Trichotomous Analysis of Climate Change, Migration and Food Security in the Agro-Ecological Zones of Ghana

Azzika Yussif Tanko[1*], Delali Margaret Badasu[1], Samuel Nii Ardey Codjoe [2], Christina Antwiwaa Nti[3] and Joseph Awetori Yaro[4]

[1]Centre for Migration Studies, University of Ghana
[2]Regional Institute for Population Studies, University of Ghana,
[3]Department of Family and Consumer Sciences, University of Ghana
[4]Department of Geography and Resource Development, University of Ghana

***Corresponding author:** Azzika Yussif Tanko; azzika2002@yahoo.co.uk

ABSTRACT

Climate change, migration and food security are serious sustainable development challenges of global proportions. However, there is a dearth of research on the interrelationships among these three factors. This study examines the trichotomous relationship of climate change, migration and food security in the Coastal, Forest, Transition and Savannah agro-ecological zones of Ghana. The study adopted mixed research methods, using data from household surveys, focus group discussions (FGDs), in-depth interviews (II) and expert interviews. The Multidimensional Poverty Index (MPI) was used to construct the overall Food Security Index (FSI). The unit of analysis was the migrant household and a total of 567 households were surveyed. The study used bivariate analysis and probit logistic regression models for analysis. Three types of households were found, namely, migrant, climatic migrant and non-migrant. Migrant households have members who migrated from the household. The findings of the study indicate that overall, migrant households were more food secure compared to non-migrant ones. Furthermore, climatic migrant households are more food secure than non-climatic migrant ones. Other significant determinants of food security include age, sex, marital status, education, wealth and health status of the household head. The study concludes that when climate change impacts on food security, migration is adopted as an adaptation strategy in times of food shortages.

Keywords: Migration, climate change, food security, households, adaptation

Introduction

The Brundtland report, "Our Common Future" predicted as early as 1987, that given the unprecedented pressures on the global environment, the planet was bound to experience unimaginable altercations unless urgent concerted global giant steps were taken to halt the process. The Report further warned that the pressure on the environment, if allowed to continue, would threaten every living species on earth unless it is recognized and managed (Brundtland *et al.*, 1987). Thirty-three years later, in 2020, climate change, migration and food security have become the most serious global environmental and development challenges of all time (IOM, 2020; Shukla *et al.,* 2019; Pauly and Zeller, 2017; Black *et al.,* 2011c). The Sustainable Development Goals call for a concerted global effort to end poverty and hunger in all their shapes and forms (UNDP, 2015). The African Union Commission Agenda 2063 (AU, 2014) also calls for a prosperous Africa based on inclusive growth and sustainable development with environmentally sustainable and climate resilient economies. But all these aspirations cannot be realized without empirical evidence on the linkages between climate change, migration and food security.

Climate change is affecting human survival, livelihood and ultimately human development (Warner *et al.,* 2012; FAO, 2020). Climate change is manifested in the form of drought, flooding, erratic rainfall, windstorms and high temperatures (Tschakert *et al.,* 2010). In 2013 alone, over 320 million people were affected by extreme weather events caused by climate change, the highest in this century (Cannon, 2014). In addition, food security and food systems have been largely affected by climate change (FAO, 2019; FAO, 2020). In 2014 for instance, 795 million people were unable to afford 1,800 calories per day which is not even enough to support a medium level of activity for an adult (FAOSTAT, 2015). Poor regions such as sub-Saharan Africa would be greatly affected (Adger *et al.,* 2015; Antwi-Agyei, 2013). When food systems are affected, it poses food security threats which force people to construct their livelihood adaptations sometimes around migration (Black *et al.,* 2011b; Yaro *et al.,* 2015). It has been estimated that there are 272 million international migrants across the globe, most of them in search of sustainable livelihood options in major cities (IOM, 2020). Moreover, close to 740 million moved within their own countries as internal migrants, mostly to urban areas in search of jobs (IOM, 2010; IOM, 2020; UNDESA, 2013). Even though migration may impact positively on food security as a result of remittances sent from migrants to their households at their origin, it does have negative consequences under some conditions (Piguet *et al.,* 2011; Fussell *et al.,* 2014). This is because when the youth migrate, food production is left in the hands of the elderly (Gomez, 2013; Bawakyillenuo *et al.,* 2016; Yaro *et al.,*2015).

Some studies argue that climate change will lead to increased migration and ultimately affect food security (WMR, 2015; Brown *et al.,* 2015; Gitz, *et al.,* 2016). There is also a counter argument that migration as a result of climate change will improve food security in the long run because it is a major adaptation strategy during food shortages (Black *et al.,* 2011b; Fussell *et al.,* 2014; WMR, 2015). But given the implications of climate change for migration and food security, no one single method can comprehensively deal with the multidimensional complexities of the phenomena. Only a few studies have dealt with the trichotomous relationship of climate change, migration and food security at multivariate levels using mixed research methods (Rademacher-Schulz *et al.,* 2012; Warner *et al.,* 2012; Afifi *et al.,* 2014; Milan and Ruano, 2014).

In Ghana, studies that have dealt with climate change, migration and food security across all the agro-ecological zones are rare. This study focused on a trichotomous analysis of climate change, migration and food security in the coastal, rainforest, transition and savannah (CRTS) agro-ecological zones of Ghana. By this trichotomous approach, the research examined the linkages of climate change and migration, climate change and food security and migration and food security across all the ecological zones. It further throws light on the need to examine a contextual analysis of the relationship among climate change, migration and food security.

Conceptual Consideration

While many studies have examined the impact of climate change and food security, few have explicitly conceptualized climate change, migration and food security relationships (Black *et al.,* 2011a; Codjoe and Owusu, 2011; Fussell *et al.,* 2014). Black *et al.,* (2011a) identified environmental drivers of migration in their study while Fussell *et al.,* (2014) argued that both environmental factors and household characteristics are critical factors that influence migration. Adopting a livelihood approach, Codjoe and Owusu (2011) emphasized that households' characteristics, assets (human, social, financial, natural and physical capital) environmental drivers, public and traditional institutions and the larger socio-economic context influence migration during climate change and dwindling food security conditions. However, depending on the socio-economic context and public policies and institutional frameworks available, climate variability could also affect individuals and households (UNEP, 2011). Synthesizing from all these arguments, the conceptual framework underpinning this study is presented in Figure 1. The study areas can be categorized into four agro-ecological zones.. In these agro-ecological zones, key manifestations of climate change are likely to be rainfall and temperature. The impact of these climate change manifestations usually comes in the form of drought, flooding, erosion and sometimes, windstorms (Tschakert *et al.,* 2010; Jarawura, 2013).

