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CLIMATE-INDUCED PROBLEMS AND ADAPTATION STRATEGIES OF URBAN FARMERS IN IBADAN

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Abstract
This study examined the perceived climate-induced problems encountered by urban farmers in Ibadan, the farmers' responses and adaptation strategies. Primary data were collected through the administration of a structured questionnaire, key-informant interviews and field observation. Stratified random sampling was employed in selecting 244 urban farmers for questionnaire administration. In-depth interviews were also conducted with officials in the Department of Agriculture in the five urban local government areas of Ibadan. The climate-induced problems observed by the farmers included: loss of soil nutrient (48.4%), erosion and flooding (28.7%); deterioration of transport route (7.8%); pest invasion, and high sedimentation of farm lands owing to flooding (1.2%). Unavailability of extension workers (0.8%) was another problem reported by the farmers. The farmers' adaptation strategies were planting of short-season crops (38.1%); changing of planting dates (25.8%); irrigation (21.7%); planting of drought and flood-resistant crops (10.6%); planting of cover crops (0.4%), and crop rotation (3.3%), with an analysis of variance significance value of 0.264. The study concluded that the farmers' had a good knowledge of the climate-induced problems on farming activities but need support to strengthen their present adaptation measures aimed at reducing the effects and increase productivity. The study recommended policy support by government in the form of accurate climate information, education and capacity-building for farmers on climate-related issues and the formulation of policies to promote irrigation farming, compost utilization and flood adaptation measures to reduce the effects of climate variability and increase farmers' productivity.

Key Words: *Urban-agriculture, Climate-induced problems, Adaptation strategies, Urban farmers, Ibadan*

Introduction
Agricultural activities are very sensitive to climate and weather conditions. Changes and instability in climatic elements, such as precipitation, temperature, winds, and humidity, affect crop production directly and indirectly through changes in soil quality, pests and

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diseases. Globally, climate change is, perhaps, the most serious environmental threat that adversely affects agricultural productivity. Climate change currently decreases the yield of maize, rice, wheat, potatoes and vegetables and will reduce seriously by 2050 globally (Ignaciuk and Mason-D'Croz, 2014).

Slater *et al.* (2007) opine that, by the end of the 21st century, climate change and variability will substantially affect agricultural production, with such impacts likely to be negative on many developing countries, particularly in Africa. This is because African economy is predominantly agrarian, rain-fed, fundamentally dependent on the vagaries of weather, and being confronted with poverty and low technological development (Jagtap, 2007).

In Ibadan, urban and peri-urban agriculture is facing increasing risks of production systems and food chains from extreme climate events (Adelekan *et al.,* 2014). The threat posed by the changing climate to urban agriculture could lead to increased poverty amongst farmers and food insecurity in society. This motivated this study, which examined the perceived problems encountered by urban farmers in Ibadan as a result of climate variability, and the farmers' adaptation measures towards the induced-stress from climate variability.

Conceptual Discourse and Literature Review

This study is anchored to the concept of adaptation. The United Nations International Strategy for Disaster Reduction (UNISDR) (2009) defines adaptation as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities. The working definition for this study sees adaptation as involving a set of processes, procedures and techniques adopted by people towards reducing the negative effect of climate variability on their activity, which is driven by social, cultural and individual experiences, targeted at bringing about improved livelihood options.

Research on climate change-agriculture interactions has evolved from a "top-down" approach to a "bottom-up" approach (Gbetibouo, 2009). The top-down mode starts with climate change scenarios and estimates impacts through scenario analysis, based on possible adaptation practices identified (Wall and Smit, 2005). In this mode, adaptations are assumed and treated as primarily technical adjustments (for example, changing to different crops, adopting efficient irrigation systems, or altering production systems) to the impacts identified. The bottom-up approach, on the other hand, takes on a vulnerability perspective where adaptation strategies are considered more as a process involving the socioeconomic and policy environments, farmers' perceptions, and elements of decision-making (Bryant *et al*., 2000).

