

Migration among Farmers in Delta State, Nigeria: Is it a Climate Change Adaptation Strategy?

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Abstract: Objective: The study has the purpose of evaluating the nexus between climate change and migration of farmers in Delta State, Nigeria. The influence exerted by cognitive situations and climate – driven stress on farmers’ decisions to migrate and the socioeconomic attributes of migrating and non-migrating farm families are examined. The emphasis is the function of migration in accessing climate and agricultural extension services as well as the contribution made by migration to promote farmers’ climate change coping capacity. Methodology: Survey was articulated using farming households in three agricultural zones of Delta State, Nigeria. Perceptions of farmers about alterations in climate were examined with the use of mental map technique. Binary logistic regression model was applied to assess the function of socioeconomic attributes of farm families while descriptive statistics was employed in evaluating the adaptive capacities of the migrating farming households. Findings: Climate – driven livelihood variables form part of the main propellers of migration among farmers. Migration as well as the socioeconomic attributes is influenced by perception of farmers about climate change. There appears significant difference between migrating and non-migrating farm families with respect to utilization of information, technology and knowledge emanating from agricultural and climate extension services. The gains from remittances, knowledge and social networks from host communities or zones raise migrating farm families capacity to adapt to climate change. Theoretical Implications: This paper contributes to the progressively dynamic body of knowledge by pointing out migration as an alternative climate change adaptation strategy to promote agriculture food security in any part of the world. Originality/Value: Micro – evidence is offered by this study with respect to contribution made by migration to adaptive capacity of farmers and their ability to have access to agricultural and climate extension services. This will be useful in the analysis of climate – driven migration in other nations that are agricultural economies. Insight is also offered regarding policy needs for the scaling down of farmers’ vulnerability to climate change.

Keywords: Adaptation strategies, agricultural extension services, climate change, climate extension services, climate change mitigation, internal migration

Introduction

Movement of people prompted by environmental threats is an age long phenomenon. It has been asserted by many that people in farming communities embark on temporary migration during periods of flood when there are incidents of flooding in such communities. This may be a confirmation of the statement made by Livingstone (2000) which he credited

to Hippocrates and Aristotle that the attributes of natural environment are determinants of human habitability of a location, as well as the qualities of the humans that inhabit it. This is indicative of the fact that human beings relocate temporarily or permanently from a location of occupation to better locations where they find comfort as asserted by Bhatta *et al.* (2015a), Viswanathan and Kumar (2015), Bhatta & Aggarwal (2016), and Jha *et al.* (2018). Increase in the rate of migration is a consequence of wide differences in income levels and standards of living in developing nations like Nigeria. Harris and Todaro (1970), Lucas (1997), and Stark (1984) have offered theoretical support for this hypothesis of internal migration. Internal migration is vertically and horizontally articulated by Fei and Ranis (1964) as a process that is desirable, through which surplus labour is taken from agricultural occupations and moved to offer cheap labour or manpower for modern industrial state. According to Kohli *et al.* (2011), a nation is most likely to remain in middle income trap, should such a nation fail to create transition from labour – intensive to capital – intensive production.

Agriculture is highly dependent on climate factors as it is a climate - sensitive sector that harbours increased labour surplus and it has become one of the contributory factors of internal migration to sectors that are non-climate –sensitive. The model of economic development of Harris and Todaro (1970) articulates some propellers of migration. The fundamental postulation is that migration is prompted by the differential income of rural and urban settlements that is expected as well as income difference. Lucas (1997) supports this model. However, he went further to opine that comprehension of other pull factors continues to be poor. To buttress this, De Haas (2020) notes that occurrence of migration is significantly dependent on the skill and knowledge level of the migrants as well as the prevailing conditions in the particular economic sectors where they hope to secure employment at home and at the destination.

In concept, the new economics of labour migration (NELM) models are different from other models because they incorporate rural risk factor as a determinant of decisions to migrate (Jha *et al.*, 2018). This approach implies that decision to migrate an affair of households instead of that of the lone individual (Jha *et al.*, 2018; Stark and Lucas, 1988; Stark and Bloom, 1985). The NELM model likewise considers migration as a strategy created by a household to maximize expected incomes and reduce risk of failure in consumption by engaging in diversified sources of income by crossing sectors or agricultural zones.

Migration of humans is not only necessitated by poverty and social deprivation, but it is as well prompted by climate change (Scheffran *et al.*, 2012; Ofuoku and Chukwuji, 2012). Unfriendly weather conditions, rise in sea level and environmental degradation constitute the important outcomes of climate change. The alterations in these variables are the main causes of long – or short – term internal migration prompted by loss of occupations that are sensitive to climate and poor capacity to adapt to the situation in South Asia (Bhatta and Aggarwa 2016; Kumar and Viswanathan, 2012) and in sub-Sahara Africa, including Nigeria (Ofuoku *et al.*, 2011). As also suggested by Ahmed *et al.* (2016); Barnett and Webber (2009) suggest that households' capacity to adapt to climate change depends on diverse factors, which include financial base, social resources, infrastructure, human capital and access to information. To be resilient or be able to adapt, Gray and Mueller (2012) opine that farming households will probably cut down expenditures on goods that are non-essential, access formal and informal credit or depend on assistance from governments. On the alternative, or in combination with one or more of the earlier suggestions, a farming household may decide to allow a member of the household to move to other locations to engage in alternative sources of income, which is remitted to the household of origin (McLeman and Smith, 2006; Ofuoku, 2017). When or where group – based mitigation activities and spatial coping methods are not on ground, migration becomes a very important climate change adaptation strategy for farming households against the shocks

that accompany it (Jha *et al.*, 2018). Shatta *et al.* (2015) explain that owing to uncertainty surrounding climate – sensitive livelihood activities, farming households embark on diversification of livelihood, which is an important strategy for several economic and environmental constraints. Banerjee *et al.* (2011) emphasize that remittances are the most glaring of the factors that enhance farming households' capacities to adapt to conditions of stress. Enhanced income from diversification of sources of livelihood creates room for farming households to increase their capacity to adapt in order to cope with the risk accompanying climate change (Patnaik and Das, 2017; Tripathi 2017; Scheffran *et al.* 2012; Tacoli, 2009; Larzko and Aghazarm, 2009; Ofuoku, 2019) states that in order to avoid the disastrous consequences of climate change, adaptation has been made a very significant policy option and that one of the adaptation strategies of potent is migration. Since agriculture is the most climate – centered economic activity, it is faced with the highest risk and uncertainties that lead to loss of livelihood. At the national level, farmers first identify or observe alteration in climatic parameters and take to migration as a coping strategy (Stojanov *et al.*, 2016a, 2016b; Patnaik and Das, 2017; Tripathi 2017). At the farm level, farmers constitute the major stakeholders and actors, thus their perceptions about climate change and their socioeconomic attributes, especially of their households, form the major factors propelling their migration. The socioeconomic situations are determinants of the level of vulnerability of farming households to climate – induced economic challenges and social deprivation in spite of the fact that their perception of climate change constitutes a prerequisite for the individual farmer's adaptation reaction (Jha *et al.*, 2018). Farmers tend to choose to migrate to seek alternative means of livelihood in a situation of risk of crop failure or poor yield owing to the effect of erratic climate outcomes. Migration offers the farmers opportunities to gain knowledge on new technologies and techniques and farm practices to increase their agricultural income as well as enable them to generate defined expected income. Apart from that, the remittances made from those community or zone lowers credit related challenges to adaptation strategies (Patnaik and Narayanan, 2015), thereby enhancing the adaptive and resilience capacities of the home zone.

