https://dx.doi.org/10.4314/dujopas.v10i4c.13
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 10 No. 4c December 2024*

Investigating the Impacts of Climate Induced Migration on Food Security in the Sudano-Sahelian Geographical Region of Nigeria.

[1&2]Maiwada A. S. and [1]Aremu J. K.

[1]Department of Geography,
Nigerian Defence Academy,
Kaduna.

[2]Department of Meteorology,
Umaru Musa Yar'adua University,
Katsina,
Nigeria.

Email: abdulmaiwada24@gmail.com

Abstract

As a complex and multifaceted phenomena, human migration has shaped and reshaped human societies and history across all regions. The drivers of human migration are diverse and interconnected, usually influenced by a combination of factors. Environmental factors are increasingly recognized as significant drivers of human migration as climate stressors like droughts, floods and extreme weather events continue to render areas uninhabitable or unsuitable for agriculture, pushing people out for better living conditions. This research aimed to investigate the impacts of climatic migration on food security in the Sudano-Sahelian region of Nigeria (Katsina and Jigawa). A Key Informant Interview (KII) was conducted using a structured questionnaire to 385 respondents in order to assess the relationship between climate induced-migration and food security in the study area. The results revealed that, about 90% (n=346) of the respondents are aware of climate variability. Climate induced migrations in the study area affects food security through reduced labor force (50%), loss of farming communities (37%) and resource competition (11%). About 36% (n=140) of the respondents believed that to mitigate climate induced migration effects on food security, investments in climate smart/resilient agriculture and irrigation systems should be employed while 27% (n=104) chose enhancing social safety nets and livelihood diversification. Overall, the relationship rating between climate induced migration and food security revealed that, about 40% (n=153) believed that the relationship is moderately negative while 136 respondents (35%) believed that the relationship is strongly negative, meaning that climate induced migration worsens the food security situation in the area. The study establishes an intricate relationship between climate induced migration and food insecurity with far-reaching implications, including heightened household hunger and food insecurity and decreased agricultural productivity and resilience. It is recommended that the government should intervene through supports in small-scale agriculture and smart agriculture to encourage local food production in order to increase food availability and access.

Keywords: Climate, Food security, Impacts, Migration, Nigeria, Sudano-Sahelian.

INTRODUCTION

Human Migration is a dynamic and multifaceted phenomenon involving the movement of individuals or groups from one place or location to another encompassing diverse temporal dimensions, historical contexts and spatial scales. (Telsaç & Telsaç, 2022; Malik, 2023). Understanding the concept of migration requires examining how time and space intersect to shape migration processes, patterns and outcomes within a country (internal migration) or across international borders (international migration) (Kosinsiki & Prothero, 2023). According to Niva, *et al* (2023) the drivers of human migration are diverse and interconnected, usually influenced by a combination of social, economic, political, personal and environmental factors. In essence, understanding these drivers of migration is crucial for comprehending the dynamics of population movement and its implications for both source and destination regions.

Migration is not a static event but a dynamic process that unfolds over time. Temporal dimensions of migration include historical trajectories, life-course transitions, cyclical patterns and the duration of migration experiences (Hirschman, 2007). As individuals or groups move through different life stages, their migration decisions, motivations and experiences evolve. Historical events, societal transformations and policy changes influence migration patterns and dynamics (Castles & Miller, 2003). For example, periods of conflict, economic upheaval, or political transition can trigger waves of migration as people respond to changing circumstances. Migration patterns vary across different periods and spatial scales. Long-term trends, such as urbanization, globalization and demographic shifts, shape migration flows at regional, national and global levels (Massey, *et al.,* 1993). In terms of the migration period, some forms of migration exhibit seasonal or cyclical patterns, such as seasonal agricultural labor migration or tourist-related migration. These periodic movements are influenced by seasonal changes, economic activities and labor demands in specific sectors (Griffiths, *et al.,* 2013). The duration of migration experiences varies, ranging from temporary labor migration to permanent settlement. Temporary migration may involve circular or repeat migration, while permanent migration leads to long-term integration and adaptation in new environments (Boyd, 1989).