FAO (2008), identifies the following adaptation options for climate variability and change in different ecosystems: seasonal changes and sowing dates; planting of new crop species; water harvesting, shallow aquifers, irrigation and watershed management systems; zero-tillage farming; prevention of land degradation; improved livestock management; integrated forest pest and fire management; promotion of agro-forestry and silvicultural practices.

Farmers' concerns regarding climatic changes and variability and the adaptive

measures put in place are influenced by their perceptions of their own adaptive capacity (Bryant *et al.*, 2000), their indigenous knowledge systems, cultural practices and histories. The assessment of farmers' perceptions and adaptation to climate variability and change in Doba District, Ethiopia by Belaineh *et al.* (2013) identified agro-ecological locations, age of farmer, sex, family size, plot size, years of farming experience, education, off-farm income, livestock holding, access to credit facilities and number of extension contacts and training as factors influencing adaptation strategies. Muthonk and Wangui's (2013) study on women and climate change in Mangio village of Tanzania emphasize the relevance of finance, government planning and policies in the choice of adaptive measure.

On gender involvement in the level of adaptation strategies, women were found to be most aware of adaptation strategies, such as alteration in planting dates, application of local manure, raised-bed cultivation, use of bio-pesticides, crop replanting intensifying, and multiple cropping. However, they had low level of awareness of tree planting, zero/minimum tillage, use of shallow wells and local irrigation to help reduce drought (Nwakwasi *et al.,* 2012).

Farmers in Nigeria have little adaptive capacity owing to lack of scientific, technical, financial and institutional capacity to evaluate the impact of climate change (Kehinde and Adegunloye, 2011). As such, the impacts of climate change and variability will continue to be felt by the farmers unless adaptation strategies are employed and sustained to mitigate the adverse consequences of climate change (Yakubu *et al.,* 2012). This again provides the justification for this study.

Study Area

Ibadan is one of the major urban centres in Nigeria. The city of Ibadan is located approximately on longitude 3°5′East of the Greenwich Meridian and latitude 7°2′ North of the Equator at a distance of some 145 kilometres east of Lagos. The Ibadan metropolitan area covers a total land area of 3,123.30 km², out of which the urban local government areas cover about 463.33km². The city of Ibadan is made up of eleven (11) local government areas (LGAs), five (5) of which constitute the urban local governments (Fig.1), while the remaining six (6) form the peri-urban or rural local governments. The 2006 provisional census figures put the population of Ibadan at 2,550,593 (1,338,659 urban and 1,212,294 rural) (National Population Commission, 2010).

The Ibadan metropolitan area experiences high relative humidity and generally two rainfall maximal regimes during the rainfall period of March to October. The prevailing annual rainfall ranges from 1200 mm to 1500 mm, with a mean of about 1,350 mm.The mean temperatures are highest at the end of the harmattan (averaging 28°C), that is from the middle of January to the onset of the rains in the middle of March. Even during the rainfall months, average temperatures are relatively high, between 24°C and 25°C, while annual fluctuation of temperature is about 6°C (Oguntoyinbo, 1994). Jackson *et al*. (2012) observe that there was an overall temperature increase of 0.4°C per decade in the annual mean temperature of Ibadan.

