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Climate Adaptive Measures Among Smallholder Farmers in Akwa Ibom State, Nigeria

Obot Akaninyene and Obiekwe Ngozi

Department of Agricultural Economics and Extension, Nnamdi Azikiwe University, Nigeria

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Corresponding author:
Obot Akaninyene
Department of Agricultural Economics and Extension,
Nnamdi Azikiwe University,
Nigeria
Email: ap.obot@unizik.edu.ng

Abstract: Agricultural production/activities in Nigeria depends on rainfall, which often occurs only at certain times of the year and thus makes agriculture very susceptible to crop failure, insect infestation which causes poor returns on agricultural produce for farmers . Adoption of climate change mitigating strategies is key to coping with variations in weather conditions and the achievement of increased agricultural production and food security in Nigeria. This study analyzed the use of climatic adaptive measures among smallholder farmers in Akwa Ibom State, Nigeria. A multistage sampling technique was used in selecting 200 respondents in the study area. Primary data was collected using structured questionnaires and the data was analyzed using descriptive statistics and a regression model. The results showed that the most climatic adaptive methods adopted by the farmers were multiple cropping (90.0%) followed by mulching (62.50%), crop rotation (25.0%), and cover cropping (22.50%). According to the findings of the research, the farmers identified multiple cropping as the most suited climatic adaptive method to the farming system in the study area to avert the uncertainty associated with agriculture. The regression analysis showed that age, sex, marital status, household size, educational qualification, access to credit, agriculture extension contacts, membership of farmers groups/cooperatives, and monthly income influenced the adoption of the climatic adaptive measures by the smallholder farmers in the study area. Government and other agricultural stakeholders should therefore take steps to improve the climate resilience of smallholder farmers by building their capacity on multiple cropping.

Keywords: Climate Change, Mitigation, Smallholder Farmers, Adoption, Agriculture

Introduction

Climate change and variability due to precipitation, temperature, and wind very often exposes the agricultural sector to high risk although there are necessary for agricultural farming activities and production (Antwi-Agyei *et al.,* 2014). The high risk associated with the climatic changes and variability put more pressure on smallholder farmers who depends on agriculture but are not adequately equipped to respond to climate shocks which eventually makes them more vulnerable (Harvey *et al.,* 2014).

Smallholder farmers are the backbone of Nigeria's agriculture and suppliers of food to the tables of Nigerians. They mostly depend on rainfall for their agricultural activities which often affects their production due to irregular rainfall patterns. Nigeria's agriculture is made up of mostly smallholder farmers who dwell in rural with little or no access to infrastructure or facilities to combat climate change or adjust in the event of negative effect of climatic change on their agricultural activities or production.

Climate change has caused a decline in global agriculture by about 1–5% in the last decade and as a result of it, there is the likelihood of a 10-50% decline in agricultural production by 2050 in most of the African zones linked to the adverse climate change under prevailing farming practices (Mashizha, 2019; Serdeczny *et al.,* 2017). Climate change poses a significant threat to smallholder farmers and threatens to undermine global progress toward poverty alleviation, food security, and sustainable development (Vermeulen *et al.,* 2012; Lipper *et al.,* 2014).

Climate change adaptation is the adjustment in a system or way of operation to reduce the effect of climate change. It can also be defined as the mechanism or technique applied to reduce the effect of climate change. Climatic adaptation strategies, therefore, are becoming increasingly important in developing countries like Africa and Asia as they are the most affected regions by climate change (Pachauri and Meyer, 2014; IPCC, 2018).

Following the projected worsening of climatic conditions, understanding the impacts of climate change on smallholder farmers and developing appropriate adaptation strategies are critical so that efforts can be geared towards assisting smallholder farmers to identify effective adaptation measures in building strong resilience to climate change. The findings from this study would help the farmers and stakeholders to adopt the most common climatic adaptive measure that is suited to the study area to achieve food sufficiency. This study, therefore, assessed the climatic adaptive measures adopted by the farmers and what influences the adoption of these climatic adaptive measures.

Materials and Methods

Location of the Study

Akwa Ibom State is located in south-south Nigeria with an elevation of 42.58 m (139.7 feet) above sea level and having a tropical monsoon climate. The city's yearly temperature is 28.47ºC (83.25°F) and it is -0.99% lower than Nigeria's averages. Akwa Ibom typically receives about 342.56 mm (13.49 inches) of precipitation and has 294.37 rainy days (80.65% of the time) annually.