When households feel the impact of climate change, they are likely to construct their livelihood adaptation strategies which may include migration. Others may also migrate, not because of the impact of climate change, but due to other push and pull factors. Historically, it has always been a livelihood strategy to migrate from the Savannah agro-ecological zone, to the Coastal, Forest and the Transition zones for economic reasons (Anarfi *et al.,* 2000; Kwankye *et al.,* 2009).

Households in the agro-ecological zones may be categorized broadly into migrant households and non-migrant households. Migrant households are those whose member(s) migrated from the household. Within such households, some likely migrated because of the impact of climate change while others may have done so for economic reasons (Kwankye *et al.,* 2009). A second level of categorization thus emerges where climatic and non-climatic migrant households are sub-sets within the migrant household.

On the other hand, some characteristics such as household assets could also influence who migrates and the type of migration, whether climatic or non-climatic. Resources/assets can also influence food security status of households and the type of adaptation strategy adopted (Black *et al.,* 2011b). The adaptation strategies and household assets could determine whether or not households could improve their food security conditions (Egyir *et al.,* 2015).

It must be noted that migration as an adaptation mechanism is not always a guarantee for improved livelihood; there can be consequences. The efficacy of migration as a livelihood strategy largely depends on the context and who migrates to where. Therefore, the relationships of climate change, migration and food security are neither simple nor uni-directional. As shown in Figure 1, such relationships are complex, sometimes recursive and even internally contradictory. Much of the linkages among climate change, migration and food security are contextual, varying with time and space and depending on whether the place in question is mostly a migrant-sending or a migrant-receiving community.

In Ghana, the impact of climate change is already being felt across the ecological zones through erratic rainfall, flooding, drought and desertification (Addo *et al.,* 2008; Yaro, 2010; Van der Geest, 2011; Teye and Owusu, 2015). It has been predicted that these conditions will probably lead to low crop yield, resulting in food insecurity (Hesselberg and Yaro, 2006; Rademacher-Schulz's *et al.,* 2012). Out-migration also has implications for food and water security in an increasing population. Migration also comes at a cost and only those who can afford the cost of migrating do so. When the youth and those who can afford the cost of migration move, food production is often left in the hands of the poor and the elderly. Consequently, migration as an adaptation to climate change can contribute to increased food insecurity conditions in an agrarian economy (Hjelm and Dasori, 2012).; UNDESA, 2013; GSS, 2014; Hunter and O'Neil, 2014).

Methodology

Study Areas and Locations

This study was conducted in June-July 2016 in the agro-ecological zones in Ghana across four districts.: the Mfantseman District in the Coastal agro-ecological zone, Amansie West District in the Rainforest agro-ecological zone, Techiman South Municipality in the Transition agro-ecological zone and Tolon District in the Savannah agro-ecological zone (Figure 2). Within each district, four communities were chosen for the study (Table 1).