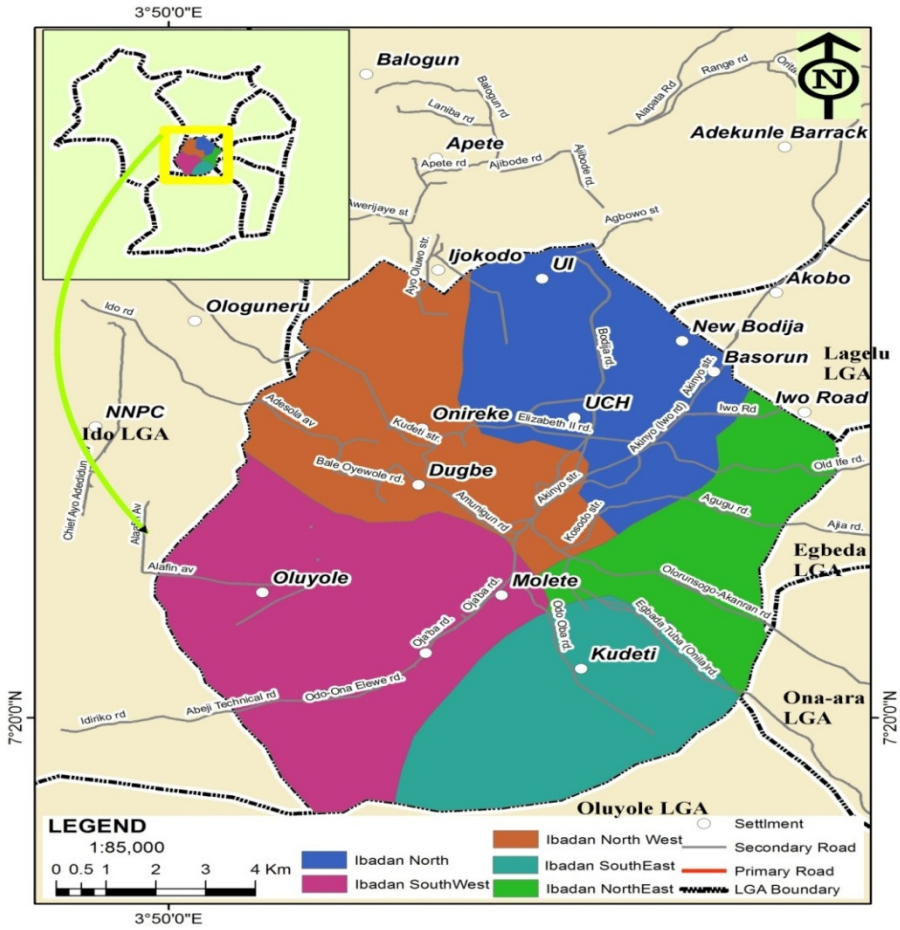

Fig. 1: Five Urban Local Government Areas in the context of the Ibadan Metropolis
Source: Department of Geography, University of Ibadan (2015)

Methodology

The data for the study were obtained from primary and secondary sources. The sample selection was based on a similar study by Odewumi *et al*. (2013), which administered a questionnaire to 145 urban farmers using a cluster sampling technique and the least-cost approach.

This study adopted the stratified random sampling technique. The sample frame for the study was the 4,073 farmers (crop and animal) registered with the Oyo State Agricultural Development Programme (OYSADEP) in five local government areas (LGAs) in the Ibadan metropolis (Ibadan North, Ibadan North East, Ibadan North West, Ibadan South East, and Ibadan South-West). A 6% sample size, representing 244 urban farmers, was adopted for the administration of the structured questionnaire in the five LGAs.

Field observation, in-depth interviews conducted among members of staff of the Department of Agriculture in the LGAs and a pre-tested structured questionnaire were used to collect primary information on the impact of climatic variability on agricultural production and the farmers'adaptive measures. Secondary data were collected through review of literature, particularly journal articles, theses, reports, other publications and online materials.

Descriptive analysis was adopted in analysing the socio-economic characteristics, while analysis of variance (ANOVA) was used to test for the hypothesis that states that there is no significant difference in the adaptation techniques adopted by urban farmers across the study area.

