity, and affect crop yields, particularly crops cultivated under rain-fed conditions. Studies conducted in Yobe state, for example, found that dunes and desert encroachment have covered from approximately 25,000 to over 30,000 hectares, undermining food and livestock production (Ebele & Emodi, 2016: 6-8). Prolonged dry spells from climate change affect livestock production, making it difficult for livestock farmers to find water and green pastures, due to reductions in surface-water resources and available pastureland. The loss of weight for animals can reduce meat and dairy production (Idowu, 2011: 149; Nkechi, 2016: 8). Warming trends also make the storage of root crops and vegetables challenging for farmers without access to refrigerators (Ebele & Emodi, 2016: 9).

The need for this study emanates from the fact that most of the studies on climate change impacts on livelihood strategies in Nigeria have been conducted on rural farming households' livelihood, from the lens of agricultural production and food security. A better understanding of how urban households perceive climate change and how that perception affects their reaction is an important input to develop strategies to sustain urban livelihoods. Thus, the study will examine the effects of changing climate on the livelihood strategies of poor and vulnerable urban dwellers in Ibadan, Nigeria.

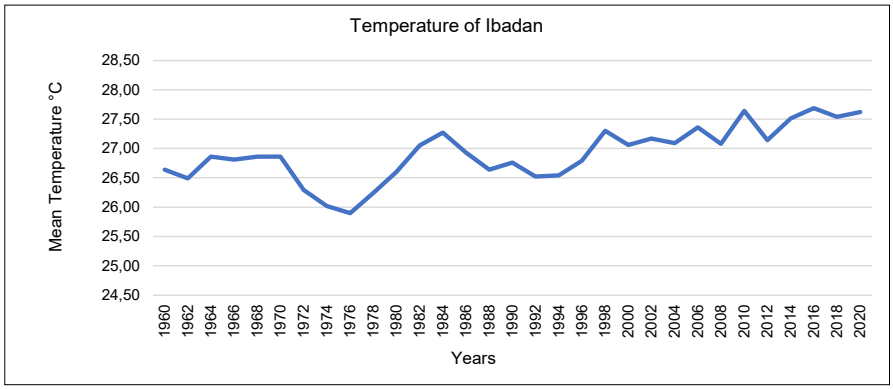

Figure 2: Temperature of Ibadan, 1960-2020

Source: Nigerian Meteorological Agency, 2022

2. LITERATURE REVIEW

2.1 Effects of climate change on livelihood activities

Conclusions from various studies indicate that agriculture, small farmers, and food security in developing countries, especially in South Asia and sub-Saharan Africa, are impacted by changes in climatic elements (Schmidhuber & Tubiello 2007; Brown & Funk 2008; Rautela & Karki, 2015; Aniah *et al*., 2016b). Aniah *et al*. (2016b) specifically posited that climate change has a negative net effect on the income and yield of crops across sub-Saharan Africa. For instance, in a study in Ghana, Aniah *et al*. (2016a:11) reported that 25.3% of farming households in Soe Kabre (Upper East Region) had their crops withered as a result of drought. The majority of the inhabitants of Uttarakhand Himalaya (India) indicated a drastic reduction in crop and animal production as a result of climate change (Rautela & Karki, 2015). Eckstein, Hutfils and Winges (2018) reported that climate events such as floods, cyclones, heavy rainfall, river erosion, and droughts are most frequent in Bangladesh. In Ethiopia, Deressa and Hassan (2009), using simulation models for the years 2050 and 2100, found that climate change will substantially reduce per hectare net crop revenue by 2050 and 2100. Li *et al*.'s (2019) estimates show that the long-term annual GDP loss, due to global warming, is US$1,927.78 billion by the year 2100 for sub-Saharan Africa.

In Nigeria, climate change affects the nature and characteristics of freshwater resources on which many Nigerians depend. Rise in sea level and extreme weather affect fishing. The viability of inland fisheries is also threatened by increased salinity and shrinking rivers and lakes (Ebele & Emodi, 2016: 11; BNRCC, 2011: 9). Unpredictable rainfall variation, heat stress, and drought can adversely affect food production and result in

food shortages (Abdulkadir, 2017: 155; Elum & Momodu, 2017: 73; Ebele & Emodi, 2016: 11; Enete, 2014: 235). The high vulnerability to climate change of states in the northern part of the country poses a serious threat to food security throughout the country (Madu, 2012: 7-9). Drought conditions in parts of Northern Nigeria have also resulted in less drinking water (Sayne, 2011: 14-16). Erosion and excessive wind reduce the number of forestry products such as wood and cane (Ogbuabor & Egwuchukwu, 2017: 219). Forests are under significant pressure, not only from climate change, but also from increasing populations and greater demand for forest resources (BRNCC, 2011: 9).

Climate change also affects income groups, classes, occupations, age, and gender in varying ways (Amobi & Onyishi, 2015: 204). Onwutuebe (2019: 4) asserted that the high vulnerability of the agricultural sector to climate change will continue to affect women disproportionately as a larger percentage of women are poor farmers who rely on small-scale and rain-fed agriculture. It is important to note that women are also more dependent on natural resources, as they are primarily responsible for gathering wood for cooking and heating, collecting the household water supply, and ensuring food security for the family.

It has, however, been projected that there will be a significant increase in temperature over all the ecological zones in the coming decades (Akande, 2017: 12). It is predicted that there will be a temperature increase of 0.4°C to 1°C for the period 2020-2050, due to climate change, and an increase of up to 3.2°C by 2050, under a high climate change scenario (Oladipo, 2010: 38; Federal Ministry of Environment, 2014: 8). Regional variations are expected, with the highest increase (4.5°C by 2081-2100) projected in the Northeast (BNRCC, 2011: ii). Such heightened temperatures will have negative impacts on agriculture and food security (Akande, 2017: 14).

