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Climate change adaptation, indigenous practices and food security: A Gender Perspective

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Abstract: This paper explores the gender differences in the utilization of indigenous climate change adaptation practices as food security strategies among smallholder horticulturists in Osun State, Nigeria. A multistage sampling procedure was adopted in selecting 210 smallholder horticulturists. Using binary logistic model, the study analysed gender differences as it relate to indigenous climate change adaptation practices and food security. The results show marked gender differences in access to climate change information, with about 37.3% of male compared to 18.7% female horticulturists having access to climate change information. Also, gender differences were shown in the type of horticultural crops cultivated. For example, while majority of men (38.9%) cultivated fruits, women (38.4%) focused primarily on fruit vegetables. The study also reveals marked gender differences in determinants of food security. Male horticulturists with access to climate change information were 7.6 times ($e^{2.033}$) likely to have increase in yield per hectare. On the other hand, female horticulturists who engaged in planting ahead of rains and intensive manure application were 6.9 times ($e^{1.937}$) and 11.4 times ($e^{2.437}$) respectively likely to have increase in yield per hectare. Similarly, experienced female horticulturists were 7.6 times ($e^{2.027}$) more likely to have increase in yield. The study recommended mainstreaming gender-sensitive policies in tackling the challenge of climate change impact among horticulturists.

Keywords: Indigenous practices, Climate change adaptation, Gender analysis, Smallholder farmers, Horticulturists

INTRODUCTION

Food insecurity has been one of the incessant problems affecting many populations in developing countries. The importance of food security is reflected in the Sustainable Development Goals (SDGs) which has 'halving hunger and ensuring food security by 2030' as its third goal (Osborn *et al*., 2015). In addition, governments at different levels in many countries have continually devised strategies at improving food security. In Nigeria, such initiatives included the Agricultural Development Programmes (ADP), Operation Feed the Nation, River Basin Development Programme, and Agricultural Transformation Agenda (ATA). At present, the country's agricultural policy is tagged 'the Green Alternative'. However, with all the concerted efforts, achieving food security seem far from been attainable (ATPS, 2013). One of the reasons attributed to this is climate change which manifests in form of increase in the frequency and intensity of severe weather events such as floods, cyclones and hurricanes will increase; prolonged drought in some regions; and water shortages; and changes in the location and incidence of pest and disease outbreaks. Studies have shown that rural dwellers who supply about 70-80% of agricultural labour force in developing countries (FAO, 2011) are usually the worst hit by the effects of climate change (IPCC, 2007). This is because their livelihoods depend directly or indirectly on agriculture (Schlenker and Lobell, 2010).

In Nigeria, the horticultural sub-sector remains relatively under-developed. The sub-sector also reflects the challenges in the agricultural sector. A significant problem experienced by many horticultural farmers in Nigeria is inadequate knowledge and technology of production (Babatola, 2004). Efforts to enhance productivity in agricultural sector with conventional and technological approaches have been hugely inadequate, leaving most farmers and rural dwellers to continually utilize indigenous and traditional modes of sustenance. Concentration of efforts at fighting climate change using technologies from developed countries at the expense of indigenous, local or community-based approaches have largely been unsuccessful (Berkes and Jolly, 2001; Gyampoh and Asante, 2011). Also, failure to properly contextualize the implementation of these technologies and improved practices has led to non-achievement of policy objectives. One such issue is gender. Since men and women experience the impact of climate change differently, it is inevitable that there would be differences in their access and use of coping mechanisms to adaptation and resilience. Therefore, it is important to identify the gender dimension of access, sources and use of traditional and indigenous practices in responding to the changes in climate (UN, 2013). This has received little attention (Roehr, 2007; Ajani *et al*., 2013). Research that examines how men and women utilize indigenous practices in coping and adapting to changes in climate could produce useful insights for developing sound policies. Furthermore, undertaking the study in horticultural sub-sector, which has attracted limited empirical studies in literature,

provides an interesting context because of its importance to rural dwellers as a source of livelihood and food security (Nakashima *et al*., 2012; UNDP 2013); hence, the need for this study.