Sampling Design

The study employed a multi-stage sampling technique in selecting 200 respondents in the study area. Two Agricultural Zone, Ikot Ekpene and Uyo Agricultural Zone, out of the 6 in the State were randomly selected in the first stage as shown in Fig. 1. The second stage involved the random selection of 4 farming communities from the list of farming communities in the selected zone. In the final stage, 50 crop farmers were randomly selected from the list of crop farmers in each chosen community. In all, 200 respondents were used for the study.

Selection of Variables

Based on a review of related literature, the researcher selected eleven characteristics of the farmer as independent variables. These included age, sex, marital status, household size, educational qualification, farming experience, farm size, access to credit, access to extension services, membership in a cooperative, and monthly income. The adoption of climatic adaptive measures was the dependent variable of the study Umoh *et al*. (2015).

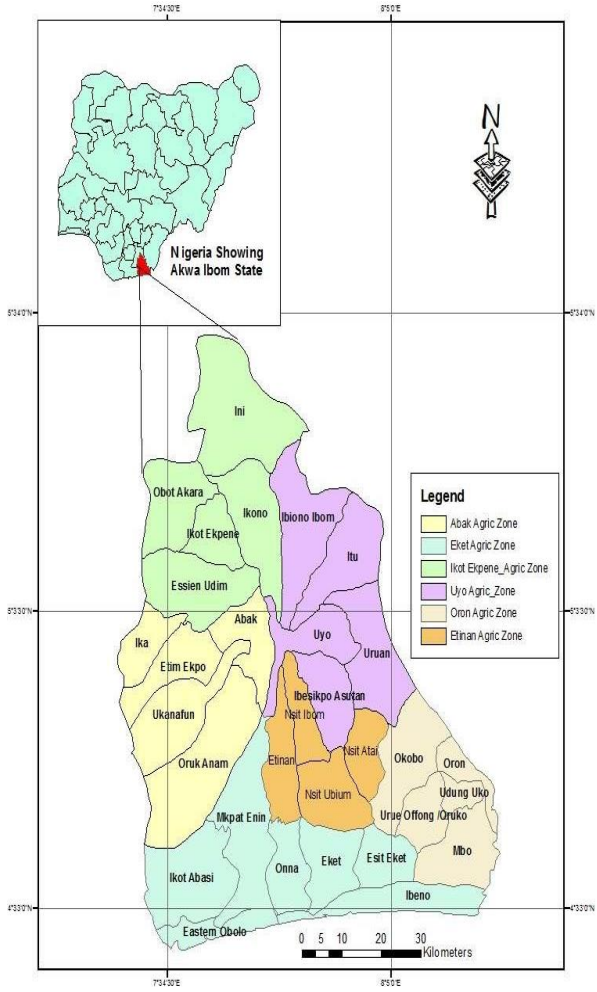

Fig. 1: Akwa Ibom state showing the different agricultural zones

Regression Model

$$R^{*}\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ...\beta_{11} X_{11} + e, LL(1.0) \quad (1)$$

where:

R^* = Adoption of climatic adaptive measures
$\beta...\beta n$ = Parameter of estimate
X_1 = Age
X_2 = Sex
X_3 = Marital status
X_4 = Household size
X_5 = Educational qualification
X_6 = Years of farming experience
X_7 = Farm size (ha)
X_8 = Access to credit
X_9 = Access to extension services
X_{10} = Membership of cooperative
X_{11} = Monthly income (₦) and
e = error term.

Collection of Data

The study used primary data collected with structured questionnaires designed to elicit information on the awareness of climate change, the effects of climate change on the farmers' farm activities, their coping strategies, etc.

Data Analysis

Using SPSS software, the socio-economic characteristics and the climactic adaptive measures adopted by the respondents were analyzed using descriptive statistical tools such as frequency counts and percentages. On the other hand, the factors influencing the adoption of climate change mitigation strategies were analyzed using a regression model.