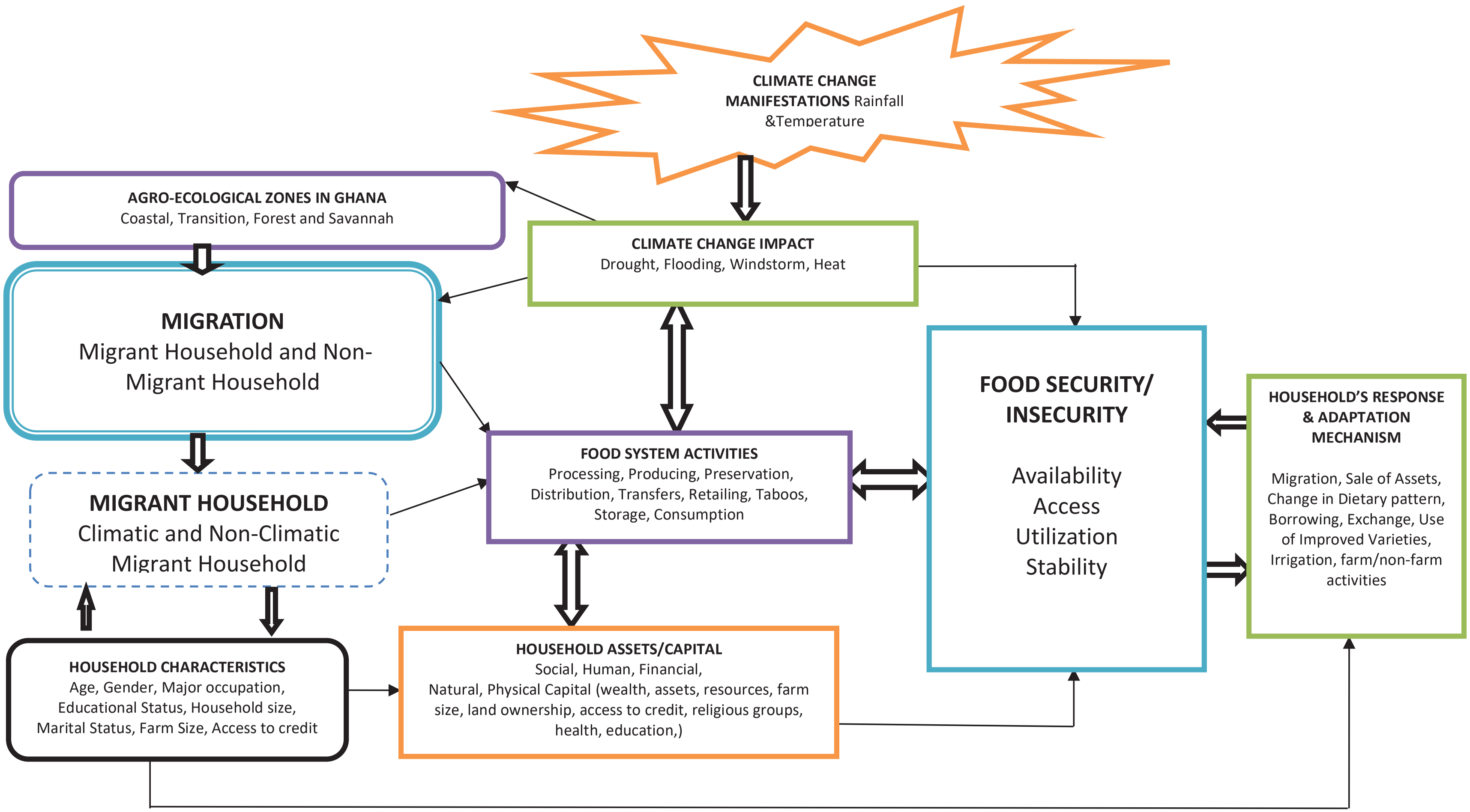

Fig. 1: Climate Change, Migration and Food Security Conceptual Framework

Source: Authors' own construct 2016

Table 1: Agro-ecological zones and communities of study

Agro-ecological zone/ Districts	Study communities of Study	Number of respondents
The Coastal agro-ecological zone (Mfantseman District),	Biriwa, Kormantse, Akobima and Dominase	141
Rain Forest ecological Zone (Amansie West District)	Manso Atwere, Manso Dominase, Manso Mosea-soe and Manso Kwahu	140
Transition ecological Zone (Techiman South Municipality)	Nkwaeso, Nsuta, Tadieso and Hansua.	140
Savannah ecological zone (Tolon District)	**Tunaayili, Koblimahgu, Tingoli, Kukuonayilli**	**146**
TOTAL	**16**	**567**

The major occupation of these communities is farming. However, some households, especially in the Coastal zone, engaged in fishing as their major occupation. The districts and communities chosen were largely representative of the various features of each ecological zone. The Coastal and the Forest zones benefit from bi-modal rainfall seasons, making them greener compared to some parts of the Transition zone and the entire Savannah zone which largely depends on a uni-modal rainfall season.

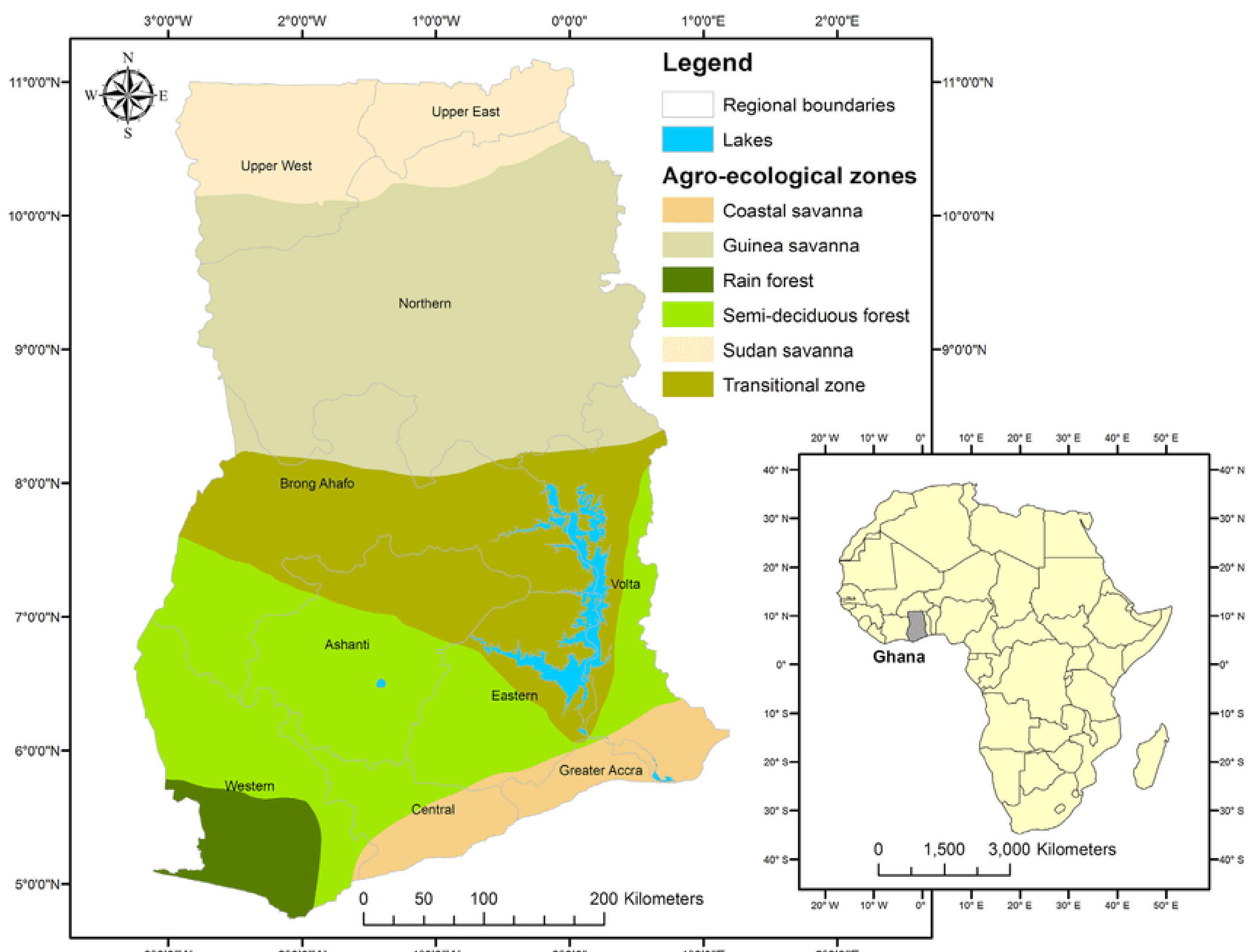

Fig. 2: Location of Agro-ecological zones

Source: Research Gate, https://www.researchgate.net/figure/307569254_fig6_Fig-A1-Map-showing-six-agro-ecological-zones-in-Ghana (accessed on 08.06.17)

The Study Design

This study adopted a mixed methods approach. To understand the triadic relationships of migration, climate change and food security, quantitative data alone was not enough to help make inferences and to understand how some household level decisions were undertaken for members to embark on migration. To assess the perceptions of households, it was important that qualitative data were collected and used to match evidence collected from quantitative data. Qualitative data were collected through key informant interviews (KII), In-depth Interviews (IDI) and Focus Group Discussions (FGDs) while the quantitative data were collected through household surveys. The mixed methods approach was considered more appropriate to holistically deal with the research objectives.

Overall, 567 household heads were interviewed. The focus of this study was farmer-based households and migrant households, but not the migrants themselves. But as at the time of the field work, no such comprehensive data existed across all the agro-ecological zones. Therefore, it became necessary to determine the sample size through mathematical *computation*. The study used a method for calculating sample size for large populations given by Fox *et al.,* (2009). The mathematical formula for computing the sample size was given as:

$$N = \frac{P(100\% - P)}{(SE)2}$$

Where
N= required sample size,
P= proportion of the population having the characteristic; and SE is the standard error.