In Nigeria, inundation is the primary threat for at least 96% of the land at risk (Ebele & Emodi, 2016: 7). A rise in sea level of 1m could result in the loss of roughly three-quarters of the land area of the Niger Delta (Federal Ministry of Environment, 2014: 31; Oladipo, 2010: 38). It has also been estimated that a rise in sea level by up to 59cm by 2100 will result in the submersion of several Nigerian coastal states. This includes parts of Lagos and other smaller towns along the coast (Ebele & Emodi, 2016: 7). This will disrupt the life and activities of residents and wreak immense havoc on the ecological balance and consequently livelihood activities (Ebele & Emodi, 2016: 9). Flooding is expected to occur alongside droughts in northern Nigeria, arising from a decline in precipitation and rise in temperature (Oladipo, 2010: 35). This will lead to loss of agricultural produce, farmlands, and other livelihood resources.

2.2 Climate change livelihood-adaptation strategies

Among the livelihood-adaptation strategies adopted, Ahmed and Haq (2017) reported crop diversification, modification of planting, harvesting periods, and alternative livelihoods as the most commonly used in Bangladesh. Rautela and Karki (2015) reported engagement in extra income-generating activities (e.g., running a grocery store, tourist guides, handicrafts production), changing grain composition, multiple crop practices, and intensive use of chemical fertilizers and pesticides as common strategies for many communities in India. Some livelihood-adaptation strategies identified in South Africa and the Ethiopia Nile Basin by Bryan *et al*. (2009) were engagement in food-for-work programmes, migration, reducing consumption, and seeking off-farm employment. Smallholder farmers in Teso Sub-Region of eastern Uganda have applied some strategies, including begging, saving planting materials (seeds), and involving in casual labour (Egeru, 2012). In a study in Pakistan, Batool *et al*. (2018) found that, in dealing with climate effects in the short term, women reduced their frequency of buying clothes, resorted to buying less expensive food, selling large ruminants, using household savings, and using less costly health services.

3. STUDY AREA

Ibadan, the capital city of Oyo State in southwestern Nigeria (Figure 1) is located between longitudes 7°20¹E and 7°40¹E and latitudes 3°35¹N and 4°10¹N (Oguntoyinbo, 1994: 46). Ibadan is located at roughly 145km north of Lagos and 345km south-west of Abuja. Ibadan's climate is characterized by a tropical wet and dry climate. The rainy season is between March and October, with the prevalence of the moist maritime south-westerly monsoon from the Atlantic Ocean, and the dry season is from November to February when the city is influenced by the typical West African harmattan from the Sahara Desert (Audu, Isikwue & Eweh, 2015: 72; Adediran, 2020). The mean annual rainfall in Ibadan was 1,258.9mm between 1911 and 1988, and 1,407.5mm between 1989 and 2018 (Ayeni *et al*., 2020: 93). NiMet (2022: online) predicted 1,590mm for 2022. The mean annual temperature fluctuates around 26.6ºC and 27ºC (measured between 1970-2018) (Egbinola & Amocichukwu, 2013: 37; Durowoju, Samuel & Anibaba, 2021: 175). The city is drained mainly by the Ogunpa, Ogbere, and Ona rivers with their tributaries.

The Ibadan region is made up of five metropolitan (Ibadan North, Ibadan South, Ibadan Northwest, Ibadan Southwest, and Ibadan Northeast) (Figure 1) and six rural/peri-urban local government areas (LGAs). This study focuses on the five metropolitan LGAs. Ibadan has had rapid growth both spatially and demographically. The developed land area grew from 3,080km^2 in 1996 to 4,684km^2 in 2020 (Atlas of Urban Expansion, 2021), while the city's population increased from 3.1 million in 2015 to 4 million in 2021 (National Bureau of Statistics, 2022). Ibadan, spatially the largest city in Nigeria, is home to diverse ethnic groups and foreigners. Analysis of the socio-economic structure of the city indicates that most of the inhabitants fall into the low- and

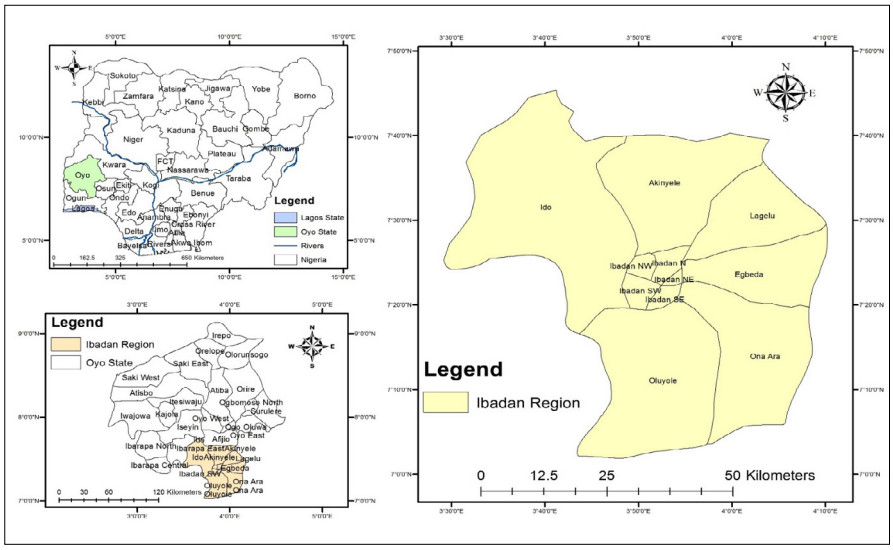

Figure 3: Ibadan region in the context of Oyo State and Nigeria
Source: Kasim, Agbola and Oweniwe, 2020: 73