The rest of the paper is structured as follows: The next section reviews literature on issues of gender, indigenous practices and climate change. This is followed by the methodology. After that, the study provides the detailed analysis followed by the empirical results. In the final section, we discuss the results, and implications for practice and policy.

Gender, indigenous practices and climate change

Climate change as a global phenomenon, affects many people irrespective of sex, age, class or any other social classification. According to Bran *et al* (2013), climate change is perceived changes in average temperature, rainfall or rainfall variability over the last 30 years. Climate change worsens existing gender gap and women tend to face greater negative impacts than men (Lambrou and Piana 2005; Roehr, 2007). Meanwhile, studies have shown that majority of smallholder farmers in many developing countries lack adequate access to improved technology that could improve their productivity and livelihoods (IFAD, 2003; Njeri, 2007; Muzari *et al* 2012; IFPRI, 2014). In order to reduce their vulnerability to climate variability and extremes, farmers in sub-Saharan Africa have developed several indigenous practices and knowledge (Obidike, 2011; Gyampoh and Asante, 2011; Ajani et. al., 2013). This is obtained through observation and it accrued from cumulative experience passed down from generation to generation (Pareek and Trivedi, 2011). In recent years, there has been an increasing realization that rural dwellers are a valuable source of such knowledge (Gyampoh and Asante, 2011). This becomes more important as most of the technologies derived from the mainstream scientific processes are not readily available and accessible by smallholder farmers (Akullo and Kanzikwera, 2007). In addition, reliance on age-long, indigenous practices for coping both with variability in weather patterns offers a sustainable path to tackling the challenges of changing climate (Ajani *et al*, 2013). These include practices such as cover cropping, bush fallowing, crop rotation, mixed cropping among others. Since climate change have differing effect on men with dissimilar gender response, it is very important to examine the differences. The main objective of this study therefore is to understand complex and multidimensional gendered indigenous climate change adaptation practices and food security among smallholder horticultural farmers in Nigeria.

METHODOLOGY

Data and sampling procedure

The data was collected from smallholder horticulturists in Osun State. The State is largely made up of Yoruba people in South West, Nigeria. A large proportion, over 90 percent of the rural population in the state, is involved in farming (Fakayode etal, 2012). In addition to the production of food and cash crops, majority of the farmers produce a range of horticultural crops ranging from fruits e.g. orange, tangerine, plantain/banana, mango, lemon, pawpaw, pineapple, grape etc and vegetables e.g. pepper, tomato, *Amaranthus spp* (tete), okra, ewedu (*Corchorus olitorus*), eggplant, fluted pumpkin (*Telfaria occidentalis*), melon (*Celocynthis citrulus*) etc. (Osun State, 2009). The study adopted a multi-stage sampling procedure. First, the State was stratified along the three agro-ecological zones under the Osun State Agricultural Development Programme (OSSADEP) namely Iwo, Osogbo and Ife/Ijesa. Second, some towns and communities were purposively selected based on the fact that they have a high settlement of smallholder hortiulturists in each zone. Based on this, Ipetu-Ijesha was selected from Ife/Ijesa zone, Iwo from Iwo zone and Ilobu and Okinni from Osogbo zone. Horticulturists were then sampled using the assistance of a key informant in the area. Farmer groups were targeted and their selection was made from a list of known groups in the area. This included a gender criterion along with group function. From the targeted groups, farmers were listed and stratified by gender and then randomly selected to ensure that both men and women were equally represented in the sample. There was no exhaustive list of all the farmers in the area so it was difficult to get appropriate sampling frame. However, we computed the minimum sample size using the sampling method when the population is unknown. At the end of the procedure,some 70 respondents were randomly selected from each of the towns making a total of 210 respondents. These comprise male and female horticulturists.