This method usually assumes a 50 percent proportion as the worst-case scenario in cases where one has no idea what the actual proportion should be. However, this study assumed a confidence level of 99 percent, a 5 percent margin of error and a response rate of 70%.

Therefore;
P= 70% (maximum heterogeneity of 70/30 split)

To be 99% confident that the confidence parameters included the true population, the confidence interval was divided by 2.56. to get the Standard Error (SE).
The standard error was therefore computed to be 5/2.56 = 1.95.

The true sample size of the study population was determined as follows:

Therefore $N = \frac{70\%\,(100\% - 70\%)}{(1.95)2}$, N=553

While a sample size of 553 was estimated, a total of 567 questionnaires were completed due to an improved response rate. This was nearly evenly distributed as 141 for the Coastal agro-ecological zone, 140 for the Forest Zone, 140 for the Transition zone and 146 for the Savannah agro-ecological zone. The slight increase in the number of questionnaires completed over the estimated sample confirms the 99 percent confidence level estimated, the 70 percent proportion assumed as the worst-case scenario and the 5 percent margin of error.

Data Collection and Analysis

Primary data were collected from household surveys, Key Informant Interviews and Focus Group Discussions. Key Informant Interviews were conducted with research institutions, government officials, agricultural extension service officers and older people in the communities who were above 60 years and had experienced or observed weather patterns regarding farming and other human activities over several decades. Secondary data were obtained from reviews of both published and unpublished literature from various sources which were based on observed meteorological data for the ecological zones from 1981 to 2011 (GoG, 2011). Quotes from respondents were also used to support evidence collected from the household surveys and Focus Group discussions. The quantitative data collected were coded and processed using CSPro while data analysis was carried out using STATA version 14. The Multidimension Poverty Index (MPI) (Alkire and Santos, 2010) was used to construct a Food Security Index (FSI).

The Multidimensional Food Security Index

Given that food security is multifaceted and a multidimensional phenomenon (FAO, 2014), the MPI was applied in the computation of the FSI for this study. The mathematical function for the estimation of the MPI is given below:

$$MPI = M0 = H * A$$

M0*=Adjusted multidimensional head count ration*
H*= the head count/percentage poor people (incidence)*
A*= the average percentage of dimensions in which poor people are deprived (intensity of people poverty).*

Using the MPI approach, the FSI was computed from a list of six food security indicators measuring the different dimensions of food security. These indicators were (1) condition of food shortages, (2) unbalanced diet, (3) did not eat (4) no money for food, (5) eat less food, and (6) loss of weight. These indicators were measured as often true, sometimes true and never true. The "often true" response means that the household often experiences that dimension of food security measurement and "never true" means that the household never experiences that dimension of food insecurity. The Food Security Index (FSI) was then taken as a cumulative sum of all the six indicators.

The six indicators of food security were then assigned individual weights which cumulatively sum up to 100. Given the potential value and varying effect of the indicators on food security, 'food shortages' and 'unbalanced diet' were given a weight of 10 each out of 100. The rest of the indicators (didn't eat, no money for food, eat less food and loss of weight) were each given a weight of 20, signifying their level of severity, value, depth, intensity and importance regarding household food security conditions.

The indicators such as 'food shortages', 'no money to buy food' and households inability to 'eat a balance diet' were measured by the following scales: 'often true', 'sometimes true' and 'never true'. The rest of the indicators were measured categorically with yes and no responses.

Variables of Interest for this study

The dependent variable for this study was food security. This was assessed as availability, access, utilization and stability across the ecological zones. To assess food security conditions of households, a Food Security Index (FSI) was constructed using the Multidimensional Poverty Index (MPI) approach.

The independent variables of interest for this study included climate change and migration. Households' perception of climate change such as rainfall and temperature were found to have an influence on food availability, access and utilization. Migrant households were labeled as one (1) while non-migrant households were measured as zero (0). Among the migrant households were also household members who had migrated for climate related reasons (climatic migrant household) and those who migrated for reasons other than climate (non-climatic migrant households). To determine the weight, true value, impact and direction of the independent variables on the dependent variables, it became necessary to control for some variables on the dependent variable (food security). Given that the primary unit of analysis in this study was the migrant household and the respondents were the household heads, the socio-economic characteristics of the household and household-heads were considered as determinants of the welfare and food security status of the households.

Results

Reasons for Migration in the Agro-ecological zones

For a household to qualify as a migrant household, a person from the household should have been staying outside of his/her original household in another geographical area for a minimum of six months. The focus of this study was the migrant household at the place of origin and not the migrants (absent or returned) themselves.

Various reasons accounted for migration across the agro-ecological zones (Figure 3). They are broadly categorized as climatic and non-climatic reasons. Climatic factors for migration included no dry season farming jobs (10%), low farm yield/poor harvest (19%) and degraded poor agriculture land for farming (10%) while those for non-climatic migration included job search (42%), joining relatives (6%), marriage related (6%) and education (4%). However, 3% of households could not tell the reasons why a household member migrated because such household members took the migration decision without informing the household head or giving any reason why they migrated. Almost 6 out of every 10 (58%) of the households reported that members migrated because of non-climatic reasons or gave economic reasons, compared to approximately 4 out of every 10 (39%) of the households whose members migrated because of climatic factors. While economic reasons dominate in migration in the ecological zones, climate change also accounts for a relatively large percentage of migration of household members.

The reasons for migration in the agro-ecological zones were further categorized into push and pull factors as related by Lee (1966). The pull factors included the search for job opportunities at the destination, desire to join relatives, marriage arrangements and educational opportunities at place of destination, while the push factors were largely related to climate-related reasons such as crop failure, poor harvest, poor/infertile degradable agriculture land for farming and lack of agriculture-related dry season jobs given that the communities are mostly farmers. A farmer noted:

"Now the weather has changed, the rains come late and end early. As such the yield is no more good compared to 10 years ago. So, when the dry season comes and you are not near a big dam, you cannot farm. In the past, the rain could fall for more than six months but this is no more the case today. The dry season now sets in so early. Due to shortage of rains and the failure of our crops two of my sons left the village two years ago and they are in Accra and Kumasi. I had no option than to let them go. Once in a while they send us money for food and sometimes clothing". (Alhassan Naparo, Tingoli, Tolon District, Savannah Agro-ecological zone.)