Results and Discussion

Socio-Economic Characteristics of the Farmers

Sex

According to Table 1, the study indicated that there were more male (60.5%) respondents as compared to 39.5% females in the study area (Table 1). The result was in line with (Obot *et al*., 2022a; Olabanji *et al*., 2021) who also showed in their study that smallholder farmers had more male than the female counterpart. This implied that the sex distribution of the farmers skewed towards male respondents as a result of the rigor involved in agricultural activities.

Marital Status

Table 2 showed that majority (63.0%) of the respondents were married, while 19.0, 8.0, 6.0, and 4.0% were single, widowed, separated, and divorced. The result also corresponded to Obot *et al.* (2022b) in Nigeria where smallholding farming was predominated by married farmers. The high number of married respondents could increase the release of family labor, thus making more hands available for productive activities in the farm.

Age

As revealed in Table 3, majority (40.0%) of respondents were within the youthful age range of 21-40 years while 28.0, 22.0 and 10% were within the range of 41-60 years, 60 years and above, and ≤20 years. This indicated that young people of economic active age dominated the agricultural activities in the study area. This finding aligned with the studies of Obayelu *et al.* (2014) in Nigeria, and Kom *et al.* (2020) in South Africa, which revealed that the socio-economic aspect of the perception of climate change was influenced by household age.

Household Size

Table 4 on household size showed that 80.0% of the respondents had 6-10 persons while 18.0% had less than 5 persons and 2.0% had between 11-15 persons in their household. The result corresponded to Obot *et al.* (2022a) who found that smallholding farming family size was between 4-6 persons. This means that the farmers had relatively large-sized households and this allowed them to farm since it enabled the farmers to use family labor and therefore reduced the cost of hiring labor for farm activities.

Farm Income

Table 5 showed that the farm income of the respondents. Majority of the respondents (51.0%) generated ≤ ₦10, 000, 15, 12 and 7% generated ₦31, 000-₦ 40, 000, ₦ 41, 000–₦50, 000, ₦ 1, 000–₦20, 000, and ₦21, 000–₦30, 000. The result corresponded to Obot *et al.* (2022a) that smallholder farmers' monthly income was less than ₦10, 000.

Educational Qualification

Table 6 result also showed that a greater proportion (57.0%) of the respondents had Primary education, 16.5% had secondary education, 18.5% had no formal education and 8% had tertiary education. The result supported (Obot *et al.*, 2022a; Olabanji *et al.*, 2021) that most of the smallholder farmers had primary education which indicated that the farmers were open to learning and understanding the use of new technologies.

Farming Experience

In Table 7, the majority 53.5% of the respondents had 1-10 years of farming experience, while 17.5.0% of the respondents had between 21-30 years of experience. Those that had 11-20, 31-40 and 41–50 years of farming experience constituted 15.0, 9.0, and 5.0% of the respondents respectively. The result corresponded to Obot *et al.* (2022b) that most smallholder farmers in the study area had farming experience of between 1 to 10 years. This implied that the farmers had a long period of farming experience. The farmers farming experience thus increased their knowledge, experience, and subsequent adoption of improved technologies in farm practices.

Farm Size

Table 8 on farm size, the result showed that 57.0% of the respondents cultivated 1-5 ha of farmland, 28.0% less than 1, 10.0, 6-10, 2.0 11-15, 16-20 and 1.0% above 20 ha. The result aligned with Obot et al. (2022) that smallholder farmers cultivated farmland of between 1-5 ha.

Adoption of Climatic Adaptive Measures

In Table 9, majority of the respondents 86.0% employed climatic adaptive measures in their farming practices while 14% did not employ climatic adaptive measures in their farming practices.

Access to Credit

Table 10 showed that the majority of the respondents (66.0%) had no access to credit while 34.0% had access to credit facilities. The result aligned with Obot *et al.* (2022b) findings that most smallholder farmers do not have access to institutional credit.

