Turkish Economic Review
www.kspjournals.org
Volume 4 June 2017 Issue 2

Assessment of Climate Change on Sesame Cultivation in Makurdi Local Government Area of Benue State, Nigeria

By Jacqueline A.C. EZIHE [a] Ikechi K. AGBUGBA [b†]
Gift E. SHAIBU [c] & Hrabrin BACHEV [d]

Abstract. The study was conducted to determine the assessment of climate change and ascertain the awareness among sesame farmers in Makurdi local government area of Benue state. A sample of 120 farmers participated in the study. Descriptive statistics and logit regression were used to analyse the data. The results shows that more male farmers (69.2%) within the age range of 21-40 years are involved in the production of sesame when compared to female farmers (30.8%). It was observed that most of the farmers are married (82.5%). The educational level is low among sesame farmers with most of them having only primary education (45%). The result also shows that most of the farmers have farming experience of less than 10years with a farm size of less than 4 hectares. Insect infestation, soil erosion is perceived as reasons for low yield. Sesame farmers have adapted to such changes through the use of improved seed varieties, use of chemicals and mixed cropping. Results also showed that extension agents, educated farmers and relatives were the major sources of information about climate change. It was also revealed that climate has little effect on sesame as the average yield of the crop is 57.5% compared to low yield of 13.3%, also socio-economic characteristics of the farmers do not have any significant effect on the awareness of climate change as only household size and age are statistically significant at 1% and 5% respectively. To improve farmers' awareness on climate change, the study recommends that there should be improvement in newspaper and radio/television broadcast in other to sustain sesame production in the event of climate change.
Keywords. Agriculture, climate change, perception, sesame, sandy loam, Nigeria.
JEL. O12, O13, Q18.

1. Introduction

Sesame (Sesameindicum L.), an ancient oilseed is one of the oldest cultivated plants in the world. They are the seed of the tropical annual; the specie has a long history of cultivation mostly for its yield of oil. Sesame (Sesamumindicum L.), otherwise known as sesamum or benniseed, member of the family *pedaliaceae,* is one of the most ancient oilseed crop known to mankind. The original area of domestication of sesame is obscure but it seems likely to have first been brought into cultivation in Asia or india while some other school of thought believe sesame to originate from Iraq and others believe it to have originated from tropical Africa, where there is the greatest genetic diversity. It was later taken at a

[a] Department of Agricultural Economics, University of Agriculture, Makurdi, Benue State, Nigeria.
. ezihejac@yahoo.com
[b†] Department of Agricultural& Applied Economics/Extension, Rivers State University, Port Harcourt City, Nigeria.
. 808-956-7296
. ikechi.agbugba@ust.edu.ng
[c] Department of Agricultural Economics, University of Agriculture, Makurdi, Benue State, Nigeria.
. ??????????????????
[d] Institute of Agricultural Economics, 125 "Tzarigradskoshose" Blvd, Blok 1, 1113, Sofia, Bulgaria.
. hbachev@yahoo.com

very early date to India where a secondary centre of diversity was developed (Purseglove, 1969). It is a highly priced oilseed crop in Babylon and Assyria about 4000 years ago. Historical documentation suggests that Thomas Jefferson grew sesame seeds in test plots more than 200 years ago; he referred it to as '*beni'* or '*benne'*, the name used in Africa (Oplinger*et al.,* 1990).

In Nigeria, sesame is cultivated on over 80000ha across most of the northern states for food and oil. Benue and Nasarawa state are the highest sesame producers in Nigeria, with an annual average output of not less than 40000mt (Nwalem *et al.*, 2016). Sesame, according to Falusi (2007) is widely grown in Northern and central Nigeria between latitude 7-140N and with an annual rainfall of about 1000-1500mm. In the opinion of United State Agency International Development (2002), sesame production in Nigeria probably began in the middle belt region of the country and later spread out between latitude 60 and 100N covering the derived Southern and Northern Guinea Savanna, Sudan Savanna and Sahel vegetation zone. The major Beniseedproducing states in Nigeria are Adamawa, Benue, Borno, Gombe, Kogi, Jigawa, Kano, Nasarawa, Kastina, Kaduna, Plateau, Yobe, Zamfara, Taraba, Kebbi, Sokoto, Cross River, and Federal Capital Territory, Abuja (Nwalem, 2016). Although the name sesame is used in literature worldwide and also known as '*Simsim'* in East Africa, '*Tul'* in India, and *Gingely*in Sri Lanka, the Hausa, Ibo and Yoruba, major tribes of Nigeria call it *Ridi*, *Ekuku*, and *Isasa*respectively. As a raw export commodity, sesame seeds from Nigeria are enjoying a rising profile in the world market where overall global demand has risen to 3.3 million tons in Benue state.