Measures

In the questionnaire, each respondent was asked to estimate if their yield per hectare has increased or decreased in the past few years. This constitutes the dependent variable for the study and was used as a proxy to measure food security. This is because additional income generated from increase yield will contribute to individual and household food security (Immink and Alarcon, 1992). The dependent variable, yield, was therefore coded as a dichotomous variable which takes the value '1' if it has increased, or 0, if otherwise. The independent variables include some socioeconomic variables such as age of the

farmers, educational level, and experience in horticulture (in years). Others include access to climate change information and indigenous practices used in adapting to climate change challenges. These include irrigation to augment shortfall in rain, mulching/cover cropping, planting deeper than usual, planting ahead of rains, intensive manure application and planting crops to tolerate climate change induced conditions (e.g. drought, heavy rains). In order to assess the gender differences in food security among male and female horticulturists, chi-square test was used to assess the association between food security and the independent variables while a binary logistic model was employed to assess the effects of the independent variables on food security. The regression model is appropriate for describing and testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables. Binary logistic regression with multiple predictors can be constructed for Y (yield/hectare) as follows:

$$logit\ (Y) = In\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta 1X1 + \beta 2X2 \ldots \beta nXn \quad .. (1)$$

$\boldsymbol{\pi}$ = Probability $(Y) = \frac{e^{\alpha+\beta 1X1+\beta 2X2}}{1+e^{\alpha+\beta 1X1+\beta 2X2}}$ ……(2)

Where: $\boldsymbol{\pi}$ is the probability of the event, α is the Y intercept, βs are regression coefficients, Xs are set of predictors. The study estimated α and βs using the maximum likelihood (ML) method (Schlesselman, 1982). This method maximizes the likelihood of reproducing the data given the parameter estimates. The independent variables include:

X_1 = Age
X_2 = Level of Education
X_3 = Experience in horticulture
X_4 = Irrigation to augment shortfall in rain
X_5 = Mulching/cover cropping
X_6 = Planting deeper than usual
X_7 = Planting ahead of rains
X_8 = Intensive manure application
X_9 = Planting crops to tolerate to climate change induced conditions (e.g. drought, heavy rains)
X_{10} = Access to climate change information

RESULTS

Socio-demographic characteristics of the respondents

The socio-demographic characteristics of the horticultural farmers are presented in Table 1. In terms of age distribution, the Table shows some similarities. For instance, the highest proportion of the farmers, about 32.5% and 30.3% for men and women respectively, were in the age category, 31-40. A deeper look at the Table however shows slightly aging male horticulturists. For example, over 25.0% of male horticultural farmers were within the age bracket 50 and above. On the other hand, only 15.8% of women horticultural farmers were within the same age bracket. A look at the marital status also shows an interesting result. Although majority of the horticulturists were married, there were more single male horticulturists than female. Similarly, gender breakdown shows that male horticulturists were more educated than their female counterparts. For example, over 66% of the male horticulturists had between secondary and tertiary education compared with only 44.2% for the female horticulturists with the same level of education.

Furthermore, while about half of farmers in the male and female gender had farming as their primary occupation, there were noticeable gender differences in other sources of livelihood. For example, while trading was the primary alternative economic source of livelihood of women, male horticulturists were primarily artisans. These reflect the differences in the gender role associated with economic activities practiced by male and female gender in the society. This is consistent with Awomolo (1998) who reports that majority of women in western Nigeria are active traders. Men undertake activities such as carpentry, bricklaying, among others which are generally labour intensive. This is supported by the Gender Dimension to Livelihoods Report of the National Bureau of Statistics (NBS, 2014). In addition, male farmers who had salaried work, such as civil servants, were more than women. This is not surprising considering the fact that more men horticulturists were more educated than their female counterparts. Hence, the male gender is more likely to have better opportunities to be employed in such high skilled jobs than the female gender. There was also a marked gender difference among horticulturists on the type of crops cultivated. For example, while men were preoccupied with cultivating fruits, women focus primarily on fruit vegetables. Fruits cultivated by men included crops such as oranges, plantain, mango, water melon, while the fruit vegetables planted by women included okra, pepper, and tomatoes, among others.

