Journal of Agriculture, Environmental Resource and Management
ISSN2245-1800(paper) ISSN 2245-2943(online)
5(3)809-818; Dec.2021

www.saerem.com

# Extension Services and impact of Climate Change on Food Production in Taraba State Nigeria

**Paul, A. H., Amen, N. E., and Mitu, S. B.**

Department of Agricultural Economic and Extension, Faculty of Agriculture and Life Science, Federal University Wukari Taraba State Nigeria
Department of Agricultural Extension and Management, Federal College of Animal Health and Production Technology Vom, Plateau State Nigeria
Department of Agricultural Economics and Extension, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, Bauchi, Nigeria
Email Address: amadepaul.ap@gmail.com

***Abstract***

*Climate change has become a very prominent issue in the media, international and national policy processes. This paper uses secondary data to consider extension services and impact of climate changes on food production in Taraba State. A purposive and simple random sampling techniques was used in selecting 100 respondents. Descriptive statistics was used in analyzed the data collected for the study. Results show that impacts of climate change experienced by the respondents are shortage of water for human and live stock, Shortage of pasture for grazing animals and Reduction in household income result to high rate of school dropout. The perceived roles of extension agents in capacity building on climate change are: use of demonstration methods in teaching farmers on the strategies to adapt to climate change, use of farmer to farmer extension strategies, and dissemination of innovation. Food Security involved adequacy of food supply, Stability of supply without seasonal fluctuations or shortages, accessibility to food or affordability, and utilization in teams of quality and safety of food. Important of extension services on climate change and its associated uncertainties implies that extension agents need to regularly access new knowledge and extend it in an adequate and timely manner to the farmers. and effect of climate change on food production include surface temperature, rainfall, extreme weather events and raise in sea level. Conclusion, climate change is a complex problem involving varied interactions between the environment, natural resources (land, crops, animals and water) and peoples. Recommendations, Man should reduce all activities that led to climate change and invest in activates that build the communities.*

**Key Words: Extension, Services, Impact, Climate, Change and Food**

## Introduction

The activities and the actors in the food system lead to outcomes such as food security and generate impacts on the environment. As part of the environmental impacts, food systems are a considerable contributor to GHG emissions, and thus climate change. In turn, climate change has complex interactions with food systems, leading to food insecurity through impacts on food availability, access, utilisation and stability. Assessment Report of the International Panel on Climate Change (IPCC, 2019).

Climate change impacts differ among diverse social groups depending on factors such as age, ethnicity, ability/disability, sexual orientation, gender, wealth, and class (high confidence) (Vincent and Cull 2014; Kaijser and Kronsell 2014). Poverty, along with socio-economic and political marginalisation, cumulatively put women, children and the elderly in a disadvantaged position in coping with the adverse impacts of the changing climate (UNDP 2013; Skoufias et al. 2011). The contextual vulnerability of women is higher due to their differentiated relative power, roles, and responsibilities at the household and community levels (Bryan and Behrman 2013; Nelson et al. 2002). They often have a higher reliance on subsistence agriculture, which will be severely impacted by climate change (Aipira et al. 2017)

Rural areas are especially affected by climate change (Dasgupta et al. 2014), and through impacts on employment. Jessoe et al. (2018) using a 28-year panel on individual employment in rural Mexico, found that years with a high occurrence of heat lead to a reduction in local employment by up to 1.4% with a medium emissions scenario, particularly for wage work and non-farm labour, with impacts on food access. Without employment opportunities in areas where extreme poverty is prevalent, people may be forced to migrate, exacerbating potential for ensuing conflicts (FAO 2018a). Finally, climate change can affect human health in other ways that interact with food utilisation. In many parts of the world where agriculture relies still on manual labour, projections are that heat stress will reduce the hours people can work, and increase their risk (Dunne et al. 2013). For example, Takakura et al. (2017) estimates that under RCP8.5, the global economic loss from people working shorter hours to mitigate heat loss may be 2.4–4% of GDP. Furthermore, as discussed by Watts et al. (2018); people's nutritional status interacts with other stressors and affects their susceptibility to ill health (the 'utilisation pillar' of food security): so food-insecure people are more likely to be adversely affected by extreme heat, for example. In the case of food price hikes, those more vulnerable are more affected (Uraguchi 2010), especially in urban areas (Ruel et al. 2010), where livelihood impacts are particularly severe for the individuals and groups that have scarce resources or are socially isolated (Revi et al. 2014; Gasper et al. 2011) (high confidence). These people often lack power and access to resources, adequate urban services and functioning infrastructure. As climate events become more frequent and intense, this can increase the scale and depth of urban poverty (Rosenzweig et al. 2018b). The specific objectives for the study were to:

describe the social-economic characteristics of respondents

identify the impact of climate change

**Materials and Methods**

The study area for this research work is Taraba State, Nigeria. Taraba state covers a land area of 59,400 square kilometers. the State has sixteen Local Government Areas namely; Jalingo Zing, Lau, Karim Lamido, Sarduna, Bali, Wukari and Takum. Ibi, Yorro, and Donga, Ardo Kola, Kurmi, Ussa and Gassol. Taraba State lies between latitude 6°30´ and 9°36´ north and longitude 9°10´ east. It is bordered on the north by Bauchi State, Gombe State in the north-east and Adamawa State on the east and Plateau State in the north-west. The State is further bordered to the west by both Nasarawa and Benue States, while it shares an international boundary with the Republic of Cameroun to the south and south east. The predominant population of the State engages in farming as an occupation because of the agrarian nature. The dry and rainy season common to tropical region are also the dominant climate features start in April and ends in October while the dry season begins in November and terminates in March. The dry season reaches its peak in January and February when the dusty north east trade winds blows across the state. The climate, soil and hydrology of the state provide a conducive atmosphere for the cultivation of most staple food crops, grazing land for animal and fresh water for fishing and forestry. The study made use of both primary and secondary data. The primary data were collected by administering questionnaire to household heads. Secondary data sources were utilized to provide background information and other necessary information to achieve some objectives of the study. The secondary data sources included textbooks, journals and proceedings of scientific conferences. The population of this study consists of small scale farmers in Taraba State, Nigeria. Due to the nature of this study, 100 respondents were selected as sample size, using purposive and simple random sampling techniques from the four (4) agricultural zones. Questionnaire was administered to 30 farmers in zone A, 30 farmers in zone B, 12 farmers in zone C which has only one LGA and 28 farmers in zone D.The impacts of climate change on agriculture was measured by using descriptive statistics were used to achieve all the objectives. Mean, frequency,tabulation and percentages were used to achieve the study objectives.

**Results and Discussion**

Socioeconomic Characteristics of Respondents

Table 1 show that 33.1% of the respondents were in their prime age of 40 to 49 years, while 23.8% were within the age bracket of 50 – 59 years. These are energetic individuals who do their various engagements for their survival. Again, 22.3% were very young people within 30 – 39 years with 20.8% who were 60 years old and above. Among the

respondents 60% and 40% were those who were male and female respectively. The majority (63.1%) were married, while 23.8% were widows. On educational attainment, 44.6% had secondary education; 20.8% had attended tertiary institutions; and 24.1% had primary education only. The levels of education of these individuals attest to their ability to work as contact farmers and change agents and be able to observe climate changes. The majority (78.5%) belonged to various organizations, while 28% did not belong to any organization. A household with plenty members had also labour that worked for the family. The respondents with higher family members were 38.5%, with 7 – 9 members. The second group had 4 – 6 members, while 15.4% had 10 members and more. These numbers would help provide labour needed to produce family food. A good number of the contact farmers (48%) had spent between 11 to 20 years farming; 18% had put 21 – 30 years, while 16% had spent over 30 years on farming. This explains why they were able to identify and observe evidence of climate change. The majority (43.3%) of the agents had spent 11 to 15 years in civil service; they were followed by 30% who had put in 6 to 10 years, while 20% had spent above 15 years working. Experience gained doing this work helped them to persevere and adapt to challenging weather and also adjust when the need arose.