middle-income categories (National Bureau of Statistics, 2017). The occupational structure of the city reflects a large proportion of the inhabitants in the informal sector of the city's economy (mostly artisans and farmers). In the absence of proactive physical planning strategy, this population outlook has implications for the impact of climate change on people's livelihoods. The choice of Ibadan as case study was informed by its size, population, and regional influence, being the capital of the western region of Nigeria and presently the capital of Oyo State. Ibadan is a major centre for trade that influenced constant migration of people into the city, with diverse innovations and initiatives required for diverse livelihood activities.

4. METHODOLOGY

This study examines how changing climate affects the livelihoods of the urban poor in Ibadan City, Nigeria, and identifies the adaptation strategies that the residents use. The study used a mixed methods design, in which qualitative and quantitative data are collected in parallel, analysed separately, and then merged (Creswell, 2014). Quantitative design allows for the use of questionnaires, as well as descriptive and inferential analysis. Quantitative data for this study were collected through a questionnaire survey that examined the livelihood activities of residents, awareness of climate change among the residents, effects of climate change on residents' livelihood, and climate change-adaptation strategies of the residents. Inferential analysis was used to test the effect of climate on residents' livelihood activities and determine factors that influence adaptation choices. Qualitative data were collected through observations (Yin, 2018: 33). The observation checklist collects information on the effects of changing climate on livelihood activities and livelihood-adaptation strategies. The reason for collecting both quantitative and qualitative data is to elaborate on specific findings from the grouping of the observations, such as the effects of changing climate on livelihood activities suggested from respondents' groups (Creswell, 2014: 4).

4.1 Sampling method and size

The five LGAs (see Table 1) each have 12 wards, except for north-west LGA which has 11 wards (INEC, 2015: 35-38). Ibadan's residential density patterns showed a concentration of high-, medium-, and low-density neighbourhoods in each ward. The city's high-density wards/ neighbourhoods are characterised by poor moribund sanitation facilities and sewage systems, accumulation and non-collection of refuse, poor access to basic infrastructure, poor transportation facilities, and the absence of adequate drainage facilities, which make the communities vulnerable to climate-induced disasters and consequently affect their livelihoods. Therefore, the high-density wards which theoretically housed the urban poor were selected in each LGA. Because the wards are of varying sizes concerning the population (National Bureau of Statistics, 2022: 2), the largest ward was selected from among the high-density wards in each LGA. Information from the Local Planning Authorities of the five LGAs indicated variation in the concentration of mixed land uses in the neighbourhoods that make up the wards. Therefore, two neighbourhoods with the largest mixed land uses (i.e., residential/ commercial/industrial) were selected in each ward, resulting in 10 neighbourhoods for the survey (see Table 1). A list from the National Population Commission (2022: 19-23) shows an average population of 160,000 residents in each neighbourhood with visible livelihood activities (Table 1). From these, 50 adult residents in each neighbourhood were purposively selected for the survey (Bernard, 2000: 73-75), resulting in a sample of 500 respondents. The sample size for each neighbourhood was calculated in accordance with the table recommended by Krejcie and Morgan (1970: 608). The table recommends a sample size of 504 for a population of 1.6 million. This recommendation validates the sample size of 500 as excellent for the population of 1,601,473. Purposive selection was done to avoid the incidence of full-time housewives and jobless males who may not supply quality information for the survey.

4.2 Data collection

To examine the livelihood activities of residents, awareness of climate change among the residents, effects of climate change on residents' livelihood, and climate change-adaptation strategies of the residents, a set of pre-tested structured questionnaires was administered

Table 1: Population, sample, and responses

LGA	Ward no.	Neighbourhood	**Population	Sample	Responses
Ibadan South-west	3	Agbokojo, Oke-Aare	180,944 162,307	50 50	48 49
Ibadan South-east	7	Beere Labo	168,149 161,673	50 50	44 50
Ibadan North-west	5	Agbeni Opoyeosa	163,789 150,904	50 50	47 48
Ibadan North-east	1	Oranmiyan Aremo	152,455 148,692	50 50	50 49
Ibadan North	9	Agbadagbudu Yemetu	157,219 155,321	50 50	50 49
Total			1,601,453	500	481

Source: Author's computation; **National Population Commission, 2022

to the sampled 500 residents in the study area between 8 and 17 January 2022. The questionnaire included 27 tick-box, 8 open-ended questions, and 3 Likert-scale questions in five parts. Part one on the socio-economic characteristics of the respondents included questions on gender, age, marital status, education, income, and household sizes. Part two had questions on the livelihood activities of the respondents and included questions on the types of livelihood activities, frequency of operation, years of practice, location of the activities concerning residences, mode of transport to the activities, income from the activities, access to formal or informal training in the activities, the structure of the activities (sole proprietorship or partnership), and business registration with the government. Part three sought answers on awareness of climate change among the respondents, including questions on the indicators of climate change such as seasonal rainfall fluctuation, excessive heat, long dry season, frequent floods due to uncontrolled rainfall, and changes in precipitation pattern. Part four focused on the effects of climate change on residents' livelihoods. This includes questions on the economic, social, environmental, and cultural implications of climate change on livelihood activities. Part five sought answers on the climate change livelihood-adaptation strategies of the respondents and included questions on the effectiveness of the strategies and the factors that influenced the strategies. Respondents were asked to tick the appropriate answers where options were supplied, while they were given the liberty to provide answers to the open-ended questions.