Table 1: Socioeconomic characteristics of horticulturists (%)

Variables	Male	Female
Age (n = 77; 76)		
<20	5.2	
21-30	18.2	25.0
31-40	32.5	30.3
41-50	18.2	28.9
51-60	15.6	9.2
>60	10.4	6.6
Marital status (n = 75; 77)		
Single	20.0	6.5
Married	69.3	51.9
Widowed	1.3	14.3
Divorced	2.7	18.2
Separated	6.7	9.1
Level of education (n = 74; 77)		
None	14.9	24.7
Primary Education	18.9	31.2
Secondary Education	54.1	36.4
Tertiary Education	12.2	7.8
Primary occupation (n = 77; 76)		
Farming	48.1	55.3
Trading	20.8	38.2
Artisan	11.7	1.3
Salaried Work	6.5	2.6
Self Employed	3.9	1.3
Others	9.1	1.3
Horticultural crops cultivated (n = 157; 164)*		
Fruit Vegetables	35.7	38.4
Leafy Vegetables	24.8	31.1
Fruits	38.9	28.7
Ornaments	0.6	1.8
Experience in horticulture (n = 75; 75)		
<5yrs	36.0	37.3
5-10yrs	38.7	40.0
>10yrs	25.3	22.7
Access to extension services (n = 68; 70)	32.4	15.7

*Multiple response analysis

The results, as shown in Table 1, show a wide disparity between access to extension services between male and female horticulturists. Male horticulturists with access to extension services were about twice that of female gender. This confirms previous studies among horticulturists. For example, Muriithi (2015) found out in a study among vegetable smallholders in Kenya that about 34.0% of female farmers had access to extension services compared to about 63.0% of male farmers. These probably give the male horticulturists advantage in terms of knowledge and skills needed for agricultural production and market access (Muriithi, 2015).

Farmers' perception about climate change

The importance of farmers' perceptions of climate change has been outlined to be a significant factor in adopting a particular technology (Adger *et al.*, 2009; Jones and Boyd, 2011). According to literature, their perceptions of climate change and recent climate patterns go a long way in determining the adaptive behavior of farmers (Gbetibouo, 2009; Mertz *et al.,* 2009). The result, from the gender perspective is presented in Table 2. It shows that in general, there were no perceived differences in climate change between male and female horticulturists. However, there was a slight difference in their perception about average temperature. While majority of female farmers perceived a decrease in average temperatures (20 percent), majority of the male believe otherwise (21 percent).

Table 2: Gender differences in perception of climate change (%)*

	Male (n = 105; 159; 181)			Female (n = 121; 150; 166)		
	Increased	Decreased	Unchanged	Increased	Decreased	Unchanged
Temperatures have	21.0	12.6	18.2	18.2	20.0	13.9
Rainfall has	32.4	11.3	12.7	29.8	10.7	12.7
Incidence of pests and diseases has	9.5	20.8	17.1	10.7	20.0	19.3
Frequency of drought has	4.8	25.8	13.8	0.8	22.7	19.3
Frequency of heavy rain has	9.5	23.9	14.9	19.0	20.7	11.4
Periods of planting season has	22.9	5.7	23.2	21.5	6.0	23.5

*Multiple responses

However, (Bryan *et al*; 2013) argues that farmers' perception of climate change should be interpreted side by side empirical evidence. This is because their perception may be influenced by their recent experience in agriculture which may not necessarily be objective. For example, farmers in a study in Kenya perceived a decrease in average precipitation and increase in average temperature in contradiction to evidence from weather stations in the area which showed largely unchanged climate conditions (Bryan *et al*; 2013). This makes Gbetibouo (2009) to argue that experienced farmers are more likely to correctly perceive long-term changes in temperature, precipitation, and rainfall variability.

Indigenous climate change adaptation practices

The utilization of indigenous climate change adaptation practices and access to climate change information by male and female horticulturists is presented in Table 3. The result reveals a wide disparity in access to climate change information. Male respondents who had access to climate change information were about twice that of women. This may be accounted for by their higher level of education and skilled job which may put them in a better position to access information on indigenous climate change adaptation practices. This result has lots of implications in responding to climate change impacts for women horticulturists. For instance, it could make women to be more vulnerable to the consequences of climate change because of their inadequate access to education and information that would help them to manage climate-related risks to agriculture and food security (Jost *et al.,* 2015).