De Haas (2012) revealed that, migration occurs within specific spatial contexts, including rural-urban migration, international migration corridors, migration between neighboring countries and transnational migration flows. Spatial factors such as geographic proximity, economic opportunities, cultural ties and political borders influences migration pathways (Glick Schiller & Salazar, 2013).

Environmental factors such as climate variability/change, natural disasters and environmental degradation are increasingly recognized as significant drivers of migration (Moore & Wesselbaum, 2023). Climate variability is a natural fluctuation in the earth's climate system over a time scale that ranges from years to decades or even centuries (IPCC, 2019). This can involve changes in atmospheric and oceanic circulation patterns, changes in the patterns of precipitation, temperature and other climatic parameters. Climate variability can be the result of either internal factors like changes in oceanic circulations and volcanic eruption or the external factors like changes in solar radiation reception and the concentration of harmful greenhouse gases in the atmosphere.

According to Belay, *et al* (2021) climate variability, characterized by shifts in temperature, precipitation patterns and extreme weather events, has been identified as a significant driver of human migration globally. The increasing frequency and intensity of climate-related

events, such as droughts, floods and storms, have led to population migrations and displacements within and across the borders (Kaczan & Orgill-Meyer, 2020). This phenomenon has profound implications for food security, particularly in regions that are highly vulnerable to these climate change impacts. (McMichael, 2014; Guha, & Roy, 2016).
The Key concern is the mechanism through which climate induced migration influences food security at various scales, from individual households to national and international levels. Additionally, exploring the adaptive strategies employed by people to mitigate food insecurity challenges in the context of climate variability is crucial. The research centered on the need to comprehensively understand the complex interplays between climate-related migration and its direct and indirect effects on food security in the Sudano-Sahelian Geographical region of Nigeria (Northeastern Katsina state and Northwestern Jigawa state).

Material and Methods

Study Area
The study area is located in the extreme North-eastern part of Katsina state and the extreme North-western part of Jigawa state in Nigeria. It lies between latitude $12^0 21'43''$N and $13^0 19'15''$N and from longitude $7^0 51'07''$E to $9^0 45'54''$E. It covers a land mass of approximately 6,753 km^2 spanning across both Katsina and Jigawa States. The area shares borders with Niger Republic to the north entirely and to the west, south and east, the study area boarders Kaita, Mani and Dutsi Local Government Areas in Katsina state and Gagarawa and Kaugama Local Government Areas in Jigawa state respectively. To the south also, the study area share boarder with Makoda and Danbatta Local Government Areas of Kano State. The area has a population figure of 1,904,407 people as at the 2006 Population census which was projected to be 3,348,700 people in 2022 (NPC, 2006). The region is characterized as part of the semi-arid and arid region of the country with climatic conditions that exhibit mainly two distinct seasons as the short wet and a prolonged dry season (Yelwa, Sanda, & Usman, 2019).

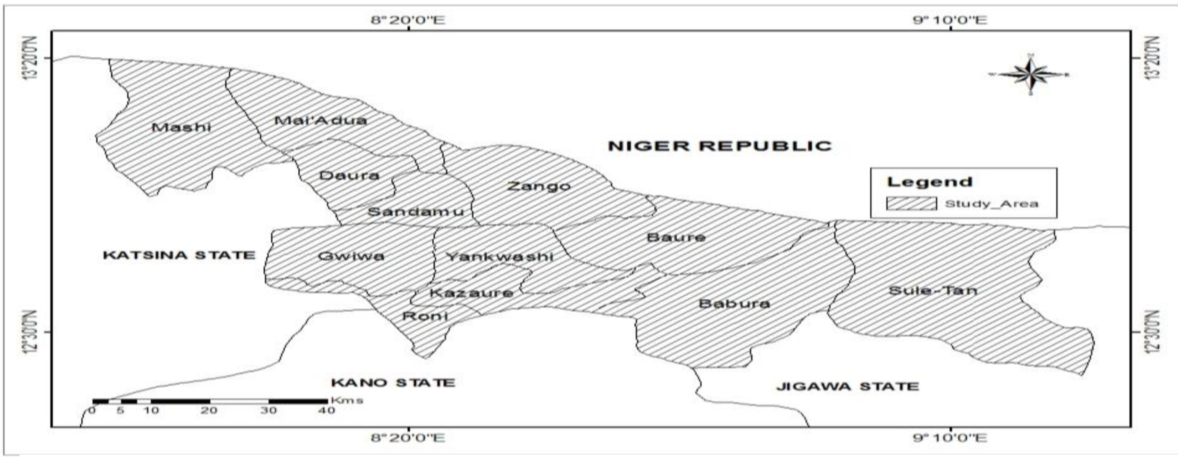

Figure 1: Map of the Study area.