Furthermore, an observation checklist was designed to collect information on issues such as the effects of changing climate on livelihood activities and livelihood-adaptation strategies. Information emanating from the observation checklist was recorded in a note-book and thematically analysed following these steps: Preparation of transcripts from the notebook; coding of the transcript (i.e., marking off sections of the transcript in a way that indicates what was observed in each neighbourhood and assigning them to code words); synthesizing codes into themes; after a thorough revision of the themes, each theme was properly defined (i.e., formulating exactly what was meant by each theme and figuring out how it helps understand the data) and named (i.e., coming up with a succinct and easily understandable name for each theme) for easy analysis.

4.3 Data analysis and interpretation of findings

The data collected were processed, using the Statistical Package for Social Sciences (SPSS) version 21 software, where two analytical statistics were employed to summarize data and make inferences. First, univariate descriptive statistics involving frequency and percentages were used to report the socio-economic profile and livelihood activities of the respondents. Tobit Regression Model was used to analyse the factors influencing climate change-adaptation strategies. The model is expressed as:

$$Y_1 = \beta_{0+}\beta_1X_{1+}\beta_2X_2 + \beta_3X_{3+}\beta_4X_4 + e$$

Where:

Y_1 = Climate Change Index (CCI). This takes values from 0.0-0.1

The explanatory or independent variables considered in the study were:

X_1 = Access to credit

X_2 = Educational qualification

X_3 = Household size

X_4 = Gender

X_5 = Income

X_6 = Access to information

X_7 = Age

X_8 = Frequency of disasters

β_0 = Constant

e = Error term

The effects of climate change on residents' livelihood were measured using the Multinomial Logistic Regression Model. As in other forms of linear regression, multinomial logistic regression uses a linear predictor function to predict the probability that observation *i* has outcome *k*, of the following form:

$$Y_{(k,i)} = a_{ok} + b_{1k}X_{1i} + b_{2k}X_{2i} + \text{----------} + b_{5k}X_{5i} + e$$

Where:

Y = dependent or the criterion variable.

a = the slope-intercept (i.e., the value of Y when X = 0).

b = regression coefficient representing the amount of change in Y that corresponds to a unit change in X.

X = independent or the predictor variable.

b_k is the set of regression coefficients associated with outcome *k*i, and X_i (a row vector) is the set of explanatory variables associated with observation *i*.

e = error term of prediction showing the difference between observed y and predicted y in the analysis.

Y = Climate change.

X_1 = Low productivity.

X_2 = Reduced income.

X_3 = Low crop yield.

X_4 = Low patronage by buyers.

X_5 = Irregular patronage by buyers.

X_6 = Delay in completion of clients' work.

X_7 = Reduction in animal yield.

The Respondents' Agreement Index (RAI) was used to measure the respondents' awareness of climate change and climate change-adaptation strategies of the respondents. Eight variables that could influence climate-change awareness were identified, including irregular rainfall patterns, excessive rainfall, excessive heat, long dry season, heatwave, destructive winds, frequent floods, due to uncontrolled rainfall, and changes in precipitation patterns. We assume that the respondents' level of agreement would indicate the magnitude of the occurrence of climate change, as shown by the strengths of these variables in the study area. To calculate the RAI, the respondents were instructed to rate each variable using one of the five ratings: Strongly Agree (SA) (5), Agree (A) (4), Just Agree (JA) (3), Disagree (DA) (2), and Strongly Disagree (SD) (1). The summation of weight value (SWV) for each variable was obtained through the addition of the products of responses for each rating of the variable and their respective weight values. Mathematically, this is expressed as:

$SWV = \sum_{i=1}^{5} X_i Y_i$ ……..equation (1)

Where:

SWV is the summation of weight value.

X_i is the respondents' rating of a particular variable indicating climate change occurrence.

Y_i is the weight value assigned to each variable.

The RAI for each variable is arrived at by dividing the summation of weight value by the addition of the number of respondents to each of the five ratings. This is expressed as:

$$RAI = \frac{SWV}{\sum_{i=1}^{5} P_i} \quad \text{..... equation (2)}$$

The same procedure was used to measure the climate change-adaptation strategies of the respondents albeit with different variables, including livelihood diversification, non-observance of regular working hours, irrigation, change in planting date and harvesting, crop diversification, mix-cropping, and agroforestry.

4.5 Limitation

A small sample size cannot be generalized across Nigeria or other countries. Therefore, the results of this study are limited to the research area.

5. FINDINGS AND DISCUSSION

5.1 Socio-demographic characteristics of the respondents

Table 2 shows that the majority of the respondents (87.5%) were married and within the economically active segment of the population, as 94.8% were aged between 21 and 70 years. Females constituted the dominant gender group (55.1%), which is a clear departure from a similar study by Lawanson and Oduwaye (2014) in Lagos, Nigeria, where males were dominant. There was a low literacy level among the respondents, according to UNESCO standards, as only 33.7% had secondary school education. The vast majority of the respondents (87.1%) had between five and ten people in their households. This is far above the national average of five as well as the Oyo State average of five people per household (National Bureau of Statistics (NBS), 2022; Oyo State Government, 2021). Over half of the respondents (55.3%) earn a monthly income below ₦50,000, placing them in the low-income category. These demographics prove that respondents are from the poor and vulnerable urban dwellers in Ibadan, Nigeria, and have experience to give information that could help make deductions on climate change-adaptation strategies.