Sesame plays an important role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes (El Khier, 2008) Sesame is grown primary for its oil-rich seeds; they are primarily used for oil and wine (Ghandi, 2009). After the extraction of oil, the cake is mostly used for livestock feed or often as manure. Its colour varies from cream-white to charcoal-black but it is mainly white or black. Other colours of some sesame seed varieties include, yellow, red or brown (Naturland, 2007). The lighter varieties of sesame which are white, yellow, and blackare considered to be of higher quality and are generally more valued in the West and Middle East, while both the pale and black varieties are prized in the far East. There are numerous varieties and ecotypes of sesame adapted to various ecological conditions (Nzioku *et al.*, 2010).

Sesame seeds are small, almost oblate in shape and have a mild and delicious aroma and taste. Sesame seed is used whole in cooking and also yields sesame oil (Oyegoke *et al.,* 2014). It has a rich nutty flavor (although such heating damages their healthfull polyunsaturated fats) and is used mainly as a food ingredient in whole, broken, crushed, shelled, powdered and paste forms. It is also used as some form of whole seed product for the confection and baking industries. A small percentage of the total production is however processed into oil, meal or flour (Hansen, 2011). In Nigeria, the seeds are consumed fresh, dried, fried or when blended with sugar. It is also used as a paste in some local soups (Fariku *et al.*, 2007). Its oil seeds are sources for some phyto-nutrients such as nomega-6 fatty acids, flavonoid phenolic anti-oxidants, vitamins and dietary fiber with potent anti-cancer as well as health promoting properties [Retrieved from]. Sesameoil is an edible vegetable oil derived from sesame seeds used in various countries. It is used as cooking oil in South India and Asia and often as a flavor enhancer in Chinese, Japanese, Korean, and to a lesser extend Southern Asia cuisine. Sesame seeds are excellent sources of copper, magnesium, calcium, phosphorous, iron, Vitamin B1,zinc, molybdenum, selenium, and dietary fiber. In addition to these important nutrients, sesame seeds contain two unique substances: *Sesaminand Sesamolin.* Both of these substances belong to a group of special beneficial fibers called *Lignans*, and have been shown to have a cholesterol-lowering effect in humans, and to prevent high blood pressure and increase vitamin E supplies in animals. Sesame has also been found to protect the liver from oxidative damage. Light sesame oil is used for deep-frying and dark sesame oil which is prepared from

roasted sesame seeds, is used for stir-frying. It is used to make pickles and refined sesame oil is used to make margarine. Sesame oil contains many nutrients, which promote good health.

The impactsof global change on agricultural production are a serious source of worry to farmers in sub-Saharan Africa. This is because their economies depend mainly on agriculture which is now affected by climate change catastrophes. Farmers' awareness and perception of these changes is therefore critical and of concern in Nigeria, particularly among sesame farmers in the study area where vulnerability is high because awareness and the ability to adapt are low. Sesame production is cultivated mostly by small scale farmers who rely mainly on their method and poor farming technique. However, to improve the production of sesame intensively, there is a need to look at the effect of climate change. The broad objective of the study is to assess the effect of climate change on sesame seed cultivation by the local farmers in MakurdiLocal Government Area. To achieve the broad objective, the specific objectives:

i. Described the socio-economic characteristics of the respondents in the study area
ii. Identified the socio-economic characteristics of the respondents that affect their awareness of climate change.
iii. Identified the perceived suitable adaptive measure employed by respondents.
iv. Determined the source of information method used by the farmer on climate change.

To address the problems of this research, the study was guided by the following null hypotheses.

H_0- the socio-economic characteristics of the respondents do not have any significant effect on their awareness of climate change.

2. Conceptual Framework

Climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, wind and other indicators (Rose, 2001). Climate change can involve both change in average conditions and change in variability. Climate change is considered one of the most important environmental issues of our time. This concern reflects the reality that so much of human activity is sensitive to climate change, and that adapting to current and projected rates of climate change could be very challenging. It also reflects the understanding that human perturbation of the climate system is essentially irreversible, for many centuries at least. How much climate change future generations are exposed to will be determined by the action that we take over the coming decades to reduced human impacts on the climate system. There is a very strong body of evidence, based on a wide range of indicators, that climate change is occurring, and the climate system is warming. The evidence includes observed increase in global average air and ocean temperatures, widespread melting of snow and ice, and rising global sea level (in response to the addition of water from melting snow and ice expansion of water when warmed). Plants and animals are responding to climate change in ways that are consistent with the observed warming with repercussions throughout natural and manage environments (Ballard *et al.*, 2012).