According to Maiwada (2017), the area has a uniformly high temperature throughout the year with varying mean monthly value of 24^0C-31^0C. In terms of precipitation, the area receives the least annual rainfall figure of 60-70cm compared to the southern location usually receiving 80-100cm as one goes southward. (Maiwada & Hassan, 2019).

Data Collection
A multistage sampling technique was applied to select the samples for the study. At the first stage, 6 local government areas were purposively selected in the region from each state

(Katsina and Jigawa) respectively. In Katsina, Mashi, Daura, Mai'adua, Sandamu, Baure and Zango Local government areas were selected while in Jigawa state, Kazaure, Roni, Gwiwa, Yankwashi, Babura and Sule Tankarkar were selected. In the second stage, The simplified sample size formula expressed in equation 1 (Chaokromthong & Sintao, 2021) was used to get the sample allocation for each Local Government Area base on its projected population size to 2022 (Table 1), the Local Government Area (LGA) headquarters were adopted together with two other randomly selected wards in the LGA for the data collection.

$$n = \frac{Nz^2\,(p)(1-p)}{Ne^2 + z^2(p)(1-p)} \qquad (1)$$

Where: n = Number of samples, N = Total population, e = Error tolerance (Level) or Margin of error at a proportion of population given as (0.05), p = Sample proportion (0.5) and z = z-value in Z-score table (1.96).

Table 1: Projected Population of the Study Area

S/N	LGA	2006 Population Census	2022 Projected Figure
1	Gwiwa (GWW)	128,730	221,400
2	Kazaure (KZR)	161,161	277,100
3	Roni (RNN)	77,414	133,100
4	Yankwashi (YKS)	95,643	164,500
5	Babura (BBR)	212,955	366,200
6	Sule Tankarkar (STK)	134,813	231,800
7	Daura (DRA)	224,884	401,900
8	Mashi (MSH)	171,070	305,700
9	Mai'adua (MDW)	201,800	360,700
10	Zango (ZNG)	156,052	278,900
11	Baure (BRE)	202,941	362,700
12	Sandamu (SDM)	136,944	244,700
Total		**1,904,407**	**3,348,700**

Source: NPC, (2006).

Finally in the third stage, after using the simplified formula for sample size, 385 respondents were selected for the conduct of the research and questionnaire administration. However, the sample size for each Local Government Area varied due to its population size through the use of the proportional sample allocation equation (Yakubu, *et al.,* 2023) expressed in equation 2:

$$n_i = \frac{N_i}{N} \times n \qquad (2)$$

where: n_i = Sample allocation, N_i = Sample size, N = Total population n = Local government area population.

A Key Informant Interview (KII) was conducted targeting only the heads of households using a structured checklist questionnaire to collect data on the relationship between climate induced migration and the food security situation of households in the study area.

Data Analysis

A mixed-methods approach combining qualitative and quantitative methods of data analysis were used for the KII data gathered through the structured questionnaire in this research. After careful input of the respondent's responses into Microsoft excel 2013 spreadsheet, the data underwent a thorough screening, cleaning and validation to ease the process of analysis in order to correct structural errors in the data set such as misspellings and other typographical errors, wrong numerical entries and missing values, such as blank or null fields that should contain data as well as inconsistent data. The Microsoft excel 2013 software is comprehensive and flexible for tabulation and statistical analysis, data management and computation for simple descriptive statistics such as frequency distribution and percentages.

RESULTS AND DISCUSSION

The study looked at how familiar the concept of climatic variability is to the respondents, the climatic variability effects on food security, the strategies and interventions employed to mitigate the negative effects and the rating of the relationship between the human migration and food security by the respondents in order to achieve a better understanding of the climate variability, human migration and food security nexus.