Results and Discussions

Socio-economic Characteristics of the Respondents

The results revealed that 65.2% of the respondents were male, while 34.8% were females. On ages of the respondents, 18.5% were below age 30years, 23% were between age 31 and 35years, 11.0% were aged between 36 and 40years, while 11.9% and 35.6% were aged between 41 and 45years, and 45years and above, respectively. Marital status of the respondents revealed that 27.1% were single, 64.0% married, while 5.1% and 3.8% were divorced and widowed respectively. About 44.7% of the respondents earned below the national minimum wage of ₦18000 ($60) per month. With the exchange rate at ₦300 per USD, about 4.5% of the respondents earned below ₦5,000 ($17) a month, 16% earned between ₦5,000 ($17) and ₦15,000 ($50), 24.2% earned between ₦16000 ($54) and ₦25000 ($84), 9% earned between ₦26000 ($87) and ₦35000 ($117), 25% earned between ₦36000 ($120) and ₦45000 ($150), while the remaining 21.3% earned above ₦45,000 ($150) monthly.

The respondents engaged in a variety of agricultural enterprises. About 74.6% of the farmers often engaged in the planting of food and tuber crops, while 25.4% rarely did so. Also, 52.5% often engaged in forestry and 47.5% rarely did so. While 79.2% often engaged in animal husbandry (in the form of fish farming and rearing of chicken, goats, pigs and sheep), 20.8% rarely did so. About 72.7% also engaged in the planting of leguminous and vegetable crops, such as *Corchorus*, African spinach, cucumber, and food crops, such as yam, cassava, and cocoyam; while 69.5% often engaged in planting of cereals, such as maize and cowpea. This result is similar to what Cofié (2008) reported in Ibadan, where 73% urban residents engaged in crop farming, 15.5% involved in fish farming, and 11.1% in livestock.

The farmers who were civil servants (18.4%) had a proper understanding of climate variability and urban agriculture. About 8.9% of the 11.1% of the farmers who were also artisans were carpenters. Most farmers (77.9%) engaged in secondary occupation, such as trading/business (41.6%), civil service (18.4%), teaching (14.2%), artisanship, such as welding and building construction (11.1%), and others, such as driving and security (14.7%). This was to augment their incomes from farming to meet up household financial demands.

Problems facing urban farming in Ibadan as a result of climate variability

The problems encountered by urban farmers in Ibadan as a result of climate variability include loss of soil nutrients (25.8%), poor crop yield and reduction in farm produce (23.8%), erosion/flooding and sedimentation of farmland (15.6%), reduction in profit (10.6%), delay in harvesting (9.8%), outbreak of pest invasion (6.5%), deterioration of transport route (4.1%), and increase in cost of fertilizer (3.3%). A non-climate but human-induced problem encountered by the farmers was the unavailability of extension workers (0.4%) (Table1). These findings tally with those of

Adelekan *et al.* (2014), that heavy rainstorms and flooding have constituted a major problem to agriculture and agriculture-related activities in Ibadan, resulting in major financial and infrastructural losses to the farmers. Yahaya and Akpenpuun's study (2015) in the middle belt in Nigeria revealed that excessive increases in temperature resulted in low agricultural productivity and that 97.9%, 96.0%, 95.2%, and 80.0% of total variability in yield of maize, sorghum, rice and millet, respectively were as a result of the effect of the climatic parameters.

Table 1: Problems encountered by urban farmers from climate variability

Response	**Number of respondents**	**Percentage**
Loss of soil nutrient	63	25.8
Poor crop yield and reduction in farm produce	58	23.8
Erosion/flooding and sedimentation of farmland	38	15.6
Reduction in profit	26	10.6
Delay in harvesting	24	9.8
Outbreak of pests and diseases	16	6.5
Deterioration of transport route	10	4.1
Increase in cost of fertilizer	8	3.3
Non-availability of extension workers	1	0.4
Total	244	100

The deterioration of transport route is one of the problems facing urban farmers in Ibadan and this has an indirect effect on the flow of farm produce. Plate 1 presents a collapsed bridge within the peri-urban farming zone of Ibadan resulting from flooding. Kwom (2001) reported that roads have strong positive impact on income and agricultural productivity in rural Indonesia, while lack of transport impedes access to markets and hence to revenues by smallholder farmers (Crossley *et al.*, 2009).