**Table 1:** Socioeconomic Characteristics of Respondents

| Characteristics | Frequency | Percentage |
|---|---|---|
| **Age** | | |
| 30 –39 | 29 | 22.3 |
| 40 – 49 | 43 | 33.1 |
| 50 – 59 | 31 | 23.8 |
| 60 and above | 27 | 20.8 |
| **Sex** | | |
| Male | 78 | 60 |
| Female | 52 | 40 |
| **Marital status** | | |
| Single | 13 | 20 |
| Married | 82 | 63.1 |
| Widow | 31 | 23.8 |
| Widower | 4 | 3.1 |
| **Education level** | | |
| Adult education | 13 | 10 |
| Primary | 32 | 24.6 |
| Secondary | 58 | 44.6 |
| Tertiary | 27 | 20.8 |
| **Membership or organization** | | |

| | | |
|---|---|---|
| Belong | 102 | 78.5 |
| Not belong | 28 | 28 |
| **Household size** | | |
| 1 – 3 | 15 | 11.5 |
| 4 – 6 | 45 | 34.6 |
| 7 – 9 | 50 | 38.5 |
| 10 and above | 20 | 15.4 |
| **Farm size (Content farmers only)** | | |
| < 2 | 25 | 25 |
| 2 – 4 | 53 | 53 |
| > 4 | 22 | 22 |
| **Farming experience (Contact farmers)** | | |
| 1 – 10 | 14 | 14.0 |
| 11 – 20 | 48 | 48.0 |
| 21 – 30 | 18 | 18.0 |
| 31 and above | 16 | 16.0 |
| **Years of service (Agents only)** | | |
| 1 – 5 | 2 | 6.7 |
| 6 – 10 | 9 | 30 |
| 11 – 15 | 13 | 43.3 |
| 15 and above | 6 | 20.0 |

Field survey Data, 2012

**Impacts of climate changes**

Climate change was evident in a number of ways as shown in Table 2. Both the extension agents and contact farmers corroborated their responses. Climate change was evident in increase surface of temperature with 86.7% and 88% responses by both the extension agents and contact farmers respectively. Other signs of climate change included increase in rainfall intensity with 80%, flooding with over 83%, unpredictable weather patterns, high winds, rise in water levels, land degradation, constant loss of biodiversity, change in relative humidity, and increase in frequency of thunder and lightning. In a study on adapting public agricultural extension in Kenya, Ifejika (2009) posited that district extension administrators and the frontline extension officers are well aware of the climate change problem. They perceive climate as change of weather patterns over a long period of time and the disruption of the annual

weather pattern/change of trend of annual weather patterns. They found that the area studied was affected by climate change in several ways: more frequent and prolonged droughts, change of rainy seasons not following pattern as before, more variability of short rains as compared to the long rains, high temperature levels; increased aridity; increased rainfall failures; untimely rains hence not able to advise farmers, drying up of water sources, reduced rainfall amounts, delayed onset of rains, decreased foliage grasses have dried up and some species have disappeared (Ifejika, 2009). The officers perceived the natural environment to be also changing. They found forests and bushes to have depleted as farmers clear more bushes for farming. Forests have also been cleared for settlement, farming, for charcoal production; building materials (timber) and the rate of depletion is not equal to the rate of replacement. The officers report that natural water sources have decreased with water levels going down in rivers and many rivers have become seasonal. They have also noted that artificial water sources are in the increase especially earth dams, water pans, shallow wells. These changes have affected agricultural productivity through crop failures thereby decreasing agricultural productivity, increasing food shortages and prolonging famines. Pasture is a problem, and water for livestock is scarce and people have to move long distances in search for water and pastures. The decrease in animal forage has led to a decrease in livestock production and livestock mortality has increased during droughts. Thus farming has become a more costly undertaking than before to failures, thereby discouraging new entries into the sector. As a result, many people, especially men migrate to mostly urban areas in search for jobs, leaving fewer people in production in rural areas. Since the households do not earn incomes as before, there is a high rate of school drop outs, as children leave schools to towns to engage in casual labour.

**Table 2:** Evidence of climate change

| | Extension Agents | | Contact Farmers | |
|---|---|---|---|---|
| **Evidence** | **Freq**** | **Perc (%)** | **Freq**** | **Per (%)** |
| Increase surface temperature | 26 | 80.7 | 88 | 88.0 |
| Increased rainfall intensity | 24 | 80.0 | 83 | 83.0 |
| Low rainfall intensity | 9 | 30.0 | 35 | 35.0 |
| Irregular rainfall(not more than 3months) | 11 | 36.7 | 53 | 53.0 |
| Increase rate of evaporation from the earth | 8 | 26.7 | 41 | 41.0 |
| Rise in water level of rivers | 18 | 60.0 | 31 | 31.0 |
| Observed flooding | 25 | 83.3 | 84 | 84.0 |
| Observed drought | 22 | 40.0 | 38 | 38.0 |
| Heavy Precipitation event | 10 | 33.3 | 21 | 21.0 |
| High wind frequency | 16 | 60.0 | 56 | 56.0 |