Migrant and Non-Migrant Households in the agro-ecological zones

Given the reasons for migration, households in the ecological zones could be categorized broadly into two: migrant households and non-migrant households. The migrant households were further categorized as climatic migrant households and non-climatic migrant households (Figure 4).

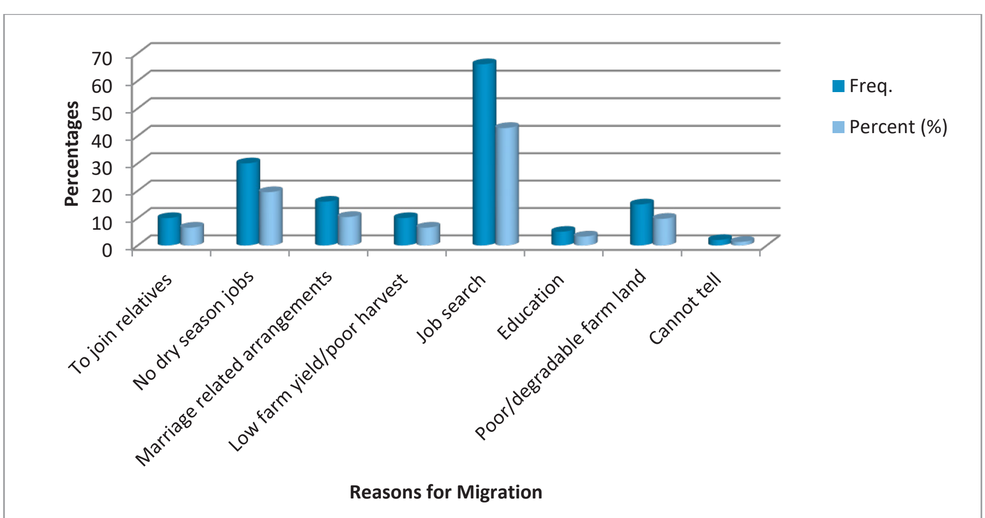

Fig. 3: Reasons for Migrations

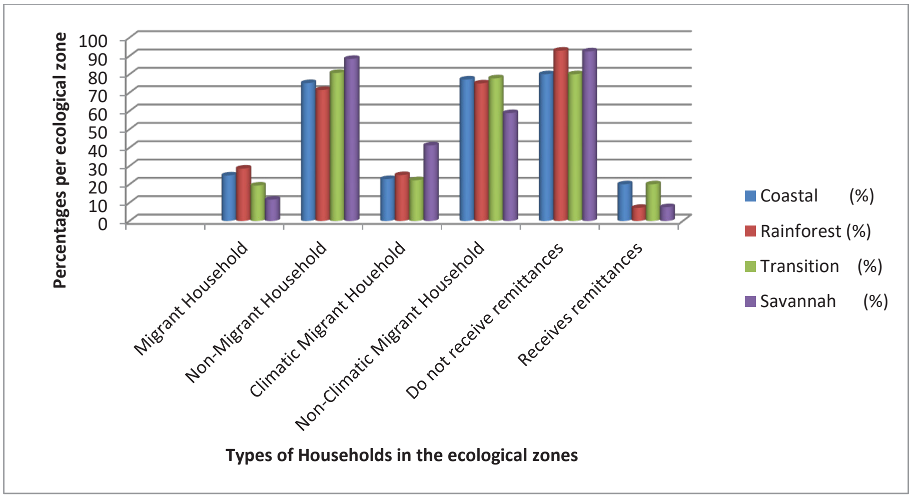

Fig. 4: Categories of Households in the agro-ecological zones

Overall Multidimensional Food Security Index

Given the indicators and assigned weights, the overall Food Security Index (FSI) was constructed (Table 4). If the MPI function by Alkire and Santos (2010), as M0=H*A is adapted to compute for the overall FSI, the results of the individual household head count (H) which show the depth of food insecurity indicated that most of the households were food insecure. The depth showed that about 73% of respondent households were food insecure.

Table 4: Overall Multidimensional Food Security Index (FSI)

Main results		N=526
Food Insecurity Index	Coef.	Std. Err
Food Insecurity Head Count (H)	0.7319	0.0193
Additional Headcount (A)	0.8467	0.0094
Adjusted Head Count (M0)	0.6197	0.0177

Note: Adjusted Multidimensional Headcount M0 = H*A

The additional headcount was computed to show the level of severity. It showed a much higher score, indicating that households are deprived in food insecurity for close to 85 percent of the indicators while the overall adjusted multidimensional head count (M0) which indicates the average intensity and share of household food insecurity deprivations experienced in depth and breadth stood at 62%.

Migrant and Non-Migrant Households and Food Security

The levels of food security among the households in the agro-ecological zones were estimated. Table 5 shows that food insecurity is more pronounced among non-migrant households (74.1%) compared to migrant households (69.7%).

Table 5: Results of food security, migrant and non-migrant households

Food Insecurity	Non-Migrant Households	Migrant Households	Total
Food Insecurity Head Count	0.741	0.697	0.732
Adjusted Head count (M0)	0.633	0.571	0.620
Pop share	0.793	0.207	1.000
Percentage Contribution of Households			
Food Insecurity Head Count	0.803	0.197	1.000
Adjusted Head count (M0)	0.809	0.191	1.000

The adjusted headcount (M0) also showed a similar pattern, with food insecurity within non-migrant households (63.3%) being higher than among migrant households (57.1%). It implies that migrant households are more food secure compared to non-migrant households. Regarding the contribution of households to food insecurity, there is a significant difference between non-migrant and migrant households. Non-migrant households contributed 80.3 percent to the overall food insecurity head count, while migrant households contributed 19.7

percent. The adjusted head count which shows the depth and breadth of the situation also indicated that compared to migrant households (19%), non-migrant households (81%) contributed more to the overall food insecurity deprivation.

Climate Change, Migration and Food Security relationships

In finding out the relationship of climate change, migration and food security, logistic regression analysis was used. The results showed that the logit regression model fits the data very well, as shown by the Chi-square at 1 percent level of significance (Table 6). The results of the logit model showed that climatic migrant households have reduced levels of food insecurity, compared with those who either do not migrate at all or do so for economic reasons or reasons other than climate change. This association underscores the argument that a trichotomous relationship among climate change, migration and food security can be observed.