Table 2: Socio-demographic characteristics of the respondents

Socio-demographic variable	Category	Frequency (n=481)	%
Age (years)	21-30	127	26.4
	31-40	112	23.3
	41-50	96	20.0
	51-60	64	13.3
	61-70	57	11.9
	Above 70	25	5.2
Gender	Male	216	44.9
	Female	265	55.1
Marital status	Married	421	87.5
	Single	60	12.5
Education	Tertiary	3	0.6
	Secondary	159	33.1
	Basic	134	27.9
	Vocational	91	18.9
	Religious	61	12.7
	Informal	33	6.9
Household size	2-4	62	12.9
	5-7	185	38.5
	8-10	234	48.6
Income (monthly)	Low [<₦50,000 (117$)]	266	55.3
	Medium [₦50,000-₦150,000 ($351)]	188	39.1
	High [Above ₦150,000 ($351)]	27	5.6

Note: The official rate is ₦427 to $1

5.2 Livelihood activities of residents

Analysis results in Table 3 show that respondents are involved in varying livelihood activities, with trading (17.9%) and hairstyling (10.6%) being the most frequently engaged activities. Poor infrastructure development, most importantly poor power, and energy supply, which serve as disincentives for manufacturing and other industrial initiatives appear to be responsible for a large number of respondents in trading. It should, however, be noted that traded items include both manufactured and agricultural as well as agro-allied produce, all of which are subject to the effects of climate change. Other important livelihood activities such as commercial cycle transport (9.4%), carpentry/ furniture making (8.9%), and fashion styling (8.1%) were almost equally practised by respondents. While these activities may be theoretically regarded as indirectly climate sensitive, a more direct climate-sensitive livelihood activity, namely urban farming, is engaged by 5.2% of the respondents. A close look at the structure of livelihood activities, as presented above, gives a semblance of what is obtained in other cities in Nigeria, as revealed by the studies of Jaiyebo (2003: 116) and Ifeanyi-obi & Matthews-Njoku (2014: 53).

Half of the respondents (51.2%), mostly hairstylists, traders, fashion stylists, tie and dyeing practitioners, and shoe cobblers had their livelihood activities located in their residences (Table 4). This influenced 36.8% who had their businesses outside their neighbourhoods to reach their locations of livelihood activities either through tricycle/ motorcycle (21.2%) or commercial bus (15.6%), while some (12.0%) who had their businesses within their neighbourhoods trekked to their locations. A majority of the respondents (68.4%) have been practising their livelihood activity for between 15 and 20 years, with 73.6% having received formal training. None of the respondents had obtained business registration with the Oyo State Government. While the non-registration of businesses facilitates tax evasion among this group of workers, it allows them to have more money to take care of their needs because they are poor. This confirms the argument of Otekhile and Matthew (2017: 12) that self-employed workers in Nigeria prefer informal operations to the cumbersome process of business registration in Nigeria. Except for civil servants, teachers and night guards, who worked for the government and individuals, 95% were sole proprietors. This corroborates the earlier assertion of Fields (2019: 5) that most of the workers in developing countries are self-employed and work alone.

Table 3: Livelihood activities of residents

Livelihood	Frequency	%
Trading	86	17.9
Hairstyling	51	10.6
Commercial tricycle/motorcycle transport	45	9.4
Carpentry/Furniture making	43	8.9
Fashion stylist	39	8.1
Masonry	35	7.3
Auto mechanic	29	6.0
Commercial bus transport	27	5.6
Farming	25	5.2
Shoe cobbling	23	4.8
Rental business	19	4.0
Electrical work	14	2.9
Teaching	12	2.5
Tie and dyeing	11	2.3
Informal waste collection	8	1.7
Night guard	8	1.7
Civil service	4	0.8
Total	481	100.0

Table 4: Characteristics of the livelihood activities of residents

Livelihood characteristics	Category	Frequency (n=481)	%
Location of livelihood activities	Home	246	51.2
	Within the neighbourhood	58	12.0
	Outside the neighbourhood	177	36.8
Mode of transport	Commercial tricycle/motorcycle	102	21.2
	Commercial bus	75	15.6
	Trekking	58	12.0
Years of practice	Less than 5 years	13	2.6
	5-10 years	69	14.4
	10-15 years	35	7.2
	15-20 years	295	61.4
	20-25 years	48	10.0
	Above 25 years	21	4.4
Mode of training for the job	Formal	354	73.6
	Informal	127	26.4
Types of business	Sole proprietorship	457	95.0
	Employees	24	5.0

5.3 Awareness of the existence of climate change

With an average RAI(MS) of 3.89, results in Table 5 show that respondents are aware and agree that climate change exists in the city of Ibadan. The MD(RAI) scores show the significance of each climate change variable. The highest RAI was 4.56, while the lowest was 2.80. Therefore, the deviations around the mean of the highest and lowest RAI were 0.67 and -1.09, respectively. The variables with positive deviations around the MD(RAI) were the variables considered by the respondents as the dominant indicators of climate change. Respondents agreed that long dry seasons (0.67), excessive heat (0.65), irregular rainfall patterns (0.39), and frequent floods due to excessive rainfall (0.33) are the main

Table 5: Respondents' Agreement Index (awareness of the existence of climate change)