Table 3: Indigenous climate change adaptation practices (%)

	Male	Female
Access to climate change information (n = 75; 75)	37.3	18.7
Indigenous climate change adaptation practices (n = 207; 195)*		
Irrigation to augment shortfall in rain	26.5	29.9
Planting ahead of rains	21.6	21.5
Planting deeper than usual	17.9	18.1
Mulching/cover cropping	16.7	17.4
Intensive manure application	9.3	6.9
Planting crops to tolerate climate change induced conditions (e.g. drought, heavy rains)	8.0	6.3

*Multiple response analysis

Among indigenous practices used in tackling the challenges of climate change, results as presented in Table 3 shows a similar pattern between male and female horticulturists. Horticultural practice such as irrigation to augment shortfall in rain was the main prevalent practice used by both male and female farmers. The least practices were intensive manure application and planting crops to tolerate climate change induced conditions.

Gender differences in factors influencing food security

In Table 4, the study presents the gender differences on the relationship between climate change adaptation practices and food security. The result shows that there were differences between factors associated with food security among male and female horticulturists. Among male horticulturists, experience in horticulture and access to climate change information are statistically associated with

food security. In the case of women horticulturists, age, experience in horticulture and planting ahead of rains were significant factors associated with food security.

Table 4: Gender variations on factors associated with food security

	Male		Female	
	X^2	Sig	X^2	Sig
Age	6.158	0.291	11.293	**0.023**
Level of education	1.002	0.801	2.990	0.393
Experience in horticulture	7.554	**0.023**	27.509	**0.000**
Climate change adaptation practices				
Irrigation to augment shortfall in rain	3.138	0.077	0.324	0.569
Mulching/cover cropping	3.020	0.082	0.945	0.331
Planting deeper than usual	0.116	0.733	0.146	0.702
Planting ahead of rains	0.029	0.864	13.905	**0.000**
Intensive manure application	0.416	0.519	0.571	0.450
Planting crops to tolerate to climate change induced conditions (e.g. drought, heavy rains)	1.090	0.297	1.316	0.251
Access to climate change information	5.980	**0.014**	3.461	0.063

Gender differences on the impact of indigenous climate change adaptation practices on food security

Table 5 presents the results from the binary logistic regression. The results of the analysis reveal the determinants of food security among male and female horticulturists. It can be inferred from the results that there were marked gender differences between male and female horticulturists. For example, among male horticulturists, access to climate change information was an important factor of food security, while among female horticulturists, experience in horticulture and indigenous climate change practices such as planting ahead of rains, and intensive manure application were significant determinants. Further analysis of the binary logistics regression reveals that male horticulturists with access to climate change information were 7.6 times likely to have increase in yield per hectare. Meanwhile, female horticulturists who engaged in planting ahead of rains and intensive manure application were 6.9 times and 11.4 times respectively likely to have increase in yield per hectare. Similarly, experienced female horticulturists were 7.6 times more likely to have increase in yield. This result is consistent with evidence in literature. For example, Omisore *et al.* (2009) in a study on the effect of application of poultry manure on maize show there was highest cob weight when manure was applied two months before planting. Similarly, Adesina and Chianu (2002) found that gender of the farmer, extent of contact with extension agents; years of experience with agro-forestry were key determinants of farmers' adoption and adaptation of agroforestry practices in Nigeria.