Having articulated this theoretical background, it is worthwhile to carry out a study on the nexus between migration and climate change in a close context specific way through integration of diverse socioeconomic, cultural, political and developmental variables. There is also the need to unveil the way farmers' household qualities exert influences on decision to migrate in order to create better informal zonal or regional policies (Upadhyay *et al.*, 2015). This study develops a comprehension of the role played by migration as a strategy for adaptation, for coping with climate alteration as well as attempt to change the course of the argument that “migration is not at all times the consequence of failure of an individual farmer to adapt effectively to climate change”. It examines the perception of farmers on climate/weather changes and in accordance unveils various cognitive situations that induce farmers' migration decision during rainy or dry season. Also, the socioeconomic situations of migrating and non- migrating farming households were assessed. The emphasis of this study was to assess the role played by migration in accessing climate and agricultural extension services. It went further to evaluate the contribution made by migration to enhancement of farmers' coping capacity.

Patnaik and Narayanan (2015), Upadhyay *et al.* (2015), and Muckere *et al.* (2014) in their studies dwelt on various coping strategies against climate change indicators, particularly excess flooding without including internal migration (temporary or permanent) driven by such events as part of the coping strategies. Thus this study was done in the direction of investigating the role of internal migration while coping with such disasters in the form of excess flood emerging from climate change effect.

The questions that need answers include: (i). is internal migration driven by climate change? (ii) If it is driven by climate change, what are the variables that differentiate the households migrating for climate change reasons from households not migrating? It is

hence hypothesized that the socioeconomic attributes of farmers do not significantly function in migration driven by climate change.

Literature and Theory

Climate change according to Warner and Afifi (2014), Gray and Bilsborrow (2013), Hunter *et al.*, (2013), and Muckere *et al.* (2014) is a stress variable that has a major under – tone for migration in regions that are vulnerable to climate alterations. Klaiber (2014) suggests that migration offers farmers the opportunity to carry out non-margin shifts in arrangement of adapting to alteration in climate, while Warner (2010) states that the effects of climate variation on migration have for many years been a subject matter of great interest among policy makers and academics.

The fundamental postulation that inundates literature is that farmers migrate to other communities because they could not succeed to adapt to climate change in an effective manner (Warner, 2010). Environmental factors, Porter *et al.*, (2014) states has indirect effect on a farmer's decision to migrate through its impact on livelihood activity, for instance agricultural productivity loss and hiked expenditure as a result of rising prices of food. Lybbert and Sumner (2012) are of the view that sources of credit may not be enough for adoption of modern technologies needed for adaptation and mitigation of climate change. In most sub-Sahara, (Ofuoku *et al.*, 2012) and South Asian countries, the likelihood of migrating during adverse environmental situations is more among farming households that have poor socioeconomic background (Bhatta *et al.*, 2015a; Bhatta *et al.*, 2015b; Etzold *et al.*, 2014). Decisions related to migration are rooted in the individual farmers' vulnerability in terms of economic, social, demographic and political factors (Yi Sun *et al.*, 2017; Stojanov *et al.*, 2016a; Stojanov *et al.*, 2016b). Individual members of farm families are probably relocated in order to generate income for the sustenance of the family expenditures, achieve knowledge and enhance capabilities for surmounting shocks and stresses in the future (de Hann *et al.*, 2002).

Rationale for migration

Migration is a capable source of transfer of capital to aid traditional or local communities to progress towards elitist knowledge and education (Taylor, 1999). For example, in developing countries, agricultural extension is a crucial mechanism of knowledge, innovation or technology and education for farm families (Rivera and Sulaiman, 2009). Swanson (2006) describes agricultural extension services as the all-encompassing institutional arrangements that are meant to aid farmers organize themselves and create linkages between farmers and markets. Transfer of resources acquired to home location or zone, such as remittances, return of migrant and knowledge make immense contributions to enhance level of awareness of the work of institution and technical sources of agricultural extension services and climate information services (Jha *et al.*, 2018). Income remitted home has direct effect on the resource base, economic welfare and resilience of the migrant source community (Adger *et al.*, 2002). Capabilities of the source community to achieve development and sustained livelihood is enhanced or propped up by individual migrants from the community. In most developing countries, high rate of migration has prompted substantial increase in income emanating from remittances. There is the need to give strength to the linkages between host and source communities in order to reactively strengthen home community resilience (Conway and Cohen, 1998), enhance its economic well – being (Adger *et al.*, 2002) and offer access to needed resources required to enrich its human, cultural and social capital (Woodrugg and Zenteno, 2007). Social relationships in the host community have likewise been indicated as a crucial factor to employment and opportunities to access shelter (Ofuoku, 2019).

Migration caused by climate change

Since in the prehistoric era there have been linkages between human migration and settlements as indicated by a wide range of literature (Jyson *et al.*, 2002). While responding to loss of occupations that are climate sensitive and the ones that are not climate sensitive, citizens of communities decided and actually diversified their sources of livelihood through intensification of farming and non-farming activities (McDowell and Haan, 1997). More emphasis was put by Tschakert and Tutu (2010) on the value of migration while coping with climatic alterations. Bhatta and Agarwal (2016) observe that an enormous population of marginal and landless farmers in South Asia migrated in the bid to cope with climate change and variability. Climate change impacts on dynamics of human migration are very much of note in rural settlements because the people do not have adaptive capacity (Kates, 2000). The way individuals perceive climate change is a valuable precondition for their adaptation (Gbetibouo, 2009; Bryan *et al.*, 2009, Hassan and Nhemachena, 2008). At the household level, climate induced decisions to migrate among farm families are driven by their perception about climate change and variability, the risk linked with it and probabilities of crop failure and loss of source of livelihood as well as the necessity of having alternative sources of income. The decision of a farmer to embark on migration goes through a course of cognition which entails remembrance of previous climate aberration incidents and this represent time comprehension of the climate rooted on intuitive knowledge as well as perceptions about risks linked with climate change (Grothmann and Patt, 2005; Marx *et al.*, 2007, Adger *et al.*, 2009). However, Hausen *et al.* (2004) opine that in the presence of the significant variations that exist between individual experience and external information sources, owing to climate variability, farmers are likely to place more value on current climatic occurrences. Indecisiveness may likewise be prompted by broader differences between farmers' expectations on climate variations and actual climate forecasts given by the agency that is in charge (Below *et al.*, 2010; Roncoli *et al.*, 2002). Alterations in agricultural systems do not entail straight line update of an individual farmer's decision making, thus the way farmers review their climate variation anticipation importantly becomes a determinant of his or her decision regarding adaptation (Bryan *et al.*, 2009; Gbetibouo, 2009).