Table 6: Probit logistic regression for Climate Change, Migration and Food Insecurity

Wald chi^2 (23) = 54.61, Prob > chi2 = 0.0002, Log pseudolikelihood = -272.21103 Pseudo R2 = 0.1032

Variables/Eco-zones	Overall	Coastal	Rainforest	Transition	Savannah
Migration: Non-Migrants (Ref)					
Non climatic migrant households	-0.117	-1.236**	-0.114	1.832**	1.427
	(0.307)	(0.622)	(0.606)	(0.887)	(1.195)
Climatic migrant households	-0.205	-1.399	-1.021	-0.880	0.262
	(0.431)	(1.026)	(0.992)	(1.152)	(0.993)
Remittances: Receive remittances (Ref)	0.548	1.274*	-0.133	1.834**	-0.560
Do not receive remittances	(0.361)	(0.769)	(0.878)	(0.926)	(0.865)
Age : <40(Ref)					
40 to 60	-0.952***	-0.263	-0.823	-3.045**	-0.709
	(0.313)	(0.691)	(0.647)	(1.312)	(0.561)
>60	-1.319***	0.928	-1.657	-6.919***	-0.459
	(0.416)	(0.930)	(1.152)	(1.872)	(0.771)
Sex: Female (Ref)	0.247	0.372	0.525	1.918	-15.64***
Male	(0.465)	(0.745)	(0.798)	(1.285)	(1.811)
Marital Status: Not in Union (Ref)	-0.0478	0.188	0.685	-0.0857	-15.38***
In Union	(0.477)	(0.815)	(0.771)	(1.494)	(1.133)
Household Size (mean)	0.0537	0.259*	-0.126	0.112	0.0936
	(0.0571)	(0.156)	(0.115)	(0.232)	(0.0956)
Education: No Formal Education (Ref)					
Basic Education	-1.012***	-1.485**	-1.894**	-1.700	-0.915
	(0.334)	(0.614)	(0.868)	(1.415)	(1.552)
Post-secondary Education	-0.683**	-1.101*	-1.818**	-1.687	0.343
	(0.298)	(0.621)	(0.757)	(1.455)	(0.785)
Agro-ecological Zones: Coastal (Ref)					
Rainforest	-0.0608				
	(0.374)				
Transition	-0.218				
	(0.339)				
Savannah	0.0692				
	(0.577)				

Table 6 cont.

Variables/Eco-zones	Overall	Coastal	Rainforest	Transition	Savannah
Occupation: Farming (Ref)	0.0048	-0.513	-0.112	0.520	-0.216
Others	(0.330)	(0.533)	(0.895)	(0.854)	(1.286)
Religion: Traditional/Other (Ref)	-0.0290	-0.210	-0.717	1.183	
Christian	(0.455)	(0.801)	(0.909)	(1.699)	
Islam	-0.364	-0.252	-2.716*	0.995	-
	(0.597)	(1.441)	(1.473)	(1.748)	
Wealth (Assets/Capital) Index: Higher (Ref)					
Lower	1.318***	-0.293	0.0943	3.526***	1.083**
	(0.349)	(0.648)	(0.951)	(1.119)	(0.536)
Middle	0.996***	-	-0.458	3.825***	1.363**
	(0.337)		(0.853)	(1.340)	(0.607)
Health Status: Less than average (Ref)					
Average	-0.331	-0.122	0.453	-0.736	-0.165
	(0.435)	(1.086)	(0.789)	(2.162)	(1.365)
Above average	-1.017**	-0.840	-0.324	-1.709	-1.001
	(0.437)	(0.895)	(0.728)	(2.182)	(1.358)
Household farmland Size	-0.0191	-0.199*	0.0001	-0.269**	-0.0449
	(0.0625)	(0.108)	(0.0115)	(0.122)	(0.0468)
Land Tenure/Ownership: Inherited or Purchased (Ref)					
Rented/Other types of ownership	-0.0188	-0.414	-0.850	0.407	-
	(0.296)	(0.624)	(0.720)	(0.841)	
Credit: Do not receive credit (Ref)	0.686	0.385	1.129	1.371	-
Receive credit	(0.424)	(0.645)	(1.015)	(1.595)	
Constant	1.821**	2.514*	4.313**	1.717	16.17***
	(0.854)	(1.482)	(1.783)	(2.458)	(1.862)
Observations	522	134	119	122	124
Wald chi² (23) = 54.61, Prob > chi2 =0.0002, Log pseudolikelihood = -272.21103				Pseudo R2 = 0.1032	

Note: Robust standard errors in parentheses, Margin of significance: (***, **, *). Coefficient is statistically significant at *** p<0.01, ** p<0.05, * p<0.1, reference categories/dummies: non-climatic migrant households, receive remittances, age<40, Female, Not in union, No formal education, Coastal, Farming, Traditional/others, Highest wealth category, Health status: less than average, Land: Inherited/purchase, Do not receive

Synthesis of the Relationship of Climate Change, Migration and Food Security

A synthesis of the relationships of climate change, migration and food security was drawn from participants through focus group discussions and key informant interviews (Figure 5.) Variation in climate in the form of increases in temperature and erratic rainfall affects farming through change in seasonality, poor crop yield and low agriculture production. Agriculture-related jobs are also lost when climate change affects the livelihoods of households. When climate change affects agricultural production, it leads to decline in food availability, and ultimately food insecurity conditions set in. Households, in an attempt to diversify their livelihood and to overcome food insecurity challenges, have some of their members embark on migration. Such migrations are supported by households in anticipation of remittances. Given that the communities under study are largely agrarian, it is possible that climatic factors are part of the larger economic reasons for migration. Some successful migrants remit their households, which helps to improve food and livelihood security conditions of their left-behind households.