| | | | | |
|---|---|---|---|---|
| Increase disruption in climate patterns | 13 | 43.3 | 30 | 30.0 |
| Increasing frequency of thunderstorm | 14 | 46.7 | 61 | 61.0 |
| Increased frequency of lighting | 14 | 46.7 | 63 | 63.0 |
| Increased observed bushfires | 15 | 50.0 | 52 | 52.0 |
| Unpredictable weather patterns | 16 | 53.3 | 73 | 73.0 |
| Increased observed desertification | 3 | 10.0 | 15 | 15.0 |
| Land degradation | 20 | 66.7 | 62 | 62.0 |
| Drying up of rivers/lake | 9 | 30.0 | 28 | 28.0 |
| Constant loss of biodiversity | 18 | 60.0 | 27 | 27.0 |
| Change in relative humidity | 13 | 43.3 | 67 | 67.0 |

** Multiple response, source: Field survey Data, 2012

**Food Security**

Climate change is projected to negatively impact the four pillars of food security – availability, access, utilisation and stability – and their interactions (FAO et al. 2018) (high confidence). This chapter assesses recent work since AR5 that has strengthened understanding of how climate change affects each of these pillars across the full range of food system activities. While most studies continue to focus on availability via impacts on food production, more studies are addressing related issues of access (e.g., impacts on food prices), utilisation (e.g., impacts on nutritional quality), and stability (e.g., impacts of increasing extreme events) as they are affected by a changing climate (Bailey et al. 2015). Low-income producers and consumers are likely to be most affected because of a lack of resources to invest in adaptation and diversification measures (UNCCD 2017; Bailey et al. 2015).

There are many routes by which climate change can impact food security and thus human health (Watts et al. 2018; Fanzo et al. 2017). One major route is via climate change affecting the amount of food both from direct impacts on yields and indirect effects through climate change's impacts on water availability and quality, pests and diseases, and pollination services. Another route is via changing CO2 in the atmosphere, affecting biomass and nutritional quality. Food safety risks during transport and storage can also be exacerbated by changing climate. Further, the direct impacts of changing weather can affect human health through the agricultural workforce's exposure to extreme temperatures. Through changing metabolic demands and physiological stress for people exposed to extreme temperatures, there is also the potential for interactions with food availability; people may require more food to cope, whilst at the same time being impaired from producing it (Watts et al. 2018). All these factors have the potential to alter both physical health as well as cultural health, through changing the amount, safety and quality of food available for individuals within their cultural context. Climate drivers relevant to food security and food systems include temperature-related, precipitation-related, and integrated metrics that combine these and other variables. These are projected to affect many aspects of the food security pillars (FAO 2018b). Climate drivers relevant to food production and availability may be categorised as modal climate changes (e.g., shifts in climate envelopes causing shifts in cropping varieties planted), seasonal changes (e.g., warming trends extending growing seasons), extreme events (e.g., high temperatures affecting critical growth periods, flooding/droughts), and atmospheric conditions for example, CO2 concentrations, short-lived climate pollutants (SLCPs), and dust. Water resources for food production will be affected through changing rates of precipitation and evaporation, ground water levels,

and dissolved oxygen content (Cruz-Blanco et al. 2015; Sepulcre-Canto et al. 2014; Huntington et al. 2017; Schmidtko et al. 2017). Potential changes in major modes of climate variability can also have widespread impacts such as those that occurred during late 2015 to early 2016 when a strong El Niño contributed to regional shifts in precipitation in the Sahel region. Significant drought across Ethiopia resulted in widespread crop failure and more than 10 million people in Ethiopia requiring food aid (U.S. Department of State 2016; Huntington et al. 2017).