Aggregate migration flow stands for the consequence of the underlying individual decision – making process. Migration being a human behavior is, thus a complementary approach more than an alternative approach. Right thinking individuals tend to maximize their anticipated utility function, as a result, the decision whether to migrate or not is determined by the cost – benefit analysis. Hicks (1932) argued that maximizing behavior is born out of differences in net economic advantages. The gains of migration are the main causes of migration. In spite of the catalogue of literature on climate change and variability, adaptation and migration, there are still gaps in unveiling the ongoing heterogeneous influences in the home of origin that propel migration and the way migration go on to promote the ability of the migrating household member to gain knowledge on management of farm and benefits of extension services. There are limited studies on climate – induced patterns of migration among various heterogeneous groups (Bhatta *et al.*, 2015b), in Nigeria. Enughwure (2020) concludes that some cases of internal migration are prompted by climate change induced flood incidences in Delta State, Nigeria. This however needs to be verified before it can be established as a fact. It is thus a matter of necessity to comprehend how migration forms the main source of resilience of household in climate change situation or scenario.

However, while this study considers internal migration as a coping strategy against climate change, previous studies did not. Thus, this study is meant to fill that gap and add to the existing literature.

Methodology

The Study Area

The study was carried out in the three agricultural zones of Delta State, Nigeria. The agricultural zones are demarcated according to the ecological zones of the state. The agricultural zones include Delta North, Delta Central and Delta South Agricultural Zones. Delta North Agricultural Zone lies majorly under the derived Savannah vegetation cover; Delta Central Agricultural Zone is covered by fresh water and rainforest, while Delta South Agricultural Zone is under mainly mangrove swamp forest cover. Delta State experiences two distinct seasons – the raining season which commences in April and terminates in October in Delta Central Agricultural Zone. In the Delta South Agricultural Zone, raining season begins in March and ends in November, while rains start falling in Delta North Agricultural Zone in the month of May and terminates in August. While Delta Central does not experience much of drought, there is the period of drought and flooding is being experienced for some years now. The level of flooding in Delta South Agricultural Zone has increased, with moisture still being present in the soil during dry season. However, much of drought is experienced in Delta North Agricultural Zone during the dry period (November to April). Two farming seasons exist in Delta State, early cropping season (April) and late farming season (September).

Delta State is located in Southern Nigeria with the River Niger bordering it. Delta lies in the coordinate of longitude 5° 50' and 6° 45' east of the Greenwich meridian and latitudes 5°, 25' and 6° 30' North of the Equator. The state is predominantly rural with about 80% of the population found in the rural areas. Internal migration is known to occur regularly, however, there is no official record of internal migration as such records are not in existence and no agency has been put in place to take care of that issue. Internal migration is highly implicated in the economy of the state and Nigeria at large. Deltans are one of the most mobile people after the Ibo tribe in Eastern Nigeria.

Sampling and Sample Size

Delta North Agricultural Zone is constituted by 9 local government areas. Delta Central Agricultural Zone is made up of 10 local government areas, while Delta South Agricultural Zone houses 6 local government areas. From each zone, 50% of the local governments were randomly selected using the lottery method. Consequently, in Delta North 5; Delta Central 5 and Delta South 3 local government areas were randomly selected. Three rural communities were randomly selected from each of the 13 local government areas selected. The heads of the villages were met for identification of the full-time farmers. This exercise led to identification of 7,226 farming households. For equitable representation, ten percent (10%) of the farmers were randomly selected and 723 respondents were arrived at. At the end the enumerators used to collect data from the farmers were able to return complete data from 698 farming households. This is attributed to the fact that 25 respondents failed to complete the copies of the questionnaire given to them.

Design of the Questionnaire

The issues relating to the questionnaire were discussed with the farming household heads (FHHs) to make sure that they are answered as accurately as possible and the data were collated. Only the FHHs were involved in the study because, traditionally, the farming FFHs regard themselves as the ones to be met for anything that involves their households. They thus frown at it if the otherwise is done. The selected FHHs belonged to various land ownership strategies (that is, either farming on own land or rented land). The questionnaire captured local perception of the farmers as well as their observation about climate change

and their experiences with variation in climate and extreme occurrences for the period of over the past two decades. Mental map technique (MMT) was also applied. In the MMT, the farmers were requested to give their local perceptions about alterations in climate based on their experiences and observations of alterations/variations in climate parameters such as rainfall and temperature. Ethnographic studies have the confirmation that persons are capable of identifying change in climate a decade or more on the basis of his or her own experience (Ofuoku and Albert, 2014; Marin, 2010). A previous study by Ofuoku *et al.* (2012) saw through the lenses of the farmers and found that the farmers identified alterations in climate parameters such as rainfall and temperature for over a period of 30 years. The questionnaire also had questions on the FHHs socioeconomic situations, as well as the choices of information on climatic issues and new agricultural innovations (agricultural extension and climate). Their access to this information and the innovations were also captured. Their adaptation strategies choices among a list of diverse adaptation options for the rainy and dry seasons separately. The adaptation alternatives included capital – intensive, labour – intensive and knowledge – intensive innovations for the facilitation of the assessment of contribution status of migration to adaptation measures adopted.

Analysis of Data

The climate parameters put into consideration in this study included temperature and rainfall behavior as observed by the farmers. The perceptions of the farmers about climate change were assessed on the basis of dichotomous responses, (yes or no), applying Logit regression model to the question of whether they observed long term variations or alterations in average levels of temperature and rainfall since the past 20years or more. The farmers' decision to migrate was evaluated for the two existing farming seasons – early farming and late farming seasons owing to climatic conditions that are ideal for crop yield level and consequently, farm cost of production and management practices vary according to farming season. Rooted in the farmers' responses to questions are their perceptions of alteration in temperature and rainfall as well as their options to embark on migration because of sensitivity of crops, (Jha *et al.*, 2018) four cognitive situations of farmers were put into consideration. These included perceived changes in climate and migrate; perceived changes in climate but do not migrate; do not perceive changes in climate and hence do not migrate; and do not perceive changes in climate, but choose to migrate.

While assessing the role played by socioeconomic attributes of the FHHs, binary logistic regression model was applied. For assessment of the function of socioeconomic situations or background as determinant of internal migration as an adaptation strategy, a dichotomous (binary) logistic regression model was utilized with the migration option of farmers (migration = 1 and non – migration = 0) being a single categorical predictor. Socioeconomic qualities of the farm families including age of household head (HH), formal education level of the farming HH; proportion of males in the farm households to sum of household size; proportions of other members of the household (proportion of females and children below the age of 10years); farm land size; land ownership status (own farm land = 1; rent = 0); and livestock ownership formed the independent variables. Logit regression model was used because the dependent variable is dichotomous. The model was employed to make an estimation of the migration status the farming households as a function of a group of socioeconomic variables. The model has been used severally for logistic dependent variables by Bamire and Olubode (2002), and Oni *et al.* (2004). The Logit Regression model employed in determining the influence socioeconomic attributes of households on migration as an adaptation strategy is presented thus:

$$Z = \ln \frac{P_I}{1 - P_I}$$

$$= \ln Y_a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7$$

Where:

Z = Probability of migration (migrated = 1; non- migrated = 0)

bs = Coefficients of explanatory changes in Z causes by change in independent variables

X1= Age of HH head

X2 = Education level of HH head

X3 = Farming size

X4 = Land ownership status

X5 = Male proportion to household size

X6 = Others' proportion to household size

X7 = Livestock ownership

The study was rooted majorly on an assumption that decisions by farmers to migrate are strategies of the family to mitigate climate change effects, hence, if the farmers do not embark on migration, one or more members of the farm family is made to migrate to a location that is close or a distant urban settlement (Enughwure, 2020). In the study, behavioural qualities of migrating and non-migrating farm families were utilized. No psychological factor apart from perceptions about climate – induced stress as a propeller or pushing force of migration of farmers was considered. Descriptive statistics (percentages) were useful in description of the socioeconomic attributes of farming HH heads and unveiling the variations in adaptation behavior, choice of climate extension and agricultural services and the pattern followed in adoption of various adaptation methods between migrating and non-migrating farming households. The percentages were presented using bar charts. This was done to make any reading audience to have a clear comprehension of the data.