S/N	Awareness of climate change	(5) Strongly agree - (1) Strongly disagree (n=481)					SWV	RAI(MS)	MD(RAI)
		5	4	3	2	1			
1	Long dry season	274	203	4	0	0	2194	4.56	0.67
2	Excessive heat	302	148	23	6	2	2185	4.54	0.65
3	Irregular rainfall pattern	197	251	33	0	0	2061	4.28	0.39
4	Frequent floods due to excessive rainfall	122	297	68	11	6	2030	4.22	0.33
5	Heatwave	56	107	125	129	64	1405	2.92	-0.97
6	Destructive winds	7	118	205	72	79	1345	2.80	-1.09
	Average RAI(MS) (composite score)							3.89	

Table 6: Effects of climate change on residents' livelihood

Livelihood	Frequency	%
Low patronage of buyers	143	29.7
Low productivity	109	22.7
Reduced income	96	20.0
Irregular patronage of customers	65	13.5
Delay in completion of clients' work	43	8.9
Reduction in animal yield	14	2.9
Low crop yield	11	2.3
Total	481	100.0

indicators of climate change. The variables with negative deviations around the mean were heat waves (-0.97) and destructive winds (-1.09). The respondents were not in agreement that these could be considered principal indicators of climate change in the study area.

The high level of awareness of the existence of climate change among the residents of Ibadan, as revealed by this study, is a departure from the findings in the literature. For instance, Odjugo (2013) reported in his study in two agro-ecological zones of Nigeria that over half of his respondents were unaware of the existence of climate change. Statista (2022) equally reported that over 60% of Nigerians were not aware of the changing climate. The awareness in Ibadan may be attributed to the role of mass media in disseminating climate-change information promptly as well as the long history of climate-induced disasters particularly flooding in the city, which has impinged on the residents' consciousness of climate-change issues.

5.4 The effects of climate change on residents' livelihood

The respondents were asked to state the effects of the changing climate on their livelihood activities. These expectedly generated diverse responses. Low patronage of buyers (29.7%) was the major effect indicated by the respondents. Other important effects include low productivity (22.7%), and a reduction in income (20.0%) (Table 6).

To statistically determine the effects of climate change on residents' livelihood activities using Multinomial Logistic Regression, climate change (dependent variable) was regressed against its effects on the livelihood activities (independent variables), as indicated by the respondents. The stated effects are low productivity, reduced income, low crop yield, low patronage of customers, irregular patronage of customers, delay in completion of clients' work, and reduction in animal yield. The result of the analysis is presented in Table 7. The multinomial regression model derived from the analysis is given as Y = 17.025 – 29.217x1 – 27.342x2 – 16.463x3 – 24.755x4 – 23.591x5 – 14.376x6 – 15.173X7.

The 2-log likelihood of the model, which is 17.025, indicates a direct negative relationship between the independent and predictor variables. The Nagelkerke pseudo r^2 of 0.483 shows that the seven independent variables accounted for 48% of the variation in the effects of climate change. All the predictors in the model relate negatively to climate change. Low productivity with –29.217 was the most visible effect. This is followed by a reduction in income with –27.342x2, while low crop yield, low patronage of customers, irregular patronage of customers, delay in completion of clients' work, and reduction in animal yield with –16.463x3, –24.755x4, –23.591x5, –14.376x6 and –15.173X7, respectively, were found to be moderate negative effects of climate change on livelihood activities. These results corroborate the earlier literature which identified low income and productivity (Onwuemele, 2015), low animal yield and patronage (Ayanda, 2013), as well as irregular client engagement (Tharkur & Bajagain, 2019) as the effects of climate change on livelihood activities. The researcher observed low crop yield during the field survey, as some crops had stunted growth and could not yield much, while parts of some farmlands had been washed away by flood, leaving a few crops for harvest. It was also observed that destruction of power infrastructure and properties, where livelihood activities take place, caused delay in completing clients' work, and low and irregular patronage by clients.

5.5 Livelihood-adaptation strategies to climate change

It is important to note that, of the 481 residents who participated in the survey, 35 (7.3%) did not adopt any livelihood-adaptation strategy to cope with the effects of climate change. With an average RAI(MS) of 2.68, results in Table 8 show that respondents on average 'agree' that all five climate-adaptation strategies provided an effective cushion against the adverse effects of climate change on people's livelihood activities in the city of Ibadan. To statistically determine the weight and the magnitude of the use of livelihood-adaptation strategies among the respondents, the RAI was also employed. The highest RAI was 3.51, while the lowest was 1.12. Therefore, the deviations around the mean of the highest and lowest RAI were 0.83 and -1.12, respectively.

Table 7: Multinomial Logistic Regression result

Effects	Model Fitting Criteria	Likelihood Ratio Tests			Pseudo R-Square	
	-2 Log Likelihood of Reduced Model	*Chi*-Square	df	Sig.		
Intercept	17.025	.000	0		Cox and Snell	.111
Low productivity	–29.217[b]	7.569	11	.721	Nagelkerke	.483
Reduced income	–27.342[b]	11.899	16	.938	McFadden	.546
Low crop yield	–16.463[b]	49.696	25	.646		
Low patronage	–24.755[b]	4.482	2	.851		
Irregular patronage	–23.591[b]	19.503	37	765		
Delay in completion of clients' work	–14.376[b]	6.762	65	527		
Reduction in animal yield	–15.173[b]	18.453	43	.293		
Model Fitting Information						
Model	Model Fitting Criteria	Likelihood Ratio Tests				
	-2 Log Likelihood	*Chi*-Square	Df	Sig.		
Model Fitting Criteria	Likelihood Ratio Tests					
-2 Log Likelihood	Chi-Square	Df	Sig.	1.000		

[b] = slope

Table 8: Respondents' agreement index (livelihood-adaptation strategies)