Table 5: Gender differences on the impact of indigenous climate change adaptation practices on food security

	Male			Female		
	B	Sig	Exp(B)	B	Sig	Exp(B)
Age	-0.122	0.738	0.886	0.066	0.895	1.068
Level of education	0.061	0.888	1.063	0.530	0.281	1.698
Experience in horticulture	0.858	0.201	2.358	2.027	**0.013**	7.593
Indigenous climate change adaptation practices						
Irrigation to augment shortfall in rain	1.129	0.230	3.091	-0.399	0.649	0.671
Mulching/cover cropping	0.851	0.420	2.342	-0.314	0.720	0.730
Planting deeper than usual	-1.669	0.144	0.188	-0.246	0.761	0.782
Planting ahead of rains	-0.177	0.844	0.838	1.937	**0.026**	6.938
Intensive manure application	-0.527	0.630	0.590	2.437	**0.045**	11.441
Planting crops to tolerate to climate change induced conditions (e.g. drought, heavy rains)	-1.104	0.426	0.331	-0.136	0.914	0.873

Access to climate change information	2.033	**0.021**	7.634	-2.236	0.092	.107

The use of manure by smallholder farmers has been argued to be an effective strategy for climate change adaptation and effective tool in enhancing household food security by increasing yield per hectare (Di Falco *et al.,* 2010). It holds the advantage over conventional fertilizer by ensuring sustainability of the environment, especially when balanced with nitrogen-fixing crops which would provide additional nutrient for the crops (Spiertz, 2010). In addition, Lal (2010) argues that the use of indigenous practices such as use of manure or compost create positive carbon, and nutrient budgets, conserve water, control soil erosion, improve soil structure and minimise soil disturbances. These assist in addressing soil degradation which often lead to the depletion of soil organic carbon (SOC) pool, a worrying development in soils used by smallholder farmers in developing countries (Dang and Klinnert 2001; Lal 2010). The depletion of the SOC pool leads to degradation in soil quality and declining agronomic/biomass productivity (Lal*et al.,* 2007). Furthermore, experience in horticultural production was found to be an important determinant of food security among female horticulturists. This can be explained by the fact that women who have been cultivating these crops for a long period of time would have developed and internalized knowledge about changing pattern in climatic conditions and their impact on productivity of their crops. Hence, they are more prepared with knowledge to tackle current changes in the climate thereby mitigating the impact on the crop yield and ultimately on household food security. Result about men's advantage on access to climate change information supports previous findings (Olasore *et al.,* 2012; Jost *et al.,* 2015). This is due to the fact that in many rural areas in developing countries, men face lower barrier in social capital formation such as group formation and participation which provide useful and veritable sources of information about different activities including information on climate change activities. In addition, membership of association could enable the farmers to get more information on indigenous practices because members of the association are fellow farmers (Nnadi *et al.,* 2013). Even where women are members of groups, the triple role of women in reproductive, productive and community activities poses additional constraints. In addition to their livelihood activities, they spend a lot of time in fetching firewood, water, cooking and caring for family members (Quisumbing *et al*., 1995). These restrict them from actively participating in groups that can open them to relevant information and knowledge that can help in tacking the challenges of climate change and enhance their food security. All these factors play a role in why men are generally early adopters of new technologies or practices (Jost *et al.,* 2015).

CONCLUSION AND POLICY RECOMMENDATION

The main objective of this paper is to examine gender differences in the indigenous climate change adaptation practices used by smallholder horticulturist and assess the impact on food security. The study reveals that male farmers have twice as much access to agricultural extension services and climate change information than their female counterparts. On the effect of indigenous climate change adaptation practiceson food security, the study observed marked gender differences. The paper found that while access to information was the main determinant of food security among male horticulturists, for women, experience in horticulture, and indigenous adaptation practices such as intensive manure application and planting ahead of rains were important determinants. The results underlie the importance of education and agricultural extension service as key factors in accessing information on climate change impacts because they enhance farmer's capability to access skills and knowledge to improve their food security status. The limitation of women to access information about climate change should be a concern in implementing climate change adaptation interventions. This could be addressed by employing more women extension agents and also deploying effective agricultural extension service that can provide technical information needed by the horticulturists most especially women.