**Importance of Extension Services**

Agricultural extension services are essential to improving agricultural productivity by providing farmers with useful farming and weather related information and skills training that can enhance their productivity (Oluwole et al., 2016; Federal Ministry of Environment, 2014). A study of farming practices in Southeast Nigeria finds, for example, that it is important to educate farmers to cultivate away from flood prone areas in order to reduce the impacts of flooding in the farms (Nnadi et al., 2019). Another study also conducted in Southeast Nigeria, recommends that farmers should be taught through extension services the benefits of pooling resources together through co-operative societies to more effectively counter the impacts of climate change (Ifeanyiobi and Nnadi, 2014). Agricultural extension professionals need to be more engaged to improve local agricultural practices. Their cost is relatively low; however the current irregularity of extension services in Nigeria is a constraint to agricultural adaptation (Oluwole et al., 2016; Federal Ministry of Environment, 2014). For further discussion, see the section on capacity.

In order to integrate climate change adaptation into every aspect of national life, Nigerians must have awareness and knowledge – and access to knowledge – of what climate change is, how it is impacting them and how they can adapt (BNRCC, 2011). They also need to be equipped with specialised skills to enable individuals, communities and the country to address climate change risks and implement adaptation (Nkechi et al., 2016). It is necessary to strengthen climate change knowledge architecture in Nigeria to reach policy-makers, community-based organisations, students and researchers, who are in the frontline of delivering adaptation projects (Amanchukwu et al., 2015). Ideally, it would include an organisation, special unit and platform for coordinating and facilitating the regular generation,management, exchange and dissemination of climate-related knowledge and capacity-building services (Amanchukwu et al., 2015). Information and knowledge sharing must be made accessible to a wide range of people, particularly those most vulnerable (Anabaraonye et al., 2019; BNRCC, 2011). Indigenous people should also be incorporated within climate change oriented organisations to enable local fishermen and farmers to have a sense of belonging (Anabaraonye et al., 2019). Information and awareness: The level of public awareness on issues related to climate change in Nigeria is considered to be low (BNRCC, 2011). In the Niger Delta, for example, results of a household survey indicate that the level of awareness of local communities of climate change impacts is low, with close to 60 percent of respondents knowing little or nothing about climate change and its impacts (Nzeadibe et al., 2011, 5). Studies indicate that the Nigerian media did not give sufficient attention to climate change issues. This could be attributed to inadequate funding and the perception of climate change stories as "hard sell" (Ajaero and Anorue, 2018). There is a need for news editors to look for ways to make climate change reports more interesting, perhaps by framing stories more to reflect the human angle (Ajaero and Anorue, 2018). In contrast, a study conducted in Southwest Nigeria finds that the high level of awareness among farmers of climate change (84 percent of those surveyed were aware of it) can be attributed to extensive awareness creation made through the print and electronic media and through other social and religious networks (Ozor et al., 2012, 243).

Agricultural extension services: There is an urgent need to educate farmers and fishermen in rural areas in Nigeria on climate change issues and to build their technical capacity to engage in mitigation and adaptation. Currently, many of them have little or inadequate understanding or knowledge of climate change and possible responses (Anabaraonye et al., 2019). A study conducted in Southwest Nigeria finds that there is a need for capacity building of farmers to cope with changing climate. It suggests that agricultural extension workers develop climate smart agriculture training (Avanlade et al., 2017). Agricultural extension services involve the application of scientific research and knowledge to agricultural practices and delivery of information and skills training to farmers. Education and training to impart specialized climate change knowledge and skills is necessary to equip farmers with the ability to understand and address climate change risks and opportunities; and to engage in possible adaptive and mitigation measures feasible in their locality (Nkechi et al., 2016; Dimelu et al., 2014). Farmers also need to have access to adaptive technology and innovations— through extension and information systems (Dimelu et al., 2014). In addition, farmers need to learn about and understand the consequences

of some of their farming practices that can exacerbate ecological problems (for example, mono cropping, bush burning, indiscriminate use of synthetic agrochemicals and felling of trees) (Dimelu et al., 2014). It is established in the literature that the greater contact farmers have with agricultural extension personnel and services, the better their production, productivity, efficiency in use of resources and profitability (Otitoju and Enete, 2016). Farmers with better access to information and knowledge of the changing climate through extension services have a greater likelihood of adopting agricultural technologies and other adaptation measures (Solomon and Edet, 2018; Otitoju and Enete, 2016; Ozor et al., 2012). The absence of adequate agricultural extension programmes directed to meet climate change adaptation strategies in food crop production and/or poor agricultural extension delivery have been key constraints in the adoption of adaptation measures, such as among cocoa agroforestry households in Southwest Nigeria (Otitoju and Enete, 2016). Recognition of the need to educate farmers and rural communities in Nigeria through agricultural extension services has not been matched with corresponding capacity building (improved knowledge/skill or information and responsive attitude) for extension professionals (Dimelu et al., 2014). Extension professionals in such contexts are expected to build awareness, facilitate generation and transfer of knowledge and technologies, and implement actions for effective management of climate change risks. They need to be competent in terms of technical knowledge of climate change issues and responses and information management skills. They require training to act as educators and information/service providers. All of this necessitates comprehensive capacity building of extension professionals and extension systems in Nigeria and elsewhere (Dimelu et al., 2014). The government has a role to play in building the capacity of agricultural extension systems to achieve these various functions in relation to climate change (Avanlade et al., 2017).