Although climate change can be caused by both natural processes and human activities, the recent warming has been largely attributed to human activity, primarily the release of carbon dioxide and other greenhouse gases to the atmosphere. These gases enhance the insulating properties of the atmosphere, reducing heat loss, thereby warming the planet. Continued emission of these gases is the primary cause for concern about climate change now and into the immediate future (IPCC, 2013). Particularly important is the emission of carbon dioxide stays in the atmosphere with ongoing human emissions. Even with human emissions eliminate, atmospheric levels of carbon dioxide would fall very gradually as natural processes slowly remove carbon dioxide from the atmosphere. This means that past

emission from human activity continue to affect the climate system for a very long time (Royal Society and National Academy of Sciences, 2014).

3. Methodology

The study was conducted in a North Central State of Benue, Nigeria. Benue State is one of the six states constituting Nigeria'sgeopolitical zone, and was created out of the former Benue, Plateau state in 1979. The area is situated within the transition belt of Nigeria, and is located between longitudes $6^0 33^1$E and 10^0E and latitudes $6^0 30^1$N and $8^0 10^1$N. The area is popularly known as food basket of the nation. It is bounded by NasarawaState, Cross RiversState in the South, Kogi, Enugu, and EbonyiStates in the West and Taraba State in the East. Benue State has 23 Local Government Areas (LGAs) with headquarter in Makurdi. Going by the 2006 national population census, the state was indicated as having a population of 4,780,389 million persons (NPC 2006) covering a total land area of about 33,955 square kilometers. Thetwo distinct seasons in the area are the wet and dry seasons. The wet season commences fromApril and ends in November while the dry season starts in December and terminates in March of the following year. The average annual rainfall ranges between 150-188mm per annum (Benue State Executive Council, 2014). Predominant tribes are Tiv and Idoma, while others include Igede, Etulo, Hausa, Abakwa, Nyifon, Fulani, Jukun and Agatu. The annual temperature ranges between 22.7^0c-36^0c. Most of the inhabitants are farmers who engage in trading as part-time commercial activities (Seibert, 2007). Specifically, Makurdi LGA shares boundary with the following LGAs: Guma, Gwer-West, Tarka, and Gwer-East, comprising of 11 council wards.

More so, the population of the respondents is comprised of all the small-scale sesame farmers in the study area. A systematic random sampling and simple random sampling techniques wereemployed to select 120 respondents. Data were collected using well-structured questionnaire and interview schedules. Moreover, the data collected were analyzed using descriptive statistics and logit regression model.

The effect of climate change will be estimated using this model due to its simplicity in the interpretation of the coefficient. The cumulative logistic probability model was specified by Pindyck & Rubinfeld (1981) as:

$$Pi = F(Zi) = 1 + \frac{1}{1+e-(\alpha+\sum\beta iXi)} \quad (1)$$

Where Pi is the probability of the effect of climate change, Xi (the explanatory variables); α and βi are the parameters to be estimated. The log odd of the probability of the effect of climate change is given by;

$$\text{Log}\frac{Pi}{1-Pi} = Zi = \alpha + \beta_1X_1 + \beta_2X_2 + \ldots\ldots\beta_kX_k \quad (2)$$

The logistic model is specified explicitly as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 \quad (3)$$

Where;

Y = probability that respondents are aware of climate change (1= aware, 0 = not aware)

X1 = Age of household head (years)

X2 = Household size (number)

X3 = Income of household head (naira)

X4 = Education (years) (1 = educated, 0 = none)

X5 = Farm size (hectares)

X6 = Marital status (1 = married, 0 = single)
X7 = Farm yield (1 = high, 0 = low)

4. Results and Discussion

4.1. Socio-economic characteristics of the respondents

The socio-economic characteristics of the respondents are presented in table 1, the result reveals that 30.8% of the respondents are within the active age of 21-30 and 31-40 years respectively, this result shows that most farmers can make positive contribution to agricultural production. Analysis of gender in sesame production indicates that male comprises of 69.2% whereas female comprises of 30.8%. This result therefore implies that the men are more involved in sesame production than the women. The result also shows that 82.5% of the respondents are married. The high proportion of the respondents who are married is an indication that family labour could be available for sesame farmers. The distribution of respondents according to educational level shows that majority (42.5%) of the respondents has primary education, 23.3% has secondary education, 22.5% has no formal education, and 9.2% has tertiary education. Furthermore farm experience in sesame production has majority (44.2%) of the farmers with less than 10years farming experience. Annual income of the farmers shows that majority (33.7%) of the respondents earn less than ₦100,000 per annum.