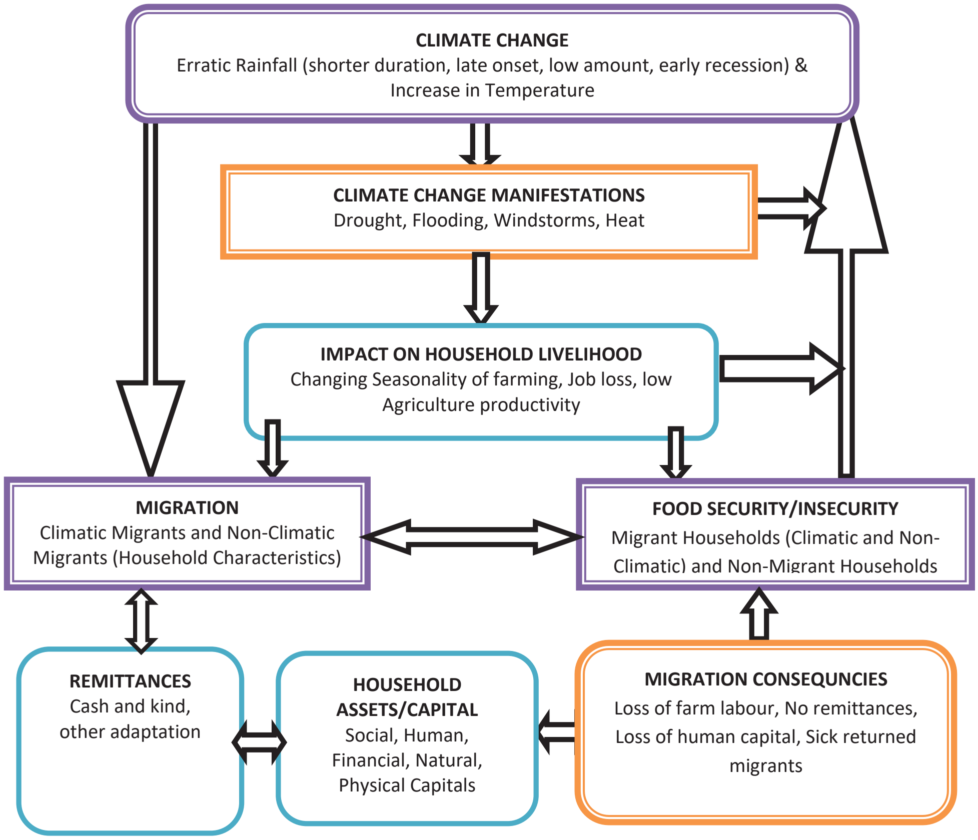

Fig. 5: Synthesis of the Relationship of Climate change, Migration and Food Security

Source: Authors construct (FGD/KII 2017)

On the other hand, migration of household members could also lead to loss of farm labour or present other consequences to the household such as unsuccessful return migrants or the return of sick migrants. As a result, migration does not always result in benefits to the household. Therefore, under some conditions, migration can have serious consequences for the household. Household accumulated resources can be depleted on a household member who migrated or returned with other burdens.

Discussion

Analysis of Trichotomous Relationships of Climate change, Migration and Food Security

The geographical location of individuals and households is a crucial influencing factor of their food security status and potential to migrate during climate change conditions (Brown *et al.* 2015). The results of the present study showed that location tends to play a critical role in influencing food security conditions of households across the agro-ecological zones under study. In the Coastal agro-ecological zone for instance, climatic migration tends to have a positive impact on food security. When household members migrate as a result of climate change it tends to improve the food security status of the household compared to non-climatic migration in other zones such as the Forest agro-ecological zone. But the Coastal agro-ecological zone recorded the highest rate of food insecurity. This is probably due to the influence of climate change on fishing which is the main occupation of inhabitants along the coast in addition to some farming (WHO, 2018; Teye and Owusu, 2015; AGRER, 2011). The onset of climate change in the form of high temperatures which affects fish catch is negatively affecting the main livelihood of the people. The result of the present study is consistent with those of previous studies which indicate that sea level rise, coastal erosion, flooding and rise in temperatures are eroding the gains and fish harvest of households in coastal communities (Addo, *et al.,* 2008; Stabinsky, 2014; Huq *et al.,* 2015; Pabi *et al.,* 2015). Fish catch and fish stock have been projected to further reduce if immediate steps are not taken to deal with the impact of climate change on marine life (FAO, 2008; Gitz, *et al.,* 2016). This implies that more coastal residents who are in the fishing and related sectors are likely to further migrate as a result of the impact of climate change on fishing in the coastal communities in the form of dwindling fish catch and the associated food insecurity conditions (AGRER 2011; Fisheries, 2014; WHO, 2018). Changing rainfall pattern was identified as a major change in the zone.

The Savannah agro-ecological zone recorded the second highest rate of food insecurity under climate change conditions. This evidence is consistent with the findings of previous studies which indicate that the Savannah zone, due to its relative historical deprivation, has high levels of poverty and food insecurity incidence (Awumbila and Ardayfio-Schandorf, 2008; Stanturf *et al.,* 2011; Rademacher-Shultz's, *et al.,* 2014; Van der Geest, 2011; Hjelm and Dasori, 2012; Yaro, 2013). The results further showed that climatic reasons for migration are associated with high food insecurity conditions in the Savannah agro-ecological zone. This result is also consistent with the findings of Awumbila and Ardayfio-Schandorf (2008), Van der Geest (2011) and Rademacher-Schulz's *et al.,* (2012), that when households are food stressed in the Savannah agro-ecological zones, they turn to migration as an adaptation strategy. Historically, migration has been a livelihood adaptation strategy among the people of the Savannah zone (Anarfi *et al.,* 2003; Kwankye *et al.,* 2009; Awumbila *et al.,* 2014).

In the Forest agro-ecological zone, non-climatic migration is having a greater impact on food security compared to climatic migration. This is because even though household members might have migrated, they are probably not remitting enough to lift their households out of food insecurity The household survey confirmed by focus group discussions that the Forest zone has been more attractive to migrants because of its greater economic opportunities, mostly in the informal sector in recent decades, that draw especially the youth from the northern Savannah agro-ecological zones. .

The Transition agro-ecological zone which shares some similarities with the Forest agro-ecological zone recorded the lowest food insecurity rate. In this zone, however, climatic migrant households tended to be more food secure, but compared to the Forest zone, the variation was insignificant. The Transition zone's better food security could probably be attributed to many factors including rich soil nutrients and abundant labour from the Savannah agro-ecological zones that serve farming communities in this zone (Van der Geest, 2011).

Also, given that households depend on agriculture, when crop yield is affected, farmers' source of wealth and income could also be affected. The weakening assets and resource base of the household without a corresponding increase in entitlement bundles can affect households' labour, trade, production and exchange-based entitlements. Entitlement failure under climate conditions can further expose farmers to other vulnerabilities and food insecurity conditions (Sen, 1981) depending on the household characteristics. When food insecurity conditions set in, households begin to reconstruct their livelihood adaptation strategies with migration as an option. This corroborates previous findings (Black *et al.,* 2011c; Black *et al.,* 2011b; WHO, 2018). However, being utility maximizing entities, the households undertake decisions that embrace the welfare and aspirations of other household members. The decisions about migration revolve around the household head. Given dwindling agriculture fortunes, households begin to devise different ways to discharge surplus labour in a beneficial way by supporting a household member to migrate. Prior to departure, potential migrants are supported financially and spiritually in order to arrive with luck for jobs at destination. This narrative conforms to the arguments of the New Economics of Labour Migration (NELM) theory that migration ultimately is a utility maximizing decision of entire households (Massey *et al.,* 1993) and not merely a wage-labour affair.