**Observed Changes in Climate and Weather Events**

**Surface Temperature:** At the national level, increase of 0.4° C has been observed in surface air temperatures over the past century. A warming trend has been observed along the west coast, in central India, the interior peninsula, and northeastern India. However, cooling trends have been observed in northwest India and parts of south India.

**Rainfall:** While the observed monsoon rainfall at the All India level does not show any significant trend, regional monsoon variations have been recorded. A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh, and north-western India (+10% to +12% of the normal over the last 100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (-6% to -8% of the normal over the last 100 years)

**Extreme Weather Events:** Trends of Extreme Weather Events observed in multi-decadal periods of more frequent droughts followed by less severe droughts. There has been an overall increasing trend in severe storm incidence along the coast at the rate of 0.011 events per year. While the states of West Bengal and Gujarat have reported increasing trends, a decline has been observed in Orissa. Scientists, while analysing a daily rainfall data set, have shown (i) a rising trend in the frequency of heavy rain events, and (ii) a significant decrease in the frequency of moderate events over central India from 1951 to 2000.

**Rise in Sea Level:** Using the records of coastal tide gauges in the north Indian Ocean for more than 40 years, Scientists have estimated that sea level rise was between 1.06-1.75 mm per year. These rates are consistent with 1-2 mm per year global sea level rise estimates of the IPCC. Indian Summer Monsoon (ISM) intensity is projected to increase in the beginning of 2040 and by 10% by 2100.

**Conclusion**

The subject of climate change is a relatively new science, and is widely accepted as an unprecedented man-created calamity that requires more than immediate action and response to solutions. Climate change is a complex problem involving varied interactions between the environment, natural resources (land, crops, animals and water) and peoples. These interactions are likely to change the ecological and agricultural landscape, and therefore influence agricultural production. Analyses of the issues involved and well informed opinions clearly indicate that the looming effects of climate change are potentially awesome. Agriculture involves the science, art and business of cultivating soil, growing plants and raising animals for producing food, feeds, fibre and a whole range of other services. Together with forestry and fisheries, it provides the primary source of food and nutritional security for the welfare of the people. Extension services have an important role to play in assisting farmers to acquire new technology, skills, innovation and production advice.

The importance of extension services to avoid food scarcity cannot be over emphasized.

**Recommendations**

1. The Nigerian government should support private insurance firms through policies that would encourage public-private partnerships, in order to encourage firms to be more willing to provide insurance to agricultural businesses for climate-related affects
2. Irrigation facilities are increasingly important as rain fed agriculture becomes increasingly unreliable
3. Policies and programmes should be aimed at increasing access to information for and raising awareness among public policy makers, the organised private sector, civil society organisations, users of natural resources and those working in agriculture, and managers of infrastructure
4. Alongside information provision and awareness-raising of climate change impacts and responses, more generally, access to specific weather information, early warning and forecast technologies can help farmers to develop and readjust coping or adaptation strategies

**Reference**


Aipira, C., A. Kidd, and K. Morioka, 2017: Climate change adaptation in pacific countries: Fostering resilience through gender equality. In: Climate Change Adaptation in Pacific Countries. Climate Change Management [Leal Filho W. (ed.)]. Springer International Publishing, Cham, Switzerland, pp. 225–239

Ayanwuyi, E. 2013; Extension Services Strategies in Adaptation to Climate Change in Oyo State,

Nigeria. Civil and Environmental Research www.iiste.org ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online) Vol.3, No.7, 2013 Pp115

Bailey, R. et al., 2015: Extreme Weather and Resilience of the Global Food System. Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience. Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience, The Global Food Security programme, UK, 17 pp

Bryan, E., and J.A. Behrman, 2013: Community-Based Adaptation to Climate Change: A Theoretical Framework, Overview of Key Issues and Discussion of Gender Differentiated Priorities and Participation. CAPRi Working Paper No. 109, International Food Policy Research Institute, Washington, DC, USA, pp 36.