S/N	Livelihood-adaptation strategies	(5) Strongly agree - (1) Strongly disagree (n=446)					SWV	RAI(MS)	MD(RAI)
		5	4	3	2	1			
1	Diversifying income sources	75	204	91	27	49	1567	3.51	0.83
2	Non-observance of regular working hours	59	111	190	65	21	1460	3.27	0.59
3	Modifying food habits to cope with a food crisis	44	83	175	116	28	1337	3.00	0.32
4	Adjusting tasks within households	0	87	125	148	86	1105	2.48	-0.20
5	Irrigation	8	1	2	14	421	499	1.12	-1.56
	Average RAI(MS) (composite score)							2.68	

The variables with positive deviations around the mean MD(RAI) were diversifying income sources (0.83), non-observance of regular working hours (0.59), and modifying food habits to cope with food crises (0.32). The respondents considered these variables to be the dominant livelihood-adaptation strategies. The variables with negative deviations around the mean were adjusting tasks within households (-0.20) and irrigation (-1.56). The respondents were not in agreement that these could be viewed as principal livelihood-adaptation strategies in the study area.

Earlier studies have posited that people in various communities in Nigeria tend to evolve and adopt diverse livelihood strategies to cope with the adverse effects of climate change on their livelihood activities based on the prevailing socio-cultural and environmental conditions of their communities (Federal Ministry of Environment, 2011: 29-30; Ifeanyi-obi *et al*., 2011: 27; Okoroh, 2016: 136; Oluwole, 2016: 369). Various authors point to the importance of diversification as an overarching strategy for the livelihoods of the urban poor (Tharkur & Bajagain, 2019; Edilegnaw, Mmaphuti & Eliaza, 2022). Income diversification appears to be the easiest and most effective adaptation strategy since switching livelihood, when one has been prevented from practising one's major livelihood by the changing climate, guarantees a reasonable income flow. The alternative income sources of the respondents include casual labour, food vending, hawking, urban agriculture, waste picking, and hair plaiting (see Table 4). The non-observance of regular working hours by the respondents suggests that the respondents worked for longer hours during unfavourable climatic conditions. This adaptation strategy was visible during the observations made by the researcher when most of the commercial bus drivers and tricycle/motorcycle operators worked throughout the night during the rainy season because they are usually prevented from operating for the larger part of a day and because there is the availability of passengers at night during this period. The reduction in consumption of certain food and vegetable items because of their relative scarcity, due to adverse climatic conditions, as an adaptation strategy was largely adopted by the respondents who were farmers and those who traded in agricultural produce. Because they consume what they produce and sell, a reduction in consumption will keep them in business and ensure survival during a period of unfavourable climate. While most of these studies have focused on rural communities, this article has reported the adaptation strategies of urban dwellers. Thus, considering the peculiarities of urban centres concerning climate change, the strategies reported are slightly different from most of those reported by earlier studies.

5.6 Factors influencing the choice of adaptation methods

The results of the Tobit Regression Analysis in Table 9 shows seven major factors that influence the residents' choice of adaptation strategies. The results indicate that access to credit (t=3.44), at 5% significance level, was positive and statistically significant. This indicates that the residents' access to credit influences the effectiveness of their adaptation strategies and relatively mitigates the adverse effects of the changing climate on their livelihood activities. Adi (2007: 93) identified the availability of funds as a significant variable in determining non-agricultural livelihoods. The findings of this study agree with Adi's findings. Attempts to have access to credit to diversify their livelihood activities influenced the selling of large ruminants and the purchase of less expensive food by some households in Pakistan (Batool *et al*., 2018).

Educational qualification (t=3.73), at 5% significance level, was also found to be positive and significant. Thus, the higher the level of education, the more diversified the livelihood activities of the respondents to cope with the impacts of climate change.

This result concurs with the findings of Adi (2007: 94) in South-Eastern Nigeria, where educational status plays a major role in determining livelihood diversification to ensure uninterrupted income flow that may arise from the effects of climate change and other socio-economic challenges. Educational qualification plays a role in seeking off-farm employment as a livelihood-adaptation strategy by respondents in South Africa and Ethiopia Nile Basin (Bryan *et al*., 2009). It is important to note that, age (t=1.68), at 5% significance level, was statistically not found to be significant as a predictor for adaptation strategies.

Household size (t=6.31), at 1% significance level, was positive and statistically significant. This implies that the more a household expands, the more their livelihood activities become expanded and the more they tend to evolve strategies to mitigate the adverse effects of climate change. This indicates that, as a household increases in size, there will be the need to expand livelihood activities, in order to cater to the number of mouths to be fed, and the multiplicity of these activities will trigger several strategies aimed at mitigating the impacts of climate change. This agrees with Mutangi (2013: 500) who identified household size as one of the major determinants of livelihood diversification in the peri-urban area of Masvingo (Zimbabwe). As reported by Bryan *et al*. (2009), some livelihood-adaptation strategies that were likely influenced by household size in South Africa and Ethiopia Nile Basin were engagement in food-for-work programmes, migration, and reducing consumption.

The respondents' income (t=1.05), at 5% significance level, was also found to be positive and statistically significant. This suggests that growing income from a livelihood activity enables the respondents to create an adequate buffer to withstand the adverse effects of climate change on their livelihood activity. This result conforms to the earlier assertion of Ifeanyi-Obi and Matthews-Njoku (2014: 54) that income plays a dominant role in livelihood diversification in the South-Eastern region of Nigeria. The availability of savings from major livelihood activities facilitates the running of a grocery store as an alternative livelihood strategy in India (Rautela & Karki, 2015).