Familiarity of the Concept of Climate Variability and its Impacts

The finding that 90% of respondents are familiar with the concept of climate variability in the study area is consistent with other studies conducted in similar contexts (Table 2). For instance a study by Ado, *et al* (2019) in rural Nigeria found that more than 85% of respondents were aware of climate change and its impacts. Research by Fosu-Mensah, *et al* (2012) in Ghana revealed that about 88% of farmers recognized changes in climate patterns and a survey in Ethiopia also showed that about 92% of households were aware of climate variability (Alemayehu, & Bewket, 2017). However, the percentage of respondents attributing climate variability to divine acts (10%) is higher than reported in other studies. A study in Tanzania found that only about 2% of respondents attributed climate change to supernatural forces (Fundisha, 2019) while Ayeri *et al* (2012) reported that 5% of farmers believed climate change was caused by divine intervention in Kenya. The absence of respondents unfamiliar with climate variability in the study area contrasts with findings from a study by Schmidt (2019) in Uganda, where about 15% of respondents had never heard of climate change and also in South Africa, where more than 20% of respondents were unaware of climate change (Kutywayo, *et al.,* 2022).

Effects of Climate induced Migration on Food Security

Climate variability around the world exerts a variety of effects on many aspects of human endeavors and the environment. In this study, respondents respond to certain questions on the effects of the influence that climate induced migration exerts on food security such as reduced agricultural labour force leading to decreased food production, increased competition for limited resources in migration destination regions leading to food shortages, loss of farming communities and disrupting traditional agricultural practices and facilitating knowledge transfer and adoption of innovative farming strategies (Table 3). The findings that about 50% of respondents (n=192) believed that, reduced agricultural labour force is the leading factor that leads to decrease in food production aligned with existing literature in Tanzania and Ghana where Duda, *et al* (2018) and Karamba, *et al* (2011) identified reduced agricultural labor as a significant impact of climate migration on food security respectively. Loss of farming communities and disruption of traditional practices covering about 37% (n=144) also a concurred with the findings of Jellason, *et al* (2021) and Amsalu & Adem, (2009) who highlighted similar consequences of climate migration. Information from some African countries (Kenya and South Africa), corroborate with the findings that support the notion that climate migration leads to competition for resources (Njiru, 2012; Freeman, 2017). However, the percentage of respondents citing positive effects (2%) in knowledge transfer and adoption of innovative farming strategies is lower than that reported by Nkonya, (2018) where about 15% of respondents believed climate migration facilitated knowledge transfer in Uganda.

Strategies and Interventions to Mitigate Negative Effects of Climate induced Migration on Food Security

People in all areas around the world engage in certain activities to mitigate or adapt to the detrimental effects of climate variability and climate change (Smit, & Pilifosova, 2003; Toromade, *et al.*, 2024). In this context, climate induced migration is not left out due to the fact that, it always bring about different forms of challenges that needs to be addressed. The findings that 36% amounting to 140 respondents who believed investments in climate-smart/resilient agriculture and irrigation systems is the best way to mitigate climate-induced migration effects on food security (Table 4) align with the findings form other African countries which identified investments in climate-resilient agriculture as a key strategy (Dougill, *et al.*, 2021). Enhancing social safety nets and livelihood diversification having about 27% (n=104) of respondents in this research also correlate with the findings of Weldegebriel & Prowse (2013) who highlighted similar importance of social safety nets and livelihood diversification among household as adaptation strategies to climate variability effects.

Table 2: Familiarity to the Concept of Climate Variability

Location	Very Familiar		Somewhat Familiar		Not familiar at all		Total	
	F	%	F	%	F	%	F	%
Sandamu (SDM)	24	86	4	14	0	0	28	100
Daura (DRA)	41	89	5	11	0	0	46	100
Zango (ZNG)	30	94	2	6	0	0	32	100
Mashi (MSH)	35	100	0	0	0	0	35	100
Mai'adua (MDW)	38	90	4	10	0	0	42	100
Baure (BRE)	36	86	6	14	0	0	42	100
Roni (RNN)	14	93	1	7	0	0	15	100
Gwiwa (GWW)	22	88	3	12	0	0	25	100
Kazaure (KZR)	32	100	0	0	0	0	32	100
Yankwashi (YKS)	14	74	5	26	0	0	19	100
Babura (BBR)	38	90	4	10	0	0	42	100
Sule Tankarkar (STK)	22	81	5	19	0	0	27	100
Total	346	90	39	10	0	0	385	100

Source: Author's field survey, 2024.