Plate 1: Effect of climate on transport route along River Ona floodplain in Ibadan and artificial wooden bridge provided to enhance easy accessibility along the Eleyele floodplain.
Source: Oyo State Government (2011)

Coping Strategies and Urban Agriculture in Ibadan

A majority (77.5%) of the farmers in Ibadan had adaptive strategy in place to manage the effects of climate variability, while 22.5% did not have any. The type of adaptive measures put in place by the farmers included (Table 2); planting of short duration crops (38.1%), changing of planting dates (25.8%), irrigation (21.7%) (Plate 2), planting of crops and vegetable resistant to drought (5.7%), such as cassava, *efo green* (a variety of vegetable) and flood-resistant crops (4.9%), such as water melon, *egusi* (melon), sugarcane and banana. However, while 3.3% of the farmers practised crop rotation and changing of farm location (moving downstream, closer to the river basin or wetland during the dry season and sometimes moving farther away from the floodplain during the raining season), 0.4% engaged in planting of cover crops, such as cowpea, lettuce and curry. Mulching and irrigation were also largely practised. Out of these farmers, 63.0% had at one time or the other changed their crops from cereal (maize) to vegetable and legume, from vegetable such as *Telfairia occidentalis* to vegetables (*African spinach, Corchorus*) and cassava owing to the adverse effects of climate variability of the crops planted.

Table 2: Adaptive measures put in place by farmers

Response	**Number of respondents**	**Percentage**
Planting of short season crops	93	38.1
Changing of planting date	63	25.8
Irrigation	53	21.7
Planting of drought-resistant crops	14	5.7
Planting of floodresistant crops	12	4.9
Crop rotation and change in farm location	8	3.3
Other methods	1	0.4
Total	244	100

Plate 2: A woman irrigating her vegetable farm

In order to ascertain whether the coping strategies adopted by the farmers differed across the surveyed LGAs or not, Analysis of Variance (ANOVA) was used. The results of the analysis showed that there was significant difference in the type of coping strategies adopted (planting of short-season crops, changing of planting date, irrigation, planting of drought-resistant crops, planting of flood-resistant crops, crop rotation/change in farm location and planting of cover crops) across the studied LGAs. The statistical analysis revealed a level of significance of 0.264 (Table 3). This establishes that there is significant variation in adaptation strategies adopted by farmers. This variation in adaptation across the study area is well explained by Ian *et al.* (2006).

Table 3: ANOVA between farm location and various adaptive strategies

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	18.403	6	3.067	1.286	.264
Within Groups	565.400	237	2.386		
Total	583.803	243			

The study revealed that the coping strategies adopted by urban farmers varied from one farm location to the other across the study area. This is because the locational characteristics of farms often define the techniques adopted. Farmers in Ibadan North LGA engaged in irrigation because of the presence of rivers and wetlands in the area as compared to Ibadan South East farmers that complained about the rugged nature of the area. Farmers in Ibadan South East LGA could only engage in poultry farming, subsistence animal husbandry and peri-urban farming along the rural interface.

It was observed during the field exercise that female farmers often practised irrigation, while males could engage in mulching, changing of planting dates, and change of crop. About 66.4% changed from the planting of cereal crops, such as maize, to vegetable and legume farming, or the planting of vegetables, such as *fluted pumpkin* (native name: *ugwu*), *green vegetable* (native name: *efo*), *Corchorus* (native name: *ewedu*), or the cultivation of drought-resistant plants, such as cassava. The climatic factors responsible for the change in crops planted were high temperature (24.7%) and late rain (17.3%). Farmers also identified factors such as late arrival of fertilizer (3.7%), cattle invasion (1.2%), labour scarcity (18.5%), and finance (18.5%), all of which can be classified as human-induced or institutionally-induced (Table 4).

The choice of adaptive measures put in place by farmers to combat climate variability was influenced by a number of factors of which finance (77.9) was the major. Other factors were nearness to source of water (68.9%), farm size (66.4%) and farmers' experience (63.1%). This finding is in line with the findings of Gbetibouo (2009) and Muthonk and Wangui (2013).