Table 1: Distribution of the farmers according to sex

Category	Frequency	Percentage
Male	121	60.5
Female	79	39.5
Total	200	100.0

Table 2: Distribution of the farmers according to marital status

Category	Frequency	Percentage
Single	38	19.0
Married	126	63.0
Widowed	16	8.0
Divorced	8	4.0
Separated	12	6.0
Total	200	100.0

Table 3: Distribution of the farmers according to age

Category	Frequency	Percentage
1-20	20	10.0
21-40	80	40.0
41-60	56	28.0
61-80	44	22.0
Total	200	100.0

Table 4: Distribution of the farmers according to household size

Category	Frequency	Percentage
1-5	36	18.0
6-10	160	80.0
11-15	4	2.0
Total	200	100.0

Table 5: Distribution of the farmers according to farm monthly income

Category	Frequency	Percentage
1-10, 000	102	51.0
11, 000-20, 000	24	12.0
21, 000-30, 000	14	7.0
31, 000-40, 000	30	15.0
41, 000-50, 000	30	15.0
Total	200	100.0

Table 6: Distribution of the farmers according to educational qualification

Category	Frequency	Percentage
Primary	114	57.0
Secondary	33	16.5
Tertiary	16	8.0
No formal education	37	18.5
Total	200	100.0

Table 7: Distribution of the farmers according to a farming experience

Category	Frequency	Percentage
1-10	107	53.5
11-20	30	15.0
21-30	35	17.5
31-40	18	9.0
41-50	10	5.0
Total	200	100.0

Table 8: Distribution of the farmers according to farm size

Category	Frequency	Percentage
<1ha	56	28.0
1-5ha	114	57.0
6-10ha	20	10.0
11-15ha	4	2.0
16-20ha	4	2.0
>20ha	2	1.0
Total	200	100.0

Table 9: Distribution of the farmers according to the adoption of the climatic adaptive measure

Category	Frequency	Percentage
Yes	172	86.0
No	28	14.0
Total	200	100.0

Table 10: Distribution of the farmers according to access to credit

Category	Frequency	Percentage
Yes	68	34.0
No	132	66.0
Total	200	100.0

Climate Change Mitigation Measures Adopted by the Farmers

The study revealed a total of 90% of the respondents adopted multiple cropping, 62.50% adopted mulching, 30.50% adopted the use of improved varieties crops, 22.50% adopted the planting of cover crops and 15% adopted the change in the planting date (Table 11). Multiple cropping which was the most adopted climate adaptive measure by the respondents was to protect the farmers from the risk associated with crop failure due to variation in climate conditions. This corresponded with the findings of (Antwi-Agyei *et al*., 2015; Asare-Nuamah and Amungwa, 2020) that the dominant climate adaptation strategy among smallholder farmers was crop diversification.

Factors Affecting the Adoption of the Climatic Adaptive Measures

The socio-economics characteristics that were found to be statistically significant in influencing the adoption of these climatic adaptive technologies as shown in Table 12 were.

Age was statistically significant and positive which showed that the respondents were more readily receptive to innovations and the result agreed with the findings of (Ojo and Baiyegunhi, 2018; Ali *et al.*, 2016).

Gender

The coefficient of gender was significant and positively related to the adoption of the adaptation techniques. This implied that the adoption of the adaptation techniques was more common among the male than the female respondents in the study area and the result aligned with Iheke and Agodike (2016).

Table 11: Climate change mitigation measures adopted by the farmers

Adopted mitigation measures	Frequency	Percentage
Drainage construction/flood barriers	20	10.00
Planting cover crops	45	22.50
Mulching	125	62.50
Crop rotation	50	25.00
Multiple cropping	180	90.00
Use of improved varieties of crops	61	30.50
Change of planting date	30	15.00
Irrigation	10	5.00
Tree planting/afforestation	8	4.00
Planting of grasses	12	6.00
Zero/minimum tillage	5	2.50
Agroforestry	3	1.50

Table 12: Factors affecting the adoption of the climatic adaptive measures

Variables	B	Std. Error	Beta	T	Sig.
Constant	-0.172	0.127		-1.354	0.177
Age	0.208	0.054	0.162	3.855	0.000*
Sex	0.174	0.092	0.064	1.890	0.060*
Marital Status	0.120	0.045	0.080	2.701	0.008*
Household size	-0.180	0.068	-0.048	-2.633	0.009*
Years in school	0.062	0.012	0.102	4.931	0.000*
Farming experience	0.341	0.072	0.234	4.757	0.000*
Farm size	-0.080	0.057	-0.044	-1.401	0.163
Access to credit	0.141	0.051	0.052	2.768	0.006*
Extension contacts	0.271	0.073	0.090	3.695	0.000*
Member Cooperative	-0.277	0.040	-0.197	-6.861	0.000*
Monthly Income	-0.245	0.065	-0.127	-3.782	0.000*

* Correlation is significant at the 0.05 level (2-tailed)

Marital Status

The coefficient on marital status was positive and statistically significant which implied that married respondents were more receptive to the adoption of the adaptive techniques than others.