Table 3: Climate induced Migration Effects on Food Security

Location	Reduced Agricultural Labor force leads to decreased Food Production		Increased competition for resources in destination leading to food shortage		Loss of farming communities and disruption traditional agricultural practices		Facilitating knowledge transfer and adoption of innovative farming strategies		Total
	F	%	F	%	F	%	F	%	
Sandamu (SDM)	14	7	3	7	11	8	0	0	28
Daura (DRA)	18	9	16	39	12	9	0	0	46
Zango (ZNG)	17	9	0	0	15	10	0	0	32
Mashi (MSH)	16	8	4	10	15	10	0	0	35
Mai'adua (MDW)	25	13	7	17	10	7	0	0	42
Baure (BRE)	21	11	2	5	19	13	0	0	42
Roni (RNN)	9	5	0	0	6	4	0	0	15
Gwiwa (GWW)	15	8	0	0	10	7	0	0	25
Kazaure (KZR)	11	6	6	15	7	5	8	100	32
Yankwashi (YKS)	10	5	0	0	9	6	0	0	19
Babura (BBR)	22	11	3	7	17	12	0	0	42
Sule Tankarkar (STK)	14	8	0	0	13	9	0	0	27
Total	192	100	41	100	144	100	8	100	385

Source: Author's field survey, 2024

https://dx.doi.org/10.4314/dujopas.v10i4c.13
ISSN (Print): 2476-8316
ISSN (Online): 2635-3490
Dutse Journal of Pure and Applied Sciences (DUJOPAS), *Vol. 10 No. 4c December 2024*

Table 4: Strategies/Interventions to mitigate the negative effects of Climate induced Migration on Food Security.

Mitigating Strategies/Interventions	Climate Smart Agriculture & Irrigation Systems		Livelihood Diversification Programs		Sustainable Land & Water Management Practices		Early Warning Systems & Disaster Response Mechanisms		Empowerment Policies in Destination Regions		Total
	F	%	F	%	F	%	F	%	F	%	
Sandamu (SDM)	9	6	3	3	4	7	7	16	5	16	28
Daura (DRA)	19	13	6	6	10	15	7	16	4	12	46
Zango (ZNG)	15	11	5	5	5	8	3	7	4	12	32
Mashi (MSH)	12	9	8	7	7	11	5	12	3	9	35
Mai'adua (MDW)	13	9	16	15	5	8	4	9	4	12	42
Baure (BRE)	13	9	12	11	8	12	6	15	3	9	42
Roni (RNN)	7	5	5	5	3	4	0	0	0	0	15
Gwiwa (GWW)	11	8	9	9	3	4	0	0	2	6	25
Kazaure (KZR)	17	12	9	9	5	8	1	2	0	0	32
Yankwashi (YKS)	4	3	7	7	3	4	3	7	2	6	19
Babura (BBR)	12	9	18	17	7	11	3	7	2	6	42
Sule Tankarkar (STK)	8	6	6	6	5	8	4	9	4	12	27
Total	140	100	104	100	65	100	43	100	33	100	385

Source: Author's field survey, 2024.

However, the low priority given to implementing policies to support and empower migrants (9%) contrasts with the need for policies supporting migrants as emphasized by International Organization for Migration (Geiger & Pécoud, 2010; Geiger & Koch, 2018) and how crucial the empowerment of migrants is as highlighted by the United nations Development program (Murphy, 2006).