As for migration as an adaptive strategy to climate change, to confirm migration as an adaptation measure various adaptation measures were listed along with migration to find the one most adopted by the farm families. Eleven (11) were included viz; planting improved varieties of crops, shifting from land under cultivation, controlled irrigation, adoption of soil and water conservation practices, crop insurance, migration, switching from farm to non-farm livelihood activities, leasing of land, cultivation of horticultural and vegetable crops. This was done to see the adoption levels of migrating and non-migrating farm families. The numbers of the strategies adopted by migrating and non-migration farm families were classified into low (1-3), medium (4-6) and high (7-11). The percentages were then computed based on these three classifications.

Results and Discussion

Farmers' Perception about Climate and Migration

The shape of migration (temporary or permanent) is determined by the farmers' perception and experiences of climate extremities and variability. A farmer has more likelihood of migrating permanently as a consequence of continued loss of losses, livelihood and wealth when he or she faced high level of vulnerability to climate extremities and continual experience of alterations in patterns of climate. Then the farmers who experience the effects of seasonal variations in climate and temporary climate alterations will likely have the decisions to create temporary income generation to meet up with livelihood needs. Table 1 shows that about 65% chose to migrate, while about 35% chose not to migrate during the early farming season. During the late farming season, 68% chose to migrate, while 32% opted not to migrate. Going further, with respect to crops sensitivity to alterations in rainfall patterns, 63% and 37% chose to migrate and not migrate,

respectively during the early farming season. During the late cropping season, about 70% chose to embark on migration, while 29% opted out of migration. During the two seasons, the number of farmers who opted to embark on migration as a consequence of perceived climatic alterations was much higher than the ones who chose to migrate in spite of the fact that they did not perceive climate change and variability. However, a good percentage (20 – 35%) of them perceived alterations in climate pattern, but refuse to migrate. These differences in option decision are attributable to the socioeconomic qualities of the farming households or farm families. These findings are in consonance with those of Jha *et al.* (2018).

Migration was seen as a profitable coping strategy by most of the farmers that were used for the survey. Perception of climate change and migration formed the dominating cognition situation for early cropping and late cropping seasons in Delta State.

Table 1: Perceptions on Climate Change Variability as Propellers of Farmers' Migration decision

ACTION OF FARMERS	CONDITIONS OF THE		ENVIRONMENT	
	(REASONS FOR		MIGRATION)	
	EARLY FARMING SEASON	LATE FARMING SEASON	EARLY FARMING SEASON	LATE FARMING SEASON
	TEMPERATURE RAINFALL	TEMPERATURE RAINFALL	TEMPERATURE RAINFALL	TEMPERATURE RAINFALL
	(PERCENTAGE OF N)	(PERCENTAGE OF N)	(PERCENTAGE OF N)	(PERCENTAGE OF N)
Migrated totally	65	63	68	71
Did not migrate	35	37	32	29
Perceived and migrated	59	56	61	62
Did not perceived but migrated	6	7	7	9
Perceived but not migrated	31	31	28	25
Did not perceive and not migrated	4	6	4	3

NB: there was rounding up of fractions of up to 0.5 and above

This situation is majorly laden with rural risk factors that have association with climate alterations and variations in their home community or zone. The decision to embark on migration is one of the farm household coping mechanisms and not the decision taken by an individual. Farmers who fell under the second cognitive situation (migrating when they did not perceive climate change), did so mostly because they purpose to embark on diversification and maximization on their sources of income. A few of the farmers opted not to migrate, though they perceived climate alterations (the third cognitive situation), majorly as a result of the risk of uncertainties in the host zone or community (for example, cost of migration, employment guarantee) and favorable socioeconomic situations in the home community or zone (for instance, education, household size, land size). They were risk averse because of these conditions. The number four cognitive situation indicates that farmers were not aware and were still not aware of any alterations in climatic situations and may be satisfied with their economic situations, hence did not consider migration as choice that is profitable or they may be lacking the knowledge and skill required to migrate.

Function of Socioeconomic Qualities in Migration as an adaptation measure

A good comprehension of the socioeconomic attributes of farmers is crucial to recognition the major factors encouraging migrations. The decision taken by farmers to migrate constitutes strategies of the farm households which are mainly articulated for the purpose of overcoming the income loss and social deprivation risks and ensuring smoothing of consumption.

Table 2 indicates that age and educational status of HH heads; proportion of male; proportion of other members of the family, farm size and land ownership significantly correlated with decision to migrate during early and late farming seasons. The age of farming HH heads significantly and positively correlated or contributed to choice of migration during both farming seasons. The age of the farming household head implies farming experience, which is a determinant of farmers' perception, adaptation decision and propensity to adapt. Older farmers have a high sense of felt need and responsibility to ensure that their families/households achieve sustained sources of livelihood, thus decide to migrate or advice other members of their households to migrate. The migration project is aimed at reducing dependence level and ensuring flow of remittances to the folks at home.

Table 2: Function of socioeconomic attributes in migration as an adaptation

VARIABLES	MIGRATION IN EARLY CROPPING SEASON	MIGRATION IN LATE FARMING SEASON
Age (HH head)	0.0504729 (4.69)**	0.080679 (5.75) **
Education (HH head)	0.1601680 (5.12) **	0.1617110 (4.47) **
Farming size	-0.689843 (-2.10) *	0.0515639 (4.73) **
Ownership status	-0.689842 (-2.63) *	-0.7724287 (-2.83) *
Male proportion to HH size	5.858990 (5.22) **	7.243809 (5.91) **
Others' proportion to HH size	1.213610 (8.65) **	1.770834 (10.33) *
Livestock ownership	-0.027549 (-0.20)	0.018415 (0.13)

* $p < 0.05$; ** $p < 0.01$

Level of formal education positively influenced migration of farming HH heads through which enhancement of their capacity to access and articulate information relating to conditions of climate and give response. Farmers who have reasonable levels of education have higher levels of awareness with regards to available opportunities in their host communities or zone. There is also the ripple effect of education which encourages other members of the household to also embark on movement from the home zone or community. A higher proportion of males in the farm families positively affected the decision and plan to migrate. This is attributed to the fact that more male members of the households give assurance of more hand in increasing the income of the farm family and more efficient in taking advantage of social networks in their host communities or zones. The proportion of women and children below the age of 10 years implies dependence; hence, a higher proportion positively influences decisions to migrate in order to meet up with their income need for improved consumption desires. Land ownership pattern was significant, but the coefficient bore a negative sign, implying that farmers who rent farm land have more likelihood of migrating due to poor net income. The net income is what accrues to them after rent payment. This becomes insufficient while trying to meet up with consumption desires or needs, as well as other needed expenditures of the household in the home community. Farm size significantly, but negatively influence migration in both farming seasons. Tha *et al.*, (2018) found that farm size only influenced decision to migrate in one of the farming seasons (Rubi) in India. That farm land is negatively significant implies that larger farm size requires greater family labour for farm operations; as a result, farming households that possess large farm lands may not have the intention to embark on migration or encourage any member to migrate.