In conclusion, policy-makers need context-specific strategies that help in identifying the strengths and weaknesses of society's response mechanisms. A key context is gender differences in the perception, coping, adaptation and mitigation factors with regard to indigenous practices as climate change adaptation tool in developing countries. For example, practices that will be introduced for women should be mindful of their already burdened workload, the neglect of which may be counter-productive. Therefore, it is imperative that policy instruments and interventions directed at enhancing food security and assisting smallholders' farmers to adapt to the challenges of climate change should be gender-sensitive. In order to fully benefit from the usefulness of indigenous practices in tackling the challenges of climate change, this study recommends further research on developing new knowledge systems that integrate both formal and indigenous knowledge systems. This would help strengthen the

adaptive capacity of smallholder farmers against climate change impact.

REFERENCES

Adesina, A. A. and Chianu, J. (2002). Determinants of Farmers' Adoption and Adaptation of Alley Farming Technology in Nigeria. Agroforestry Systems 55: 99-112.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J., Wreford, A., (2009). Are there social limits to adaptation to climate change? Climatic Change 93, 335-354.

Ajani E. N., Mgbenka R. N. and Okeke M. N. (2013). Use of Indigenous Knowledge as a Strategy for Climate Change Adaptation among Farmers in sub-Saharan Africa: Implications for Policy. Asian Journal of Agricultural Extension, Economics & Sociology 2(1): 23-40, 2013; Article no. AJAEES.2013.003

Akullo D. and Rogers Kanzikwera R. (2007). Indigenous Knowledge in Agriculture: A case study of the challenges in sharing knowledge of past generations in a globalized context in Uganda WLIC Durban World Library and Information Congress 73 RD IFLA General Conference and Council

Apata T.G., Samuel K.D. and Adeola A.O. (2009). Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria. Contributed Paper presented at the International Association of Agricultural Economists' 2009 Conference, Beijing, China, August 16-22

ATPS (2013): Indigenous knowledge practices for climate change adaptation and impact mitigation: The case of smallholder farmers in Tigray, Northern Ethiopia. ATPS Working Paper Series No. 70

Babatola J.O (2005)Export promotion of horticultural crops *Nigerian Journal of Horticultural Science* Vol. 9 2005: 74-78 ISSN: 1118-2733.

Berkes F, and Jolly, D. (2001). Adapting to climate change: socio-ecological resilience in a Canadian Western Arctic Community. Conserv. Ecol. 5 (2): 18.

Bryan E., Ringlera C., Okoba B., Roncoli C., Silvestri S., and Herrero M. (2013). Adapting agriculture to climate change in Kenya: Household strategies and determinants. Journal of Environmental Management, 114: 26 – 35

Osborn D., Cutter A. and Farooq (2015). Universal Sustainable Development Goals Understanding the Transformational Challenge for Developed Countries Report of a Study by Stakeholder Forum May 2015

Di Falco S., Veronesi M. and Yesuf M. (2010). Does adaptation to climate change provide food security? A micro-perspective from Ethiopia. Centre for Climate Change Economics and Policy Working Paper No. 22

Fakayode, S. B., Rahji M.A.Y. and Adeniyi S. T. (2012). Economic Analysis of Risks in Fruit and Vegetable Farming in Osun State, Nigeria. Bangladesh J. Agril. Res. 37(3): 473-491

Federal Ministry of Agriculture and Rural Development (2011). Agriculture Transformation Agenda: We will grow Nigeria's agricultural sector. Draft discussion, Federal Ministry of Agriculture and Rural Development Abuja, Nigeria

Food and Agriculture Organisation and Doss (2011). The State of Food and Agriculture. Rome: FAO

Gbetibouo, G.A., (2009). Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: the Case of the Limpopo Basin, South Africa. IFPRI Discussion Paper, 849.

Gyampoh B. A. and Winston A. A. (2011). Mapping and Documenting Indigenous Knowledge In Climate Change Adaptation In Ghana

IFAD (2003). Promoting Market Access for: The Rural Poor In Order To Achieve The Millennium Development Goals. Roundtable Discussion Paper for the Twenty-Fifth Anniversary Session of IFAD's Governing Council.

IPCC. (2007). Contribution of working groups I, II and III to the fourth assessment report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: Intergovernmental Panel on Climate Change. Available at: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html.