Relationship rating between Climate induced Migration and Food Security in the Area

Table 5: Relationship between Climate induced Migration and Food Security

Location	Strongly Negative		Moderately negative		No relationship		Moderately positive		Strongly Positive		Total
	F	%	F	%	F	%	F	%	F	%	
Sandamu (SDM)	14	10	9	6	5	6	0	0	0	0	28
Daura (DRA)	12	9	17	11	17	20	0	0	0	0	46
Zango (ZNG)	9	7	15	10	8	9	0	0	0	0	32
Mashi (MSH)	12	9	14	9	9	11	0	0	0	0	35
Mai'adua (MDW)	18	13	19	12	5	6	0	0	0	0	42
Baure (BRE)	22	16	14	9	6	7	0	0	0	0	42
Roni (RNN)	3	2	9	6	3	4	0	0	0	0	15
Gwiwa (GWW)	14	10	11	7	0	0	0	0	0	0	25
Kazaure (KZR)	6	4	7	5	8	9	4	100	7	100	32
Yankwashi (YKS)	5	4	11	7	3	4	0	0	0	0	19
Babura (BBR)	13	10	15	10	14	16	0	0	0	0	42
Sule Tankarkar (STK)	8	6	12	8	7	8	0	0	0	0	27
Total	136	100	153	100	85	100	4	100	7	100	385

Source: Author's field survey, 2024.

Respondents in the area responded to the question asking to rate the relationship between climate induced migration and food security. About 40% of the respondents amounting to 153 respondents have the opinion that the relationship is moderately negative (Table 5). This concur with the findings of McGregor, (1994) who also found a negative relationship between climate migration and food security. A research in Nigeria also reported similar findings, with a very high number of respondents indicating a strongly negative relationship (Obi, *et al.*, 2020). This correlate with 136 respondents (35%) who believed that the relationship is strongly negative, meaning that climate induced migration worsens the food security situation in the study area. However, the 2% of respondents holding the view that climate induced migration improves food security in the area contrasts with a study in Uganda where 12% of respondents believed climate migration improved food security (Nkonya, 2018).

Conclusion

In conclusion, this study unequivocally establishes an intricate relationship between climate variability-induced human migration and food insecurity in selected Sudano-Sahelian region of these North-western states of Nigeria (Katsina and Jigawa). The implications of climate variability-induced migration on food security are far-reaching, including compromise on food availability, affordability and stability, increased reliance on coping strategies, heightened household hunger and food insecurity and decreased agricultural productivity and resilience. The study recommends that, government should support small-scale agriculture to encourage local food production in order to increase food availability and access. This should be through the Climate-Smart Agriculture. In essence, implementing practices such as agroforestry, conservation agriculture and crop rotation will enhance soil health, reduce erosion and improve water management in the study area.

Acknowledgement

The Authors wish to thank the Tertiary Education Trust Fund (TETfund) for providing financial support for the conduct of this research project.

References

Ado, A. M., Leshan, J., Savadogo, P., Bo, L., & Shah, A. A. (2019) Farmers' Awareness and Perception of Climate Change Impacts: Case Study of Aguie District in Niger. *Environment, Development and sustainability*, *21*, 2963-2977.

Alemayehu, A., & Bewket, W. (2017) Smallholder Farmers' Coping and Adaptation Strategies to Climate Change and Variability in the Central Highlands of Ethiopia. *Local Environment*, *22*(7), 825-839.

Amsalu, A., & Adem, A. (2009) Assessment of Climate Change-induced Hazards, Impacts, and Responses in the Southern Lowlands of Ethiopia. Addis Ababa: Forum for Social Studies.

Ayeri, O. S., Christian, V. R., Josef, E., & Michael, H. (2012) Local Perceptions and Responses to Climate Change and Variability: The Case of Laikipia District, Kenya. *Sustainability*, *4*(12), 3302-3325.

Belay, A., Demissie, T., Recha, J. W., Oludhe, C., Osano, P. M., Olaka, L. A. & Berhane, Z. (2021) Analysis of Climate Variability and Trends in Southern Ethiopia. *Climate*, *9*(6), 96.

Boyd, M. (1989) Family and Personal Networks in International Migration: Recent Developments and New Agendas. *International Migration Review*, 23(3), 638-670.

Castles, S. & Miller, M. J. (2003) *The Age of Migration: International Population Movements in the Modern World.* Palgrave Macmillan.

Chaokromthong, K. & Sintao, N. (2021) Sample Size Estimation using Yamane and Cochran and Krejcie and Morgan and Green Formulas and Cohen Statistical Power Analysis by G* Power and Comparisions. *Apheit International Journal*, *10*(2), 76-86.

De Haas, H. (2012) The Migration and Development Pendulum: A Critical View on Research and Policy. *International Migration,* 50(3), 8-25.