Function of migration in agricultural extension services

The current context of climate change and its associated risks calls for frequent acquisition of new knowledge via adequate and time-precision extension services. Two institutional arrangements that enhance adaptation most include agricultural extension services and credit facilities (Jha *et al.*, 2018). Delivery of information or messages on seasonal variations in climate and new innovations is facilitated by agricultural extension services to assist farmers in perceiving changes in climate change rapidly and guide them to adjust their agronomic practices to align with the alterations. Through migration, farmers have awareness in their host communities through knowledge transfer and income generated from host community that is remitted to home community for effective usage of innovations and information provided by extension services. Social networks are channels through which return migrants assist local communities to master the application of technology in farm operations and raise awareness level about institutional gains. Farmers access information related to climate including anticipated seasonal rainfall and temperature levels, timing of the onset of storm and forecasting extremes of climate in the form of flood and drought from climate extension sources in the Nigerian Meteorological Agency. Agricultural extension services of the Delta Agricultural and Rural Development Agency (DARDA) offer information on agricultural mechanization, improved crop varieties, drought – tolerant varieties of crops, sources of quality seeds, plant protection methods, soil health management and market information. The Nigerian Meteorological Agency through its climate extension unit disseminates information using television, radio, mobile phone and internet. Agricultural extension sources include field officers, television, mobile phone and radio. Differences are indicated between the adoption behavior of migrated and non – migrated farmers during the two farming seasons studied (Figures 1 and 2).

Figure 1 and 2 are indicative of the higher usage of both climate and agricultural extension services among migrant farm families than non – migrant farm families. Most (70 – 76%) of the migrating farmers used radio. Radio is the oldest source of information and its usage is preferred to the usage of newspapers. Most (60 – 75%) of the migrating farm families subscribe to adoption of information offered by Nigerian Meteorological Agency and extension field officers. Scheffran *et al.* (2012) observe that migrating farm families have better information and knowledge about usage of mobile phones and television in farm management as a result of the experiences they had through their involvement in social networks and experiences gained in their host communities. Ofuoku (2019) found that rural – rural migrant arable crop farmers were included and benefitted from agricultural extension services of their host communities. The usage of other extension sources, including newspapers and mobile phones is determined by the farmers' educational level. This is more so as mobile phone is one of the knowledge-based innovations. As a result of their level of formal education, migrating farmers have become more proficient in the usage of these information resources for farm or agricultural management. Likewise, remittances received from host communities or zones create improvement in their economic well – being. This empowers them to procure and utilize mobile phones, computers, newspapers, televisions and radios in their home communities or zones. The information need of non – migrating farmers is capable of being met when migrating farmers share information, technology, knowledge and skills with them, thereby enhancing “social learning” and the capacity to adapt to climate change in the home communities or zones.

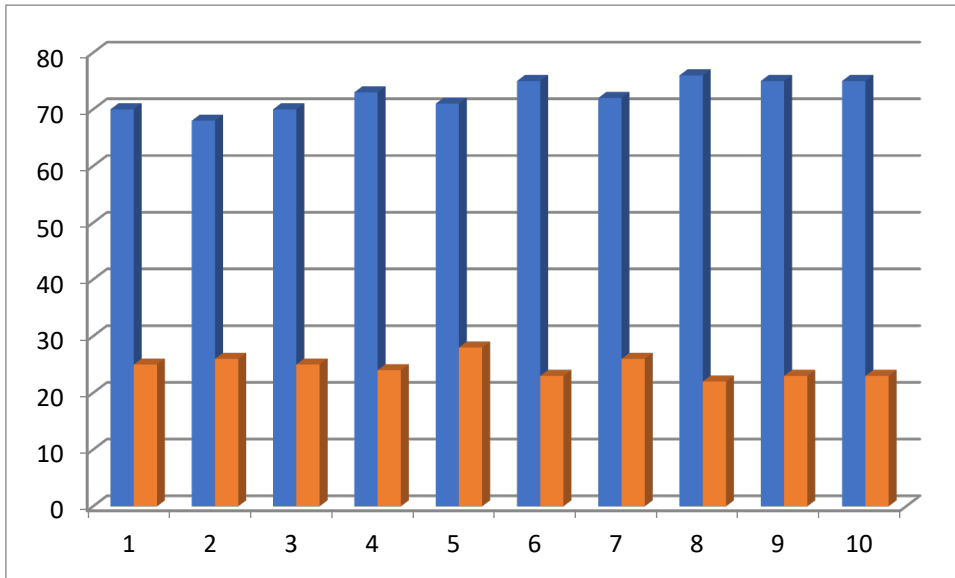


Figure 1 - Choice of extension services. Early farming season

- Early farming season migrated
- Early farming season non-migrated

1. Agric. ext- newspapers; 2. Agric ext. mobile; 3. Agric Ext. radio; 4. Agric ext. TV.; 5. Agric. ext. field officer; 6. Clim. Ext. Met. Agency; 7. Clim. ext. mobile; 8. Clim. Ext. radio; 9. Clim. Ext. TV; 10. Clim. Ext. govt

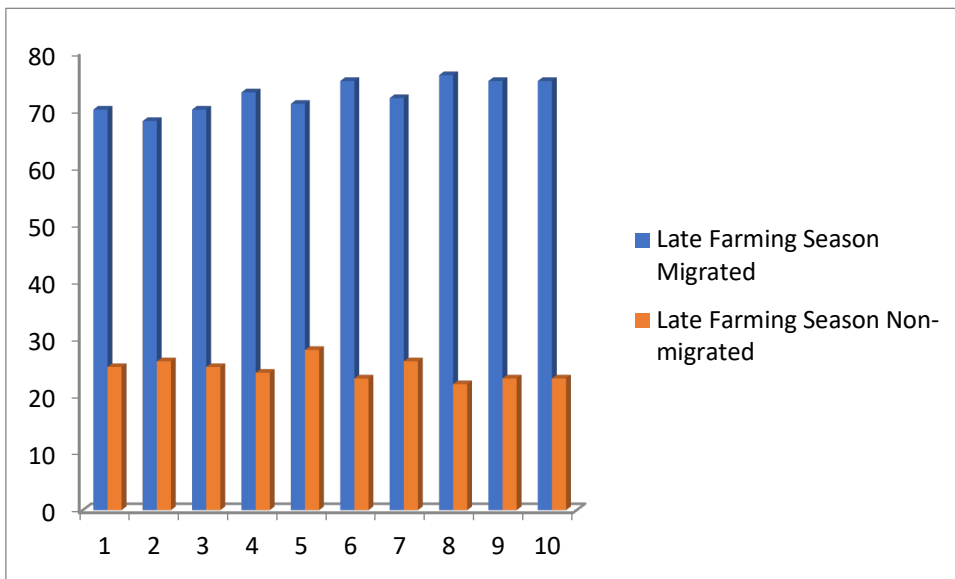


Figure 2 - Choice of extension services. Late farming season

1. Agric. ext- newspapers; 2. Agric ext. mobile; 3. Agric Ext. radio; 4. Agric ext. TV.; 5. Agric. ext. field officer; 6. Clim. Ext. Met. Agency; 7. Clim. ext. mobile; 8. Clim. Ext. radio; 9. Clim. Ext. TV; 10. Clim. Ext. govt