Cruz-Blanco, M., C. Santos, P. Gavilán, and I.J. Lorite, 2015: Uncertainty in estimating reference evapotranspiration using remotely sensed and forecasted weather data under the climatic conditions of southern Spain. Int. J. Climatol., **35**, 3371–3384, doi:10.1002/joc.4215.

Dasgupta, P. et al., 2014: Rural Areas. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B. et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, 613–657.

Dunne, J.P., R.J. Stouffer, and J.G. John, 2013: Reductions in labour capacity from heat stress under climate warming. Nat. Clim. Chang., **3**, 563, doi:10.1038/nclimate1827.

FAO, 2018a: The Future of Food and Agriculture: Alternative Pathways to 2050. Food and Agriculture Organization of the United Nations, Rome, Italy, 228 pp

FAO, 2018g: Globally Important Agricultural Heritage Systems (GIAHS). Combining Agricultural Biodiversity, Resilient Ecosystems, Traditional Farming Practices and Cultural Identity. Food and Agriculture Organization of the United Nations, Rome, Italy, 1–48 pp

Gasper, R., A. Blohm, and M. Ruth, 2011: Social and economic impacts of climate change on the urban environment. Curr. Opin. Environ. Sustain., **3**, 150 157,

doi:10.1016/J.COSUST.2010.12.009

IPCC, 2018a: Special Report on the Impacts of Global Warming of Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change 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. Econ. J., **128**, 230–261, doi:10.1111/ecoj.12448.

Kaijser, A., and A. Kronsell, 2014: Climate change through the lens of intersectionality. Env. Polit., **23**, 417–433, doi:10.1080/09644016.2013.835203.

Ozor , N. (2011) Implications of Climate Change for National Development:The way forward paper presented at policy Forum in Enugu.African Institute for Applied Economics(AIAE) Enugu. Nigeria pp25-42.

Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki, 2014: Urban areas Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. In: Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., Barros, V.R., Dokken, D.J. (eds.)]. Cambridge University Press, New York, NY, USA, 535–612.

Rosenzweig, C. et al., 2018b: Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Ruel, M.T., J.L. Garrett, C. Hawkes, and M.J. Cohen, 2010: The food, fuel, and financial crises affect the urban and rural poor disproportionately: A review of the evidence. J. Nutr., **140**, 170S–176S, doi:10.3945/jn.109.110791.

Schmidtko, S., L. Stramma, and M. Visbeck, 2017: Decline in global oceanic oxygen content during the past five decades. Nature, **542**, 335, doi:10.1038/nature21399.

Sepulcre-Canto, G., J. Vogt, A. Arboleda, and T. Antofie, 2014: Assessment of the EUMETSAT LSA-SAF evapotranspiration product for drought monitoring in Europe. Int. J. Appl. Earth Obs. Geoinf., **30**, 190–202, doi:10.1016/j.jag.2014.01.021

Skoufias, E., M. Rabassa, and S. Olivieri, 2011: The Poverty Impacts of Climate Change: A

Review of the Evidence. Policy Research Working Paper 5622, The World Bank, Washington, DC, USA.

Takakura, J., S. Fujimori, K. Takahashi, and M. Hijioka, Yasuaki and Tomoko Hasegawa and Yasushi HondaToshihiko, 2017: Cost of preventing workplace heat-related illness through worker breaks and the benefit of climate-change mitigation. Environ. Res. Lett., **12**, 64010.

UNCCD, 2017: Global Land Outlook. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany, 340 pp

UNDP, 2013: Overview of Linkages Between Gender and Climate Change. United Nations Development Programme, New York, USA, 6 pp

Uraguchi, Z.B., 2010: Food price hikes, food security, and gender equality: Assessing the roles and vulnerability of women in households of Bangladesh and Ethiopia. Gend. Dev., **18**, 491–501, doi:10.1080/135520 74.2010.521992

Watts, N. et al., 2018: The Lancet Countdown on health and climate change: From 25 years of inaction to a global transformation for public health. Lancet, **391**, 581–630, doi:10.1016/S01406736(17)324649.