Access to climate change information (t=3.73), at 5% significance level, was positive and statistically significant as a predictor for adaptation strategies in Ibadan. Thus, the availability of information on weather forecasts detailing months, times, and periods of occurrence of climatic elements such as rainfall, sunlight as well as the intensity of the elements will assist the respondents in adopting adequate and effective strategies to circumvent the impacts of changing climate on their livelihood activities. Those engaged in urban agriculture and traders involved in agricultural produce mostly fall within this category. This study amplifies Chete's (2019: 51-52) assertion that access to information on climate change ensures prompt livelihood diversification to cushion the adverse effects of climate change. Access to climate change information appears to play a role in the livelihood-adaptation strategies of some households in Bangladesh that engaged in crop diversification, modification of planting, and harvesting periods, as reported by Ahmed and Haq (2017). However, gender (t=2.24), at 5% significance level, was statistically not found to be significant as a predictor for adaptation strategies.

The frequency of occurrence of climate-induced disasters (t=1.43), at 5% significance level, was positive and significant for predicting adaptation strategies. This shows that the rate and persistency of a particular climate-induced disaster such as floods would have given the respondents an idea of when, how, and the magnitude of the disaster, thereby enabling them to evolve effective adaptation measures to mitigate the impacts of the disaster. Thus, the more the occurrence of natural disasters, the more the extent to which residents diversify their livelihood activities. This explains why farming households in South Africa and Ethiopia's Nile Basin seek off-farm employment as a livelihood-adaptation strategy (Bryan *et al*., 2009).

Table 9: Results of Tobit Regression Analysis

Variables	Co-efficient	Standard Error	T
Access to credit	.373496	.0284371	3.44**
Educational qualification	.095117	.0475326	4.20**
Household size	.724164	.5382679	6.31***
Gender	.054448	.0161742	2.24
Income	.072933	.0395860	1.05**
Access to information	.464558	.0571344	3.73**
Age	.056262	.0392730	1.68
Frequency of disasters	.035242	.0426327	1.43**
Constant	.047516	.0335281	13.15***

**Significant at 5% level

***Significant at 1% level

6. CONCLUSION AND RECOMMENDATIONS

Although the respondents in this study are aware of climate change and the impact this phenomenon has on their livelihoods, they adopted different strategies to cope with the effects of climate change. Diversifying income sources, adjustment to regular working hours, and modifying food habits are some of the strategies adopted by respondents. Adopting these strategies was influenced by the respondents' access to gaining credit, their income, household size, and access to information. Over half of the respondents were from the low-income category, making them vulnerable urban dwellers in Ibadan, Nigeria. They indicated that their income was reduced because of climate change on their livelihood activities. It is pertinent to note that the respondents' inability to optimally

perform their livelihoods, due to variations in climatic elements, has implications for individuals' efforts to escape poverty and productively engage in decent jobs. Thus, reaching Sustainable Development Goal (SDG) 1 on 'Zero Poverty' and SDG 8 on 'Decent Work and Economic Growth' will be a daunting task. It is also important to note that SDG 13 emphasizes the adoption of policies and measures to address the incidence of climate change by countries of the world.

For Ibadan city to be sustainable, its poor inhabitants must be productively engaged and the changing climate should hinder their economic activities to a minimal extent. Therefore, there is a need for coordinated and collaborative actions by stakeholders to effectively address the challenges of climate change, in order to ensure seamless livelihood activities and foster poverty reduction and zero hunger in the city of Ibadan and elsewhere. This can be achieved through the following measures:

- The physical planning system of Ibadan City should be strengthened to ensure the planning and management of the city in such a way as to build its resilience and adaptive capacity to climate-related hazards and natural disasters. The current urban planning system in the city is too weak to effectively address the planning deficiencies that permit the devastating effects of climate-induced disasters. Poor urban planning has been instrumental in the frequent occurrence of floods in the city in recent times. Therefore, the urban planning authorities will do well if climate-resilient planning approaches such as urban ecosystems and green infrastructure are adopted. These approaches provide solutions to climate change challenges at a lower cost than traditional infrastructure approaches.
- While it is gratifying to note that the master plan and waste-management plan for Ibadan City have been prepared, the implementation of the plans has been too slow. A dedicated implementation of the plans will guarantee effective containment of climate-induced disasters.
- The state and local governments should ensure that the city's inhabitants have full access to climate-related information at all times. This can be achieved through effective partnerships with the relevant agencies and organisations involved in climate monitoring such as the *Nigerian Meteorological Agency* (NiMet) and Building Nigeria's Response to Climate Change (BNRCC). The agencies and organisations can provide information on climate change detailing months, times, and periods of occurrence of climatic elements such as rainfall, sunlight, as well as the intensity of the elements. This will assist the people in adopting adequate and effective strategies to circumvent the impacts of changing climate on their livelihood activities.
- Adequate financial assistance in the form of non-interest soft loans should be provided to the people regularly to aid their livelihood diversification occasioned by the changing climate. To achieve this, governments at the local and state levels should partner with some financial institutions, especially microfinance banks and the Bank of Industry (BOI) as well as philanthropic non-governmental organisations such as the Rotary Club.
- A comprehensive climate and disaster risk-management plan for Ibadan City requires urgent preparation and faithful implementation, in order to effectively address the general challenges of climate change and its effects on livelihood, in particular. Such a plan should discourage or regulate livelihood strategies that contribute to climate change. For instance, the polluters-pay principle should be applied to any rickety (smoky) vehicles used by commercial transport operators.

ACKNOWLEDGMENTS

The author appreciates the two anonymous reviewers and the *Town and Regional Planning* editors for their constructive comments and many helpful suggestions on earlier drafts of this article.

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