Migration as an adaptation strategy

The way migration promotes farmers' capacity to adapt and make possible adoption of other strategies is examined in this section. A total of 11 adaptation strategies, inclusive of migration were identified as being very suitable for farm management operations. These included planting improved varieties of crops, shifting from land under cultivation, controlled irrigation, adoption of soil and water conservation practices, crop insurance, migration, switching from farm to non-farm livelihood activities, leasing of land, cultivation of horticultural and vegetable crops. The farmers indicated their options of adaptation methods according to their perceptions about alterations in temperature and precipitation and their individual farming practices differently for early farming and late farming seasons.

Table 3: Function of migration in promoting farmers adaptive capacity by cropping season

HOUSEHOLD (HH) ADAPTATION (NUMBER OF ADAPTATION STRATEGIES)	ADAPTATION LEVEL				TOTAL
	NO ADAPTION (0)	LOW (1 – 3)	MEDIUM (4 – 6)	HIGH (7 – 11)	
Early farming season					
Migrating HH (Temp)	132 (19)	18 (26)	307 (44)	78 (11)	698 (100)
Non-migrating HH (Temp)	0	15 (03)	288 (92)	62 (79)	496 (71)
Migrating HH (Rain)	195 (28)	202 (29)	279 (40)	21 (3)	698 (100)
Non-migrating HH (Rain)	0	165 (82)	257 (92)	17 (81)	439 (63)
Late farming season					
Total No of HH (Temp)	7 (11)	168 (24)	30 (44)	147 (21)	698 (100)
Migrating HH (Temp)	0	89 (53)	249 (81)	137 (93)	475 (68)
Total No of HH (Rain)	132 (19)	183 (26)	305 (44)	78 (11)	698 (100)
Migrating HH (Rain)	0	174 (95)	253 (83)	69 (88)	496 (71)

Their options of adaptation measures were considered to be propelled by climate parameters, though they were aimed to generate profit as pointed out by the farming family heads (Jha *et al.*, 2018; Nhemachena and Hassan, 2007; Maddison, 2006). While assessing the farmers' options of adaptation strategies, the level of adaptation was developed on the basis of the number of adaptation methods adopted by the farmers (Bhatta *et al.*, 2016; Jha *et al.*, 2018). The number of adaptation indicated by the farm family heads ranged a minimum of 0 (no adaptation) to 11 (maximum number of adaptation methods used by any of the farmers) (Jha *et al.*, 2018). The mean number of adaptation strategies adopted by the farmers during the early farming season for perceived alterations in climate parameters – temperature and rainfall was above 4 for both of the parameters. In the late farming season, the mean was about 5 for perceived alterations in temperature and precipitation. This is congruent with the findings of Jha *et al.* (2018).

Adaptive capacity according to Brooks and Adger (2005) is system – controlled and can modify its qualities or behaviour to widen its range of coping under extant climate alteration or later climate situations. In accordance, this study is of the assumption that farmers who have higher adaptation level (range of coping) possess higher adaptive capacity (Jha *et al.*, 2018). The capacity to adapt likewise represent the capacity index of the individual farmer to control the impacts of climate change at the farm level which is dependent on the skill, formal education status and the ability of the farm family head (Tarleton and Rainsey, 2008). Table 3 shows that among the 698 farmers used for the survey study, 19% and 28% failed to adapt to alterations in temperature and precipitation during the early farming season respectively. In the late farming season, 11% and 19% did not carry adaptive effort to change in temperature and rainfall, respectively.

Most (63 – 71% and 68 – 71%) adopted migration as an adaptation strategy in early farming and late farming seasons, respectively. Slightly, more farm families opted to migrate during late farming season than in early farming season. This is because early

farming season is highly labour intensive than late farming season and it involves a lot of farm operations, while late farming season is not labour intensive. Since there is no adequate amount of operations for all the household members, some of them opted to migrate during late farming season. Out – migration from a state to another align very much with alterations in the yield of rice (a crop favoured in the rain season) (Viswanathan and Kumar, 2015). The variation between the result of this study and that of Viswanathan and Kumar (2015) is attributed to the fact that while the data used by them was based on state level migration, this study is based on micro-level assessment of migration as an adaptation method and majorly utilized behavioral qualities of farmers that are wrought with uncertainty and unpredictability. However, the results of this study are in consonance with those of Jha *et al.* (2018) who also based their study on micro – level assessment of migrations. During the early farming season, for alterations in temperature, 26% had low level adaptation and for precipitation, 29% had low level adaptation. In the same period, 44% had medium level adaptation to temperature and 40% had medium level adaptation to alterations in precipitation, while 11% had high level adaptation to changes in temperature and 3% to changes in precipitation. Likewise, in late farming season, for alterations in temperature, 4% had low level adaptation and 26% had low level adaptation for alterations in precipitation. In this same season, 44% had medium level adaptation for alterations in temperature and another 44% for changes in rainfall, while 21% had high level adaptation to changes in temperature and 11% for changes in rainfall. Therefore, medium level adaptation was dominant in the study area. This implies that farmers adopted 4 – 6 distinct adaptations measures every season in reaction to alterations in temperature and precipitation.

During the early farming season, 71% migrated because of changes in temperature, while 63% embarked on migration because of changes in rainfall. In late early farming season, 68% migrated due to alterations in temperature, as 71% migrated as a result of alteration in precipitation. To evaluate the significance of migration in promotion of farmers' capacity to adapt to alterations in climate, by farming season, the proportion of migrating farmers to total households adopting climate change adaptation strategies at each level of adaptation was examined. In early cropping season, about 79 – 81% of farm families with high level of adaptation and about 92% of farmers that had medium level of adaptation were migrating farm families. Also, in late cropping season, 88 – 93% who had high level adaptation, 81 – 83% that had medium level adaptation were migrating farm families. These results are indicative of the fact that migrating farm families have a greater capacity to adapt to climate change since they have the ability and capability to adopt more adaptation strategies because of the support from host communities in the shape of remittances, social networks, knowledge and resources.