Education

The coefficient of the level of education was positively related to the adoption of the adaptation techniques. This implied that the higher the educational attainment, the more tendency the farmers were open to innovations which was in agreement with Iheke (2010).

Farming Experience

The farming experience was positive and agreed with Iheke and Nwaru (2014); Iheke and Agodike (2016) The higher the years of experience, the more tendency of the farmers to adopt new technologies.

Access to Credit

Access to credit was positive and statistically significant in the choice of adaptation strategies which aligned with the findings of Ojo an Baiyegunhi (2018); Mmbando and Baiyegunhi (2016). Some new technologies were expensive which required farmers to have access to credit to purchase it.

Contact with Extension Agents

Frequent contact with extension agents allowed the farmers to learn about the availability and application of the new farming techniques. Therefore, the positive impact of contact with extension agents also helped the farmers on awareness of the new technologies and subsequently, the adoption of such technologies which concurred with Boyaci and Yildiz (2016).

Household Size, Membership of Farmers Group/Cooperatives, and Monthly Income

The result in Table 12 also indicated that household size, membership of farmers' groups/cooperatives, and monthly income had a negative influence on the adoption the improved production practices in the State. Contrary to a priori expectation of other studies, the negative signs could be because the farmers missed

information on inputs, and credit that would have improved their adoption rate due institutional factors.

Conclusion

The finding from the study showed that age, sex, marital status, household size, educational qualification, access to credit, agriculture extension contacts, membership in farmers' groups/cooperatives, and monthly income were the factors that influenced the farmer's decision on the use of climate adaptive measures. For the farmers and stakeholders to achieve food sufficiency in the study area, there was the need for more emphasis on the use of the most adopted climate adaptive measure as identified by the study which was well suited to the farming system in the study area.

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Author's Contributions

Obot Akaninyene: Make considerable contributions to conception and design, and/or acquisition of data, and/or Analysis and interpretation of data, contributed in drafting the article or reviewing it critically for significant intellectual content; and, give final approval of the version to be submitted and any revised version.

Obiekwe Ngozi: Contributed in drafting the article or reviewing it critically for significant intellectual content.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

Reference

Ali, A., Rahat, D. B., & Erenstein, O. (2016). Irrigation water saving through the adoption of direct rice sowing technology in the Indo-Gangetic Plains: Empirical evidence from Pakistan. *Water Practice and Technology*, 11(3), 610-620. https://doi.org/10.2166/wpt.2016.058

Antwi-Agyei, P., Dougill, A. J., & Stringer, L. C. (2015). Barriers to climate change adaptation: Evidence from northeast Ghana in the context of a systematic literature review. *Climate and Development*, 7(4), 297-309. https://doi.org/10.1080/17565529.2014.951013

Antwi-Agyei, P., Stringer, L. C., & Dougill, A. J. (2014). Livelihood adaptations to climate variability: Insights from farming households in Ghana. *Regional Environmental Change*, 14(4), 1615-1626. https://doi.org/10.1007/s10113-014-0597-9

Asare-Nuamah, P., & Amungwa, A. F. (2020). Climate change adaptation among smallholder farmers in rural Ghana. *African Handbook of Climate Change Adaptation*, 1-17. https://doi.org/10.1007/978-3-030-42091-8_279-1.

Boyaci, M., & Yildiz, O. (2016). An overview of agricultural extension services in Turkey. *Bulgarian Journal of Agricultural Science*, 22(1), 151-157.

Harvey, C. A., Rakotobe, Z. L., Rao, N. S., Dave, R., Razafimahatratra, H., Rabarijohn, R. H., ... & MacKinnon, J. L. (2014). The extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. Philosophical Transactions of the Royal Society B: *Biological Sciences*, 369(1639), 20130089. https://doi.org/10.1098/rstb.2013.0089

Iheke, O. R. (2010). Impact of Migrant Remittances on Efficiency and Welfare of Rural Smallholder Arable Crop Households in South Eastern Nigeria. Unpublished Ph. D. Dissertation, Department of Agricultural Economics, Michael Okpara University of Agriculture, *Umudike*.