Dougill, A. J., Hermans, T. D., Eze, S., Antwi-Agyei, P., & Sallu, S. M. (2021) Evaluating Climate-Smart Agriculture as Route to Building Climate Resilience in African Food Systems. *Sustainability*, *13*(17), 9909.

Duda, I., Fasse, A., & Grote, U. (2018) Drivers of Rural-Urban Migration and Impact on Food Security in Rural Tanzania. *Food Security*, *10*(4), 785-798.

Fosu-Mensah, B. Y., Vlek, P. L., & MacCarthy, D. S. (2012) Farmers' Perception and Adaptation to Climate Change: A Case Study of Sekyedumase District in Ghana. *Environment, Development and Sustainability*, *14*, 495-505.

Freeman, L. (2017) Environmental Change, Migration, and Conflict in Africa: A Critical Examination of the Interconnections. *The Journal of Environment & Development*, *26*(4), 351-374.

Fundisha, E. (2019) Local Community Perceptions on Causes of Climate Change in Dry Areas of Rombo District, Tanzania. *Huria: Journal of the Open University of Tanzania*, *26*(2).

Geiger, M., & Koch, M. (2018) World Organizations in Migration Politics: The International Organization for Migration. *Journal of International Organization Studies*, *9*(1), 25-44.

Geiger, M., & Pécoud, A. (2010) The Politics of International Migration Management. In *The Politics of International Migration Management* (pp. 1-20). London: Palgrave Macmillan UK.

Glick Schiller, N. & Salazar, N. B. (2013) Regimes of Mobility across the Globe. *Journal of Ethnic and Migration Studies,* 39(2), 183-200.

Griffiths, M., Rogers, A. & Anderson, B. (2013) Migration, Time and Temporalities: Review and Prospect. *COMPAS Research Resources Paper*, *3*, 1-31.

Guha, I. & Roy, C. (2016) Climate Change, Migration and Food Security: Evidence from Indian Sundarbans. *International Journal of Theoretical and Applied Sciences*, *8*(2), 45-49.

Hirschman, C. (2007) The Role of Age in Migration Decisions. *Demography,* 44(2), 265-285.

IPCC. (2019) Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security and Greenhouse Gas Fluxes in Terrestrial Ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In Press Jessoe, K., D. T. Manning and J. E. Taylor. (2018) Climate Change and Labour Allocation in Rural Mexico: Evidence from Annual Fluctuations in Weather. *Economic Journal* 128:230–61

Jellason, N. P., Conway, J. S., Baines, R. N., & Ogbaga, C. C. (2021) A Review of Farming Challenges and Resilience Management in the Sudano-Sahelian Drylands of Nigeria in an Era of Climate Change. *Journal of Arid Environments*, *186*, 104398.

Kaczan, D. J. & Orgill-Meyer, J. (2020) The Impact of Climate Change on Migration: A Synthesis of Recent Empirical Insights. *Climatic Change*, *158*(3), 281-300.

Karamba, W. R., Quiñones, E. J., & Winters, P. (2011) Migration and Food Consumption Patterns in Ghana. *Food policy*, *36*(1), 41-53.

Kosinsiki, L. A. & Prothero, R. M. (2023) Introduction: The Study of Migration. In *People on the Move* (pp. 1-18). Routledge.

Kutywayo, A., Chersich, M., Naidoo, N. P., Scorgie, F., Bottoman, L., & Mullick, S. (2022) Climate Change Knowledge, Concerns and Experiences in Secondary School Learners in South Africa. *Jàmbá-Journal of Disaster Risk Studies*, *14*(1), 1162.

Maiwada, A. S. & Hassan, M. (2019) People's Perceptions of the Changing Climate and Human Influence in Katsina State, North-Western Nigeria. *FUDMA Journal of Sciences*, 3(2), 245- 249.

Maiwada, A. S. (2017) People's Response to Climatic Variability Awareness and Observed changes in Three Selected Population Densities of Katsina Urban Area, Nigeria. *International Journal of Science and Research,* 6(6), 1566-1572.

Malik, A. (2023) Migration Patterns and Social Change: A Global Perspective. *Al-Anfal*, *1*(01), 49-56.

Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A. & Taylor, J. E. (1993) Theories of International Migration: A Review and Appraisal. *Population and Development Review,* 19(3), 431-466.