Table 4: Reasons for change in crop planted

Response	**Number of respondents**	**Percentage**
High Temperature	40	24.7
Labour Scarcity	30	18.5
Finance	30	18.5
Late Rain	28	17.3
Pest Invasion	26	16.1
Late Arrival of Fertilizer	6	3.7
Cattle Invasion	2	1.2
Total	162	100.0

Urban farmers in Ibadan sourced their adaptive measures through indigenous practices (37.3%); 27.0% sourced theirs from seminars and relationship with agricultural researchers and consultants; 13.5% were educated by farm extension workers; 10.7% from the mass media, specifically television and radio; 7.4% sourced theirs from farmers' cooperative meetings; 3.7%, who were educated, sourced theirs from the Internet; while the remaining 0.4% learnt it from school. The result reflected that indigenous practices played a vital role in agricultural adaptation sources and that farmers were not well educated as to the uses of Internet facilities. This submission is supported by Christanell *et al.* (2009) and Adesiji and Obaniyi (2012). Chah *et al.* (2012) reported that farmers' sources of information on climate change and adaptation in Enugu, Nigeria, included radio (33.3%), film show (30.0%), farmers' meetings (28.3%), friends (26.7%) and extension workers (25.0%).

The study revealed the challenges faced by the farmers in their choice of adaptive measures to include insufficient income and lack of access to loans. Others were limited access to and expensive nature of irrigation and adaptation equipment, illiteracy and non-workability of the adaptation techniques.

Conclusion and Recommendations

This study found that the urban farmers in Ibadan were aware of the effects of climate variability in their area. As a result of climate variability, the farmers experienced loss of soil nutrients, erosion/flooding and sedimentation of farmland, poor crop yield and reduction in farm produce, delay in harvesting, pest infestation and reduction in profit.

Using their indigenous knowledge, farmers put in place adaptive measures, such as the planting of short-duration crops, changing of planting dates, crop rotation and irrigated farming. However, the farmers' adaptation options were constrained by inadequate finance, limited access to water and irrigation equipment, limited mobility, and small farm sizes. Sustainable policies are required that will facilitate farmers' access to affordable credit as a means to enhance their financial resources and improve their adaptation options and practices on climate change.

For increased food production in Ibadan and similar cities in Nigeria and Africa, there is a need for policy frameworks that encourage compost utilization to replenish soil nutrients and substantial investments in irrigative farming and sustainable floodplain management to support all-year-round agricultural activities.

The state and local governments should facilitate farmers' easy access to subsidized farm inputs, such as herbicides, pesticides and insecticides, to combat pest and disease invasion on farms; and access to sizeable and cultivable farmlands, soft loans, flood- and drought-resistant seeds and organic fertilizer to enhance crop yield and increase farmers' profitability. Farmers in LGAs with scarcity of agricultural land should engage in livestock farming. The governments should undertake extensive rural road construction and maintenance to enhance the movement of farm produce from farmlands to the final consumers.

The farmers' indigenous knowledge and local practices on climate change adaptation should be integrated with Western climatic information database and formal climate change adaptation strategies. Integrated, participatory and collaborative learning approach is needed to elicit farmers' understanding of climate and climate information, predictions and interpretations.

The Ministry of Agriculture and the Oyo State Agricultural Development Programme should collaborate and formulate an enduring policy towards increasing extension service outlets and organizing relevant training for farmers on early warnings and appropriate adaptation strategies to climate variability. Policy support in the form of accurate climate information, education and capacity-building for farmers on climate-related issues by relevant institutions in Ibadan, such as the Nigerian Meteorological Agency, Cocoa Research Institute of Nigeria, Forestry Research Institute of Nigeria and Institute for Agricultural Research & Training, will facilitate efficient seasonal forecasts in the agricultural sector and enhance efficient decision-making by farmers on issues of adaptation.

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