Iheke, O. R., & Agodike, W. C. (2016). Analysis of factors influencing the adoption of climate change mitigating measures by smallholder farmers in IMO state, Nigeria. Sci. Pap. Ser. Manag. *Econ. Eng. Agric. Rural Dev*, 16, 213-220.

Iheke, O. R., & Nwaru, J. C. (2014). Impact of Innovation on smallholders' productivity and poverty status: The case of arable crop farmers in South-East, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 3(4), 301-318.

IPCC. (2018). IPCC special report on the impacts of global warming of 1.5°C – summary for policymakers. IPCC, Incheon. http://www.ipcc.ch/report/sr15/

Kom, Z., Nethengwe, N. S., Mpandeli, N. S. and Chikoore, H. (2020). Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. *GeoJournal* 2020, 1–24.

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., ... & Torquebiau, E. F. (2014). Climate-smart agriculture for food security. *Nature climate change*, 4(12), 1068-1072. https ://doi. org/10.1038/nclim ate24 37

Mashizha, T. M. (2019). Building adaptive capacity: Reducing the climate vulnerability of smallholder farmers in Zimbabwe. *Business Strategy & Development*, 2(3), 166-172. https://doi.org/10.1002/bsd2.50

Mmbando, F. E., & Baiyegunhi, L. J. (2016). Socio-economic and institutional factors influencing adoption of improved maize varieties in Hai District, Tanzania. *Journal of Human Ecology*, 53(1), 49-56. https://doi.org/10.1080/09709274.2016.11906955

Obayelu, O. A., Adepoju, A. O., & Idowu, T. (2014). Factors influencing farmers' choices of adaptation to climate change in Ekiti State, Nigeria. *Journal of Agriculture and Environment for International Development* (*JAEID*), 108(1), 3-16. https://doi.org/10.12895/jaeid.20141.140

Obot, A., Okeke, C., Precious, C., & Onuoha, F. (2022a). Factors Influencing the Adoption FARO-44 Rice among Smallholder Farmers in Anambra State, Nigeria. *Canadian Journal of Agriculture and Crops*, 7(1), 30-37.

Obot, A., Ozor M., Nwankwo, T., & Obiekwe, N. (2022b). Knowledge, Attitude and Perception of Smallholder Farmers on Corona Virus Pandemic in Nigeria. *American Journal of Agricultural and Biological Sciences* 2022, 17, 34.39. https://doi.org/10.3844/ajabssp.2022.34.39.

Ojo, T., & Baiyegunhi, L. (2018). Determinants of adaptation strategies to climate change among rice farmers in Southwestern Nigeria: *A Multivariate Probit Approach*. https://ageconsearch.umn.edu/record/277011

Olabanji, M. F., Davis, N., Ndarana, T., Kuhudzai, A. G., & Mahlobo, D. (2021). Assessment of smallholder farmers' perception and adaptation response to climate change in the Olifants catchment, South Africa. *Journal of Water and Climate Change*, 12(7), 3388-3403. https://doi.org/10.2166/wcc.2021.138

Pachauri, R. K., & Meyer, L. A. (2014). Climate change 2014: Synthesis Report. Contribution of working groups i, ii, and iii to the fifth assessment report of the intergovernmental panel on climate change.

Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., ... & Reinhardt, J. (2017). Climate change impacts in Sub-Saharan Africa: From physical changes to their social repercussions. *Regional Environmental Change*, 17(6), 1585-1600. https://doi.org/10.1007/s10113-015-0910-2

Umoh, N. E., Offiong, R. A., Ekpe, I. A., & Yta, E. M. (2015). Assessment of income poverty among farmers in Akwa Ibom state, Nigeria. *Journal of Emerging Trends in Economics and Management Sciences*, 6(8), 345-349. https://hdl.handle.net/10520/EJC174489

Vermeulen, S. J., Aggarwal, P. K., Ainslie, A., Angelone, C., Campbell, B. M., Challinor, A. J., ... & Wollenberg, E. (2012). Options for support to agriculture and food security under climate change. *Environmental Science & Policy*, 15(1), 136-144. https://doi.org/10.1016/j.envsc i.2011.09.003