Table 1. *Presentation of socio-economic characteristics of the respondents*

Variables	Frequency	Percentage
Sex		
Male	83	69.2
Female	37	30.8
Marital Status		
Marital status		
Married	99	82.5
Single	21	17.5
Educational level		
None	27	22.5
Primary education	54	45.0
Secondary education	28	23.3
Tertiary education	11	9.2
Age		
<20	8	6.7
21-30	37	30.8
31-40	37	30.8
41-50	18	15
51-60	15	12.5
>60	5	4.2
Experience		
<10	53	44.2
11-20	30	25.0
21-30	17	14.2
31-40	15	12.5
>40	5	4.2
Farm size		
<4	57	47.5
5-9	51	42.5
10-14	8	6.7
>20	4	3.3
Household size		
<4	35	29.2
5-9	69	57.5
10-14	10	8.3
15-19	2	1.7
>20	4	3.3
Annual income		
<100,000	44	36.7
101,000-200,000	42	35.0
201,000-300,000	28	23.3
301,000-400,000	6	5.0

Source: Field survey, 2014

4.2. Socio-economic characteristics of respondents affected by climate change awareness

Results fromTable 2 indicate that majority (57.5%) of the farmers has an average yield compared to high yield (29.2%) and low yield (13.3%) which are as a result of climate change. The result also reveals that majority (100%) see insect infestation as the main reason for low yield followed by soil erosion (69.6%), increase rain (47.8%), floods (30.4%), draught and animals (17.4%) which are as a result of climate change in the area.

Table 2. *Presentation of respondents' socio-economic characteristics as affectedby climate change awareness*

Variables	Frequency	Percentage
Yield		
High	35	29.2
Average	69	57.5
Low	16	13.3
Reason for low yield		
Drought	4	17.4
Increase rain	11	47.8
Insect infestation	23	100
Soil erosion	16	69.6
Flood	7	30.4
Animals	4	17.4

Source: Field survey, 2014

4.3. Perceived suitable adaptive measures employed by the respondents

The results shows that the use of chemicals, improved varieties, early planting, mixed cropping has over 50% of the respondents agreeing that this practices are suitable practice that they adopt to cope with climate change. While increase water conservation (2.5%), use of insect powder (25.8%), early harvesting (20.8%) also have respondents opting for them as adaptive measures to cope with climate change.

Table 3. *Distribution of respondents according to their adaptive measures of climate change*

Adaptive Measures	Frequency	Percentage
Mixed cropping	72	60
Improved seed varieties	90	75
early planting	73	60.8
Early harvesting	25	20.8
Use of chemicals	101	84.2
Use of insect powder	31	25.8
Increased soil water conservation	3	2.5

Source: Field survey, 2014

4.4. Source of information method used by the farmers

The result in table 3 shows that majority (71.0%) of the respondents agrees that extension agents and educated farmers are their major source of awareness, while 53.6%, 49.3%, 14.3%, and 11.6% identified relatives, radio/television, non-governmental organizations, newspapers as their source of information respectively.

Table 4. *Source of information method used by the farmers*

Source of awareness	Frequency	Percentage
Extension agents	49	71
Educated farmers	49	71
Radio/television	34	49.3
N.G.O's	10	14.5
Newspapers	8	11.6
Relatives	37	53.7

Source: Field survey, 2014

4.5. Effect ofrespondents' socio-economic characteristics on participation in agricultural activities

Results of the logit regression analysis identified respondents' socio-economic characteristics which significantly affected the level of awareness of climate change on sesame production. As presented in Table 5, the results indicate thatage and household size are statistically significant at 1% and 5% respectively, while the rest are not significant.

Table 5. *Results of Logit Regression Analysis*

Variables	B	S.E	Wald	df	Sig	Exp(B)
Age	-.103	.047	4.843	1	.028**	.902
Household size	.422	.160	6.998	1	.008*	1.525
Income	.000	.000	.113	1	.737	1.000
Education	1.055	.769	1.879	1	.170	2.871
Farm size	.189	.171	1.220	1	.269	1.208
Marital status	1.057	.727	2.110	1	.146	2.877
Yield	-.962	.786	1.498	1	.221	.382
Constant	-.836	1.581	.279	1	.597	.434

Notes: **,** represent significant at 1% and 5% level of probability respectively.*
Log likelihood ratio = 111.912, Nagelkerke R^2 =0.267
Chi-square statistic = 44.101, Sig = 0.000
Source: Computed from Field survey Data, 2014.