Adaptation strategies adopted by migrating farm families by season in the study area

In order to evaluate the significance of migration in adoption of other adaptation methods, separate analyses were done for migrating household and non – migrating households with respect to changes perceived in temperature and precipitation for early farming and late farming seasons. For both early and late farming season, their adaptation responses for alteration in temperature and rainfall were of the same trend (Figures 3a, b, c, d). Migrating farm families chose more adaptation strategies than non – migrating families. For temperature and precipitation in early farming season 94 – 95% adopted irrigation; 43 – 70% chose to adopt changing land under cultivation, 51 – 58% adopted improved crop varieties that are bred to be resilient to prevailing climate in the scenario of climate change, 58 – 66% of the migrant farm families adopted crop insurance to avert risk of loss of crops, 24 – 28% chose to adopt water conservation, 14 – 18% adopted soil conservation practices; 19 – 24% decided to move onto non – farm livelihood activities by

way of diversification, 38 – 44% planted vegetables and 15 – 20% opted for horticultural production. Likewise, in late farming season, 98 – 99% opted for irrigation, 91% chose to plant improved varieties of crops, about 71% change their farmland, 58 – 59% opted for crop insurance, 44 – 46% chose to practice soil conservation, 39 – 40% decided to cultivate vegetables, 23 – 25% practiced water conservation and about 19% diversified to non – farm livelihood activities among the migrating farm families for both temperature and precipitation. In comparison, both migrating families, the adoption score of non – migrating farm families that opted for these adaptation strategies was glaringly low. However, the common choice of adaptation strategies between migrating farmers and non – migrating farmers is planting of improved crop varieties, irrigation, crop insurance and soil conservation practices, water conservation and vegetable cultivation. The adaptation strategies are known to be intensive in nature in terms of resources, capital and knowledge. This makes the migrating households to a comparative advantage over non – migrating farm households. Migrating farm families had the benefit of remittances and knowledge acquired from host community or zone. Migrant farmers acquired knowledge of crops and soil and water conservation technology, the social network of the migrant in the host community.

Migrant farmers were quick to access and better informed about any new government agricultural development initiative, hence accessed the facilities in the schemes successfully. Remittances from migrants in host zones were utilized to buy farm inputs, especially seeds of improved varieties of crops. The remittances also helped them to procure and adopt modern or improved farm mechanization technologies. The study results imply that remittances social networks and knowledge acquired from host communities has direct positive influence on the progression and improvement migrating farm families’ economic situation. However, to limited extent, non – migrating farm families also tap from the migrating households to promote their ability to adapt the innovations for adaptation to climate change. It is therefore, convenient to assert that the micro level, migration of farmers is capable of having beneficial outcomes for improvement of adaptation, sustainability of livelihood and resilience to climate change.

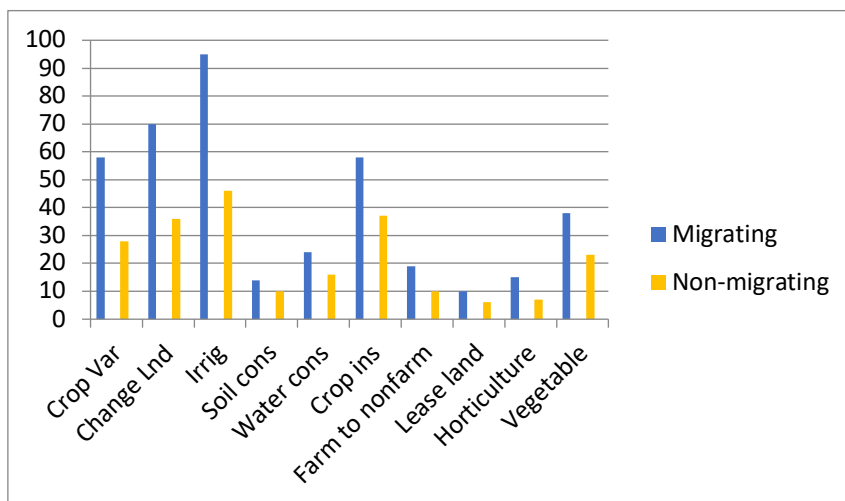


Figure 3a - Adaptation strategies (Early farming season –Temperature)

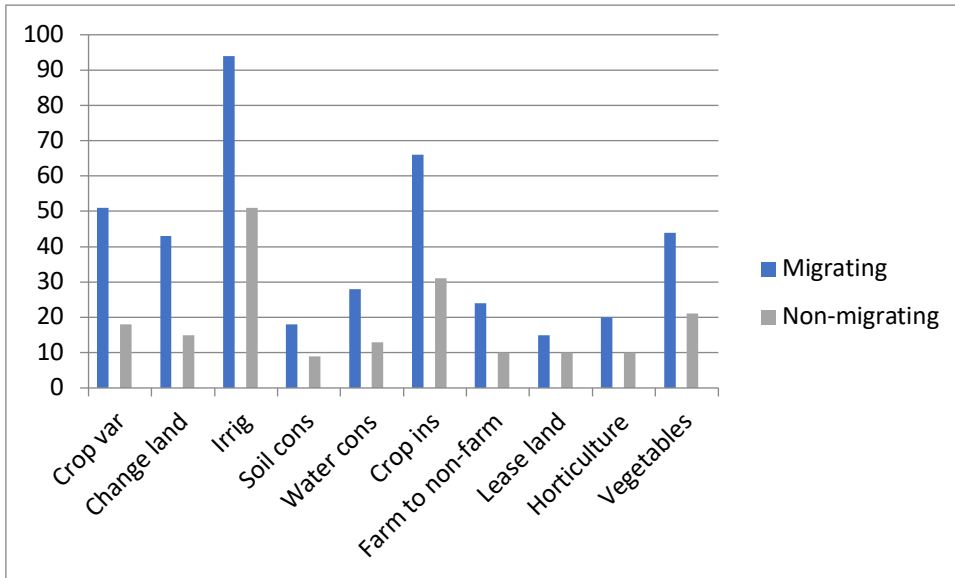


Figure 3b - Adaptation strategies (Early farming season – Rainfall)

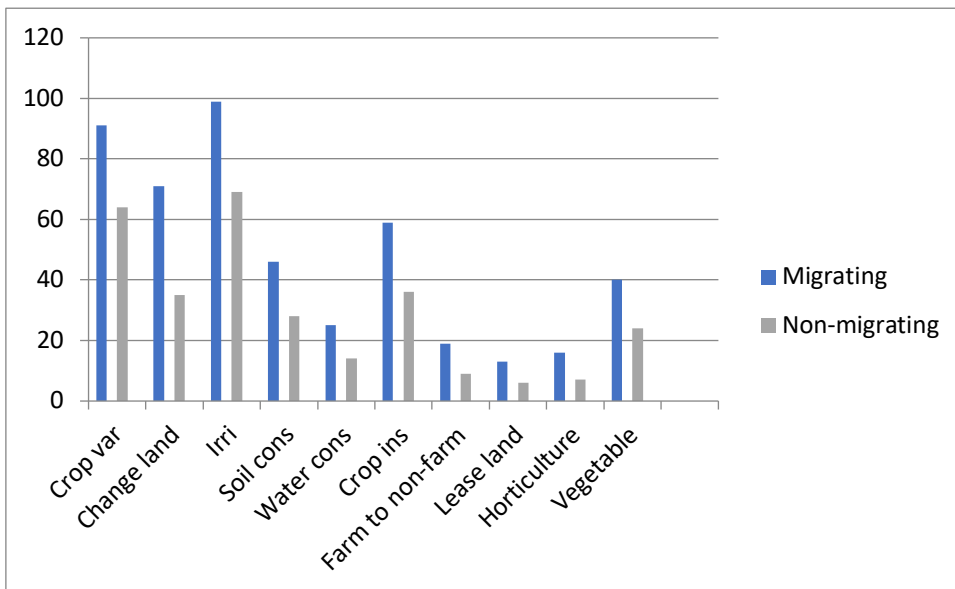


Figure 4c - Adaptation strategies (Late farming season – Temperature)