McGregor, J. (1994) Climate Change and Involuntary Migration: Implications for Food Security. *Food policy*, *19*(2), 120-132.

McMichael, C. (2014) Climate Change and Migration: Food Insecurity as a Driver and Outcome of Climate Change-Related Migration. *Environmental Deterioration and Human Health: Natural and Anthropogenic Determinants*, 291-313.

Moore, M. & Wesselbaum, D. (2023) Climatic Factors as Drivers of Migration: A Review. *Environment, Development and Sustainability*, *25*(4), 2955-2975.

Murphy, C. N. (2006) *The United Nations Development Programme: A Better Way?*. Cambridge University Press.

National Population Commission (NPC) (2006) Nigeria National Census: Population Distribution by Sex, State, LGAs and Senatorial District: 2006 Census Priority Tables (Vol. 3). http://www.population.gov.ng/index.php/publication/140-popn-distri-by-sex-state-jgas-and-senatorial-distr-2006

Ndamani, F., & Watanabe, T. (2015) Farmers' Perceptions about Adaptation Practices to Climate Change and Barriers to Adaptation: A Micro-Level Study in Ghana. *Water*, *7*(9), 4593-4604.

Ndubueze-Ogaraku, M. E., Etowa, E. B., Ekine, I. D., & Familusi, L. C. (2017) Analysis of Insecurity Shocks and Farmers' Resilience in the Niger Delta Region, Nigeria. *Nigerian Agricultural Policy Research Journal (NAPReJ)*, *2*(1), 67-81.

Niva, V., Horton, A., Virkki, V., Heino, M., Kosonen, M., Kallio, M. & Kummu, M. (2023) World's Human Migration Patterns in 2000–2019 Unveiled by High-Resolution Data. *Nature Human Behaviour*, *7*(11), 2023-2037.

Njiru, B. N. (2012) Climate Change, Resource Competition, and Conflict amongst Pastoral Communities in Kenya. In *Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability* (pp. 513-527). Berlin, Heidelberg: Springer Berlin Heidelberg.

Nkonya, E. (2018) Climate Change Awareness and Adaptation in Uganda. *Journal of Climate Change Research*, 9(1), 1-13.

Obi, C., Bartolini, F., & D'Haese, M. (2020) International Migration, Remittance and Food Security during Food Crises: The Case Study of Nigeria. *Food Security*, *12*(1), 207-220.

Schmidt, J. (2019) *Plant a Tree!: Climate Change Communication and Perception in Rural Uganda* (Master's thesis, Universitetet i Agder; University of Agder).

Smit, B., & Pilifosova, O. (2003) Adaptation to Climate Change in the Context of Sustainable Development and Equity. *Sustainable Development*, *8*(9), 9.

Telsaç, C. & Telsaç, Y. Ö. (2022) Causes of Migration and its Effects. In *2nd International Symposium" Global Migration Phenomenon" With its Security, Economic, Social, Political and Cultural Dimensions, Ankara*.

Toromade, A. S., Soyombo, D. A., Kupa, E., & Ijomah, T. I. (2024) Reviewing the Impact of Climate Change on Global Food Security: Challenges and Solutions. *International Journal of Applied Research in Social Sciences*, *6*(7), 1403-1416.

Weldegebriel, Z. B., & Prowse, M. (2013) Climate-Change Adaptation in Ethiopia: To What Extent Does Social Protection Influence Livelihood Diversification?. *Development Policy Review*, *31*, 035-056.

Yakubu, S.A., Luka, E. G., Umar, H. S., & Mohammed, T. (2023) An Assessment of Socioeconomic Determinants of Willingness to Adopt Social Media as Agro-Communication Channel among Farmers in Gombe State, Nigeria. *Journal of Plant Biology and Crop Research*. 6(2): 1078

Yelwa, S. A., Sanda, A. B. & Usman, U. (2019) Spatio-Temporal Assessment of Vegetation Resource Dynamics in Nigeria from SPOT Satellite Imageries. *American Journal of Climate Change*, *8*(04), 502.

Ziervogel, G., & Ericksen, P. J. (2010) Adapting to Climate Change to Sustain Food Security. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(4), 525-540.