5. Conclusion

Based on the result of the study, the following conclusion has been drawn. Majority of the respondent in Makurdi local government area are within their active age of 21-40 years. Sesame farmers are predominantly males (69.2%) and majority (45%) have primary education. Use of chemicals, mixed cropping, improved seed varieties has over 50% as suitable adaptive measures to cope with climate change. Extension agents and educated farmers, radio and television, relatives has majority of the respondents agreeing that they are their major source of awareness of climate change. Others identified, include nongovernmental organizations and newspapers.

Results further indicated that a relative majority (36.7%) of sesame farmers have an annual income of less than ₦100,000. In other words, the socio-economic characteristics of the farmers do not have significant effect on climate change awareness, as only age and household size are significant at 1% and 5%, respectively. Based on the findings of the study, the following recommendations are proffered: More awareness on climate change issues should be created among sesame farmers through diverse broadcasting via print and electronic media such as radio/television, newspaper, periodic publications as well as involvement of non-governmental organizations. Government is encouraged to strengthen farmers' confidence in the use of adaptive measures to reduce low yield of sesame as a result of climate change.

References

Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012). Impacts of climate change on the future of biodiversity, *Ecology Letters.* 15(4), 365–377. doi. 10.1111/j.1461-0248.2011.01736.x

Benue State Executive Council, (2014). Members and special advisers, *Library of Congress Africa Pamphlet Collection.*

El Khier, M.K.S., Ishag, K.E.A., & Yaboub, A.E.A. (2008). Chemical composition and oil characteristics of sesame seed cultivars grown in Sudan. *Research Journal of Agriculture and Biological Science,* 4(6), 761-766.

Falusi, A.O. (2007). Segregation of genes controlling seed colour in sesame (Sesamum indicum linn.) from Nigeria, *Africa Journal of Biotechnology,* 6(24), 2780-2783. doi. 10.5897/AJB2007.000-2444

Fariku, S., Ndonya, A.E., & Bitrus, P.Y. (2007). Biofuel characteristics of beniseed (Sesamum indicum) oil. *Africa Journal of Biotechnology,* 6(21), 2442-2443.

Ghandi, A.P. (2009). Simplified process for the production of sesame seed (Sesamumindicum L.) butter and its nutritional profit. *Asian Journal of Food and Agro-Industry,* 2(1), 24-27.

Hansen, R. (2011). Sesame profile. [Retrieved from].

National Population Commission, (2006). *Population Census Statistics*, Abuja FCT.

Naturland, (2002). *Organic farming in the tropic subtropics: Sesame*, 21/07/11. [Retrieved from].

Nwalem, M.P., Ukpe, U.H., Djomo, R.F., & Dzever, D. (2016). Structure, conduct and performance of sesame farmers in Benue State, Nigeria, *International Journal of Humanities Social Sciences and Education,* 3(6), 31-35. doi. 10.20431/2349-0381.0306005

Nzioku, J.M., Mvoula-Tsieri, M., Ndangui, C.B., Pambou-Tobi, N.P.G., Kimbonguila, A., Loumouamou, B., Silou, T., & Desobry, S. (2010). Characterization of seed and oil of sesame (Sesamumindicum L.) and the Kinetics of Degradation of the Oil during heating. *Research Journal of Applied Science, Engineering and Technology,* 2(3), 227-232.

Oplinger, E.S., Putnam, D.H., Kaminski, A.R., Hanson, C.V., Oelke, E.A., Schulte, E.E., & Doll, J.D. (2007). *Alternative Field Crops Manual*: Sesame. [Retrieved from].

Oyegoke, O.O., Babarinde S.A., Akintola A.J., Fatoba, A.J., & Tona, G. (2014). Physicochemical properties of sesame oil and varietal susceptibilty to tribolium castaneum herbst (Coleoptera: Tenebrionidae), infestation, *Journal of Environmental Science, Toxicology and Food Technology,* 8(5), 40-44. doi. 10.9790/2402-08554044

Purseglove, J.W. (1996). *Tropical Crops*, Longman, London.

Royal Society and National Academy of Sciences, (2014). Climate change evidence and causes, an overview from the Royal Society and the US National Academy of Sciences. Accessed 15/16/2017. [Retrieved from].

Seibert, U. (2007). Languages of Benue State. *Nigerian Languages.* Department of Languages and Linguistics, University of Jos, Plateau State, Nigeria.

United States Agency for International Development, (2002). Overview of the Nigerian sesame industry.

The United States Agency for International Development Nigeria, Chemonics International Inc, Washington DC: USAID.