Immink, M. D., and Alarcon, J. A. (1992). Household food security and crop diversification among smallholder farmers in Guatemala. Food Nutrition and Agriculture, (4).

Jones, L., and Boyd, E., (2011). Exploring social barriers to adaptation: insights from Western Nepal. Global Environmental Change 21 (4): 1262-1274.

Jost, C., F. Kyazze, J. Naab, S. Neelormi, J. Kinyangi, R. Zougmore, P. Aggarwal, G. Bhatta, M.Chaudhury, M.-L. Tapio-Bistrom, S. Nelson, and P. Kristjanson. (2015). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. Climate and Development, 2015, http://dx.doi.org/10.1080/17565529.2015.1050978

Lal R. (2010). Beyond Copenhagen: mitigating climate change and achieving food security through soil carbon sequestration. Food Sec. 2:169–177

Mertz, O., Mbow, C., Reenberg, A., and Diouf, A., (2009). Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. Environmental Management 43 (5): 804-816.

Muriithi B.W. (2015). Smallholder Horticultural Commercialization: Gender Roles and Implications for Household Well-being in Kenya. Paper presented at the 29th International Conference of Agricultural Economists, August 8th – 14th, Milan, Italy

Muzari, Gatsiand Shepherd and Muvhunzi (2012). The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saha. Journal of Sustainable Development; Vol. 5, No. 8; 2012 ISSN 1913-9063 E-ISSN 191

Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A. and Rubis, J.T. (2012). Weathering Uncertainty: Traditional Knowledge for Climate Change Assessment and Adaptation. Paris, UNESCO, and Darwin, UNU, 120 pp.

Njeri N. F. (2007), Adoption of agricultural innovations by smallholder farmers in the context of HIV/AIDS: The case of tissue-cultured banana in Kenya. Ph.D. Thesis, Wageningen University. ISBN 978-90-8504-680-6

Nnadi, F.N., Chikaire, J. and Ezudike, K.E. (2013). Assessment of Indigenous Knowledge Practices for Sustainable Agriculture and Food Security in Idemili South Local Government Area of Anambra State, Nigeria. Journal of Resources Development and Management, Vol.1

Olasore, P. O. Popoola and J. T. C-Oluwatosin (2012). Mainstreaming women in Climate Change mitigation and adaptation: Issues for consideration. Proceedings, 17th Annual National Conference AESON [11 – 14 March, 2012]

Pareek, A., and Trivedi, P. C. (2011). Cultural values and indigenous knowledge of climate change and disaster prediction in Rajasthan, India.

Obidike, N. A. (2011). Rural farmers' problems accessing agricultural information: A case study of Nsukka local government area of Enugu State, Nigeria.

Omisore, J. K., Oyelade, O. A., & Dada-Joel, O. T. (2009). Effects of Application Timing on Maize Production using Poultry Manure. *National Centre for Agricultural Mechanization (NCAM), Ilorin*, 429-435.

Roehr U. (2007). Gender, climate change and adaptation. Introduction to the gender dimensions. Background Paper prepared for the Both ENDS BRIEFING PAPER. Adapting to climate change: How local experiences can shape the debate. August 2007.

Schlesselman, J. J. (1982). Case control studies: Design, control, analysis. New York: Oxford University Press.

Schlenker, W., and Lobell, D.B., (2010). Robust negative impacts of climate change on African agriculture. Environmental Research Letters 5 (1).

Spiertz J.H.J. (2010). Nitrogen, sustainable agriculture and food security. A review. Agronomy for Sustainable Development, 30 (2010) 43–55

UN (2013). Best practices and available tools for the use of indigenous and traditional knowledge and practices for adaptation, and the application of gender-sensitive approaches and tools for understanding and assessing impacts, vulnerability and adaptation to climate change. Technical Paper. Available at www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/.../UNFCCC-TP-2013-11.pdf

UNDP (2013). Overview of linkages between gender. Gender and Climate Change Asia and the Pacific. Author Senay Habtezion. Jeffrey Stern (Suazion, Inc.) Ed.