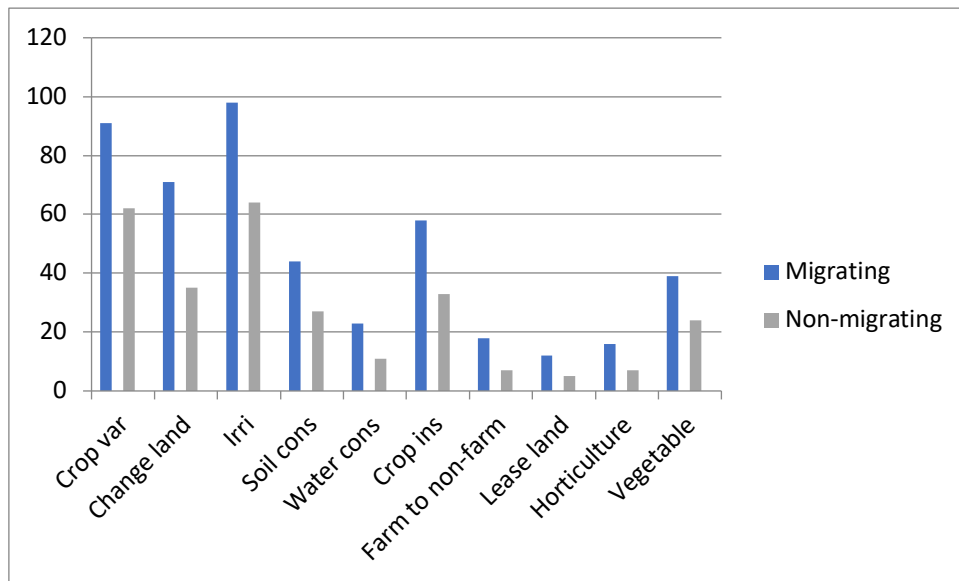


Figure 4d - Adaptation strategies (Late farming season – Rainfall)

Conclusion

Climate-driven migration is considered as an adaptation strategy for the mitigation of adverse and extreme weather situations born out of alterations in climatic conditions. Farmers tend to often embark on migration to diversify their sources of income, as well as create smooth consumption. However, migration has a far broader function as a strategy for adaptation to climate change. This study assessed the effect farmers' perception of climate has on farm family migration. It also evaluated the contribution made by migration to promotion of farmers' capacity to adapt through scale up of their financial capabilities and acquisition of knowledge relative to improved agricultural technologies. As well, the influence wielded by migration in creation of access to climate and agricultural extension services was examined. In addition, variations in adaptation methods for early and late cropping seasons were explored to unveil the advanced cultivation practices that were better resilience to climate alteration. This study reveals that climate – driven livelihood risk is the main propeller of farm family migration during both farming seasons. Migration also offered economic incentives through employment opportunities and enhanced value placed crops in the home zone. The socioeconomic qualities of the farm family, such as household head's age, male proportion in the household and the ratio of dependency promotes sense of responsibility in favour of livelihood sources sustenance of the house, thus making positive contributions to migration of farmers. Formally educated farmers have a higher propensity to migrate as they are well abreast with opportunities and gains that are available outside their communities. However, land size negatively influenced migration of farmers. Land ownership is as well a crucial consideration in migration. Large farm size and land ownership promotes farm income, which consequently helps to achieve smooth consumption and other necessities.

Comparatively, marginal and smallholder farmers and tenant farmers possess a higher sense of insecurity, this higher propensity to migrate. While comparing migrant and non – migrant farmers, migrant farm families better accept to utilize instruction – based, knowledge – based, and technology – based climate and agricultural extension services from sources such as agricultural extension field officers, meteorological agency, newspapers, television and radio. Migrating farm families most times have a higher adaptation score. They are also of superior capability for adoption of adaptation strategies that are intensive in terms of knowledge, capital and resources because of remittances

coming from migrating members of the household. Non – migrating farm families only receive encouraging resources and knowledge from outside the communities through spillover from migrating families. In all, migrating farming households have advantage over non – migrating farming households with respect to adaptive capacity. For further study, revenues of migrating farm families and that of non – migrating farm families should be examined by way of comparison, to further comprehend migration as an adaptation strategy against climate alterations.

As for policy perspectives, emphasis should be placed on creating a relationship between reduction of risk, human capacity building and development in rural communities. Efforts should be made by government to encourage livelihood options that are not climate – driven to enable farm families diversify. In order to reach non – migrating farm families, training and workshops should be organized for this set of farmers so that they can handle knowledge – intensive adaptation strategies. This will help them to develop adaptive capacity. The policy of empowerment through farmers’ groups should be sustained as this will enhance formation of social networks that will enhance adaptive capacities on non – migrant and migrant farmers.

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Appendix

MIGRATION AMONG FARMERS IN DELTS STATE, NIGERIA: IS IT ACLIMATE CHANGE ADAPTATION STRATEGY?

QUESTIONNAIRE

SECTION A: SOCIOECONOMIC QUALITIES

1. What is your age?
2. What is your level of formal education?
No formal education (); Primary school (); Secondary education (); Tertiary education ().
3. At what size is your farm? _____
- 4a. What is your household size? _____
- 4b. In your household, how many people are males _____ and females _____
5. Do you also livestock that your rear? Yes (), No ().
6. What have you notice with the temperature and rainfall?
Late rainfall (), Early rainfall (), Too much rainfall (), High temperature (), Low temperature ().

SECTION B: MIGRATION STATUS

7. Do you migrate or did anyone migrate from your household? Yes (), No ().

SECTION C: CHOICE OF EXTENSION SERVICES

- 8.(a) Which extension service do you use during early farming season?
Newspapers (), Mobile phone (), Radio (), Television (), Agricultural extension field (), Meteorological extension service (), Climate mobile phone service (), Climate radio service (), Television climate change report (), Government climate extension service ().
- 8.(b) Which extension service do you patronize during late farming season?
Newspapers (), Mobile phone (), Radio extension service (), Television service (), Field extension officers (), Meteorology department climate extension service (), Mobile phone climate extension service (), Radio climate extension service (), Television climate extension service (), Government climate extension service ().

SECTION D: ADAPTATION STRATEGIES USED (TICK) THE OPTIONS THAT APPLY TO YOU

9. Out of the under listed which one(s) do you use during early farming season and late farming season because of temperature?

S/N	ADAPTATION STRATEGIES FARMING	FARMING SEASON	
		EARLY FARMING	LATE FARMING
i	Various crop varieties		
i	Change of farm land		
iii	Irrigation		
iv	Soil conservation practices		
v	Water conservation practices		
vi	Crop insurance		
vii	Change to non-farming activities		
viii	Lease land out		
ix	Change to horticultural production		
x	Vegetable production		