Climate change, migration and food security dynamics are also influenced by some household characteristics (Table 6). Households' (migrant, climatic migrant and non-migrant) characteristics that strongly influence food security status include age, sex, household size, marital status, education, access to credit, wealth and health status of the household head. The age of the household head is a good predictor of food security status of households under climate change conditions. Elderly household heads (>60 years) in the Transition zone tend to be more food secure compared to younger household heads (40 to 60 years). This could be due to the fact that the elders could be enjoying some comparative advantage over the youth by virtue of their experience and access, ownership and control of productive resources such as land.

Younger household heads (40 to 60 years) in the Savannah zone were more food secure compared to those below 40 years and those above 60 years. While this could be attributed to ownership of land by the youth in the Savannah zone, it could also mean that, given the labour intensive nature of farming in the Savannah zone, the youth are stronger and able to farm better than the elderly and those less than 40 years. Those in the 40-60 years category may also have more young adult and unmarried children who can be a source of labour, while the children of those below 40 years may not be able to contribute to farm labour and those of the farmers aged above 60 years may be mostly married and have their own families. Resources could also be playing a key role in determining the food security status of households in the Savannah zone because the youth probably are more able to diversify and sell their labour in order to mobilize more resources to engage in more food cultivation compared to the elderly and those below 40 years. The youth are also probably more likely to be exposed to new and modern methods of farming, given their high levels of propensity to migrate compared to the elderly.

Furthermore, in the Savannah agro-ecological zone, farming is more of a subsistence activity, mostly with the use of simple rudimentary tools such as cutlasses and hoes. Labour intensive but simple methods of farming are largely used, with less agriculture mechanization, unlike in the Forest and Coastal zones where relatively non-poor farmers are able to afford agriculture extensification and mechanization (Stanturf *et al.,* 2011; Codjoe and Bilsborrow, 2011).

Experience may be playing a critical role in determining household food security status in the Coastal and Forest agro-ecological zones, given that older household heads (<60 years) are more food secure. Probably, older household heads are more experienced in farming and also have more resources since the Forest zone is well endowed with the potential of good agriculture yield compared to the Savannah zones. Experience and money could be playing a significant role in farming, given that the elderly were more food secure in the Forest and Coastal zones. This evidence corroborates previous findings that resources, labour strength and quality of the households influence farming and food security status of households (Dasgupta and Baschieri, 2010).

The sex of the household head presented varying results on food security in times of climate change across the agro-ecological zones (Table 6). With regard to sex, male-headed households are more food secure in the Coastal, Forest and Transition zones compared to the Savannah agro-ecological zone. This could mean that the male-headed households have more control over means of production, especially in the Coastal zone where the majority of male-headed households are. In the Savannah agro-ecological zone, female-headed households are more food secure than male-headed households. This could be attributed to remittances where recipients are mostly women in the Savannah zone. Women were also likely to benefit more from social capital from other family members given the strong social networks and the role the social economy still plays in that zone compared to the monetized and relatively more urbanized communities with more weakening social ties in the Coastal, Forest and Transition zones. This evidence conforms to the literature (Darkwah *et al.,* 2016; Van der Geest, 2011). Darkwah *et al.,* (2016) further indicated that the patriarchal powers of the male are dwindling as women in the Savannah zone are empowered due to remittances.

The wealth (assets/capital) and health status of the household head and access to credit are strong predictors of household food security during climate change. The higher the head of the household's position in the 'wealth category', the lower the food insecurity status of the household. Household heads in the 'lowest wealth' category were more food insecure compared with household heads in the 'highest wealth' category. A similar relationship was observed between households in the 'middle wealth' category and household heads in the 'highest wealth' category. Household heads in the 'middle wealth' category were found to be less food secure compared with households in the 'higher wealth' category. The accumulation of assets and resources by the household head therefore serves as a good protector against food insecurity.

The impact of migration on household livelihood and food security conditions is neither always positive nor uni-directional, but complex and interrelated. Migration under some conditions does not improve household livelihood conditions, but rather exacerbates them, given further exposure to other vulnerabilities. Some houses receive remittances that help improve their livelihood conditions.

There are other households that do not receive remittances probably because a migrant household member is not successful. Unsuccessful migrants may also return with further burdens, such as ill-health which further depletes accumulated household assets and resources. Against this background, Sen (1981) argued that in the face of entitlement failure (social, financial, natural, physical), the likelihood of households falling into further deprivation is high.

The impact of migration on household livelihood and food insecurity conditions also depends on who migrated from which household and to where (Warner and Afifi, 2014; Afifi *et al.,* 2014; Black *et al.,* 2011a), The findings refute generally held notions that once migration occurs, remittances in cash and in kind should be expected. Arguably, it can be said that it takes a responsible and successful migrant to remit their households to enable them to improve their livelihood and food security status, *ceteris paribus*.

Apart from migration, households used other adaptation strategies to manage food insecurity conditions, such as skipping meals in times of food shortages. This adaptation mechanism was commonly used across all the agro-ecological zones.

Across the agro-ecological zones, non-farming activities played a critical role in improving household food insecurity conditions. In the Savannah agro-ecological zone for instance, households' non-farm activities included petty trading, 'mancheli' (blacksmithing), hunting, some occasional fishing, rearing of livestock (cattle, sheep, goats), poultry, charcoal production and sale of locally brewed drinks such as 'sobolo' and 'pito'. Some households also indicated that during the farming season (a period often characterized by food shortages just before harvest), they occasionally sell wage labour to neighboring farms and communities.

Conclusion

There is evidence that climate change manifests in increasing temperatures and erratic rainfall. This further leads to drought, flooding, increase in windstorms and rainstorms. The manifestations of climate change affect the seasonality of farming and agriculture production, especially in rain-fed agrarian economies. The impact is seen in poor crop yield, poor harvest, job losses and food insecurity. In order to adapt to food insecurity conditions, household members migrate in search of better jobs. Successful migrants remit their households, which probably helps to improve food security conditions.

Given the impact of climate change on livelihoods and agriculture production, livelihood diversification of households is an important consideration. Managing migration resulting from climate change entails strengthening farmers' capacity to improve on their adaptation mechanisms in both farm and non-farm activities. Given the prevalence of drought, especially in the Savannah agro-ecological zones and some parts of the Transition zones, it is recommended that irrigation facilities be provided for farmer